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ASSESSMENT OF PLANTING GEOMETRY IN RICE UNDER SYSTEM OF RICE INTENSIFICATION (SRI)

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Abstract

On farm trials were conducted at farmers field in Umaria district during *kharif* seasons of 2014-15 and 2015-16 at three different locations under real farm situations prevailing spacing of 25cm×25cm (**T_2**), 20cm×20cm (**T_3**) 'and farmers practices (randomly dense planted, **T_1**) was treated as control for the comparison. The result of on farm testing (OFT) shown a greater impact on farmer's economy due to significant increase in crop yield more almost two fold over FP (**T_1**), the economics and benefit cost ratio of RS. 58111/ha was recorded net profit under 25cm×25cm spacing followed by Rs. 48828/ha under 20cm×20cm spacing as compared to Rs. 25008/ha under FP. Benefit cost ratio was 3.41 under **T_2** followed by 2.92 under **T_3**, while it was 2.15 under **T_1**. By conducting OFT of proven technologies, yield potential and net income from SRI system of rice cultivation can be enhanced to a great extent with increase in the income level of the farming community of the district.

Key word: Assessment, SRI, Spacing, rice, Grain yield.

Introduction

Rice (*Oryza sativa*) occupies a position of overwhelming importance in Indian agriculture and it constitutes the bulk of the Indian diet. For many people in the India, rice is the main source of energy, and it plays an important role in providing livelihood to the Indian population. It is largely grown in India under diverse conditions of soil, climate, hydrology and topography. Rice farming is the most important source of employment and income for the majority of rural people in this region.

The System of Rice intensification (SRI) is a combination of set of practices and methodology for increasing the productivity of irrigated rice by changing the management of plants, soil, water and nutrients resulting in both healthy soil and plants, supported by greater root growth and the soil microbial abundance and diversity. Therefore the application system of rice intensification technology would be necessary to sustainable rice production in the future. The crop plants growing depends largely on temperature, root volume, moisture and soil fertility for their growth and nutritional requirements. An unsuitable population crop may have limitation in the maximum availability of these factors. It is therefore necessary to determine the optimum density of plant population per unit area for obtaining maximum yield. Wider spacing had linearly increasing effect on the performance of individual plants. The plants grown with wider spacing had more solar radiation to absorb for better photosynthetic process and hence performed better as individual (Baloch *et al.* 2002).

The productivity of rice in the district can be increase by following the appropriate agronomic practices along with high yielding rice varieties. Thakur *et al.* (2009) suggested that the system of rice intensification (SRI) holds a great promise in increasing the rice productivity. The basic principles of SRI are; planting young seedlings (<14 days), singly in a square pattern (Stoop *et al.,* 2002), the soil is just kept saturated with water and flooding is not allowed till reproductive stage, after which a thin layer of water (1-2 cm) is kept in the field. Weeds are primarily controlled by mechanical weeding (*Cono weeder*) which also helps in incorporation of weed biomass and maintains proper aeration in soil (Satyanarayana *et al.;* 2007).Various planting densities have been evaluated for SRI with the general recommendation being 25 cm×25 cm. Not much information however, available on close spacing *i.e.* 20 cm x 20 cm. In this study we evaluated the effect of various spacing in SRI (25 cm × 25 cm, 20 cm × 20 cm and compared with normal planting *i.e.* farmer's practice)on yields and yield attributing characters of rice at seven different locations at farmers field in Umaria district of M.P.

Rice is the staple food crop of the Umaria district of Madhya Pradesh; occupies 45% of total cropped area of *kharif* season (45000 ha of total 100000 ha cultivated area). The productivity of rice in the district is only 2.26 t/ha, which is much below the national productivity (3.37 t/ha). The reason of low productivity may be attributed to non adoption of improved production technology which includes the agronomic practices and socioeconomic conditions of the tribal people. An effort made by the KVK scientists by introducing the SRI system of paddy production through on farm trials at farmers field during *kharif* seasons of 2014-15 and 2015-16.

Materials and Methods

On farm trials were conducted in Umaria district of Madhya Pradesh under close supervision of krishi vigyan Kendra. Total 59 trials under real farming situations were conducted during *kharif* seasons of 2014-15 and 2015-16 at seven different villages namely; Taali, Salaiya, Dhaurkhoh, Baka, Rampur, Chandia and Kherwa khurd; respectively under krishi vigyan Kendra operational area. The area under each trial was 0.4 ha. The soil was sandy clay-loam in texture with moderate water holding capacity, low to medium in organic carbon (0.34-0.61%), low in available nitrogen (113.6-216.3 kg/ha), medium in available phosphorus (12.8-20.4 kg/ha), low to medium in available potassium (218.4-317.1 kg/ha) and soil pH was neutral in reaction (6.8-7.2). The treatment comprised of plant spacing at 25 cmx 25 cm (**T_2**), plant spacing 20 cm × 20 cm (**T_3**) vs farmer's practice (random-dense planting *i.e.* (**T_1**). The rice nursery was grown on *puddled* raised beds of 10mx1.5m with half meter wide irrigation cum drainage channel around the beds. Sprouted seeds of high yielding variety MTU-1010 sown using 5 kg/ha seed rate in both years of experimentation. The trial fields were well prepared by the suitable implements; fields were puddle twice and leveled properly. 8-12 days old seedlings were transplanted singly (one seedling per hill) as per the treatment spacing using SRI line marker in muddy field. Balance dose of fertilizers (100:60:40 kg NPK/ha was supplied; 25% through organic sources *i.e.* FYM and remaining 75% through chemical fertilizers *i.e.* Urea, DAP and MOP) supplied. The demonstration plots were kept moist throughout the vegetative growth by applying light and frequent irrigations, when required. During flowering to milking stage about 2-3 cm standing water was maintained continuously. Pyrazosulfuron @ 25 g a.i./ ha as pre emergence was applied at 3-4 days after transplanting (DAT). *Cono weeder* operated at 20, 30 and 40 DAT for the mechanical weed control and increase the soil aeration.

Farmer's practice (**T_1**) constituted the application of high seed rate (30 kg/ha), planting of old seedling (30-45 DAS), closer planting, not adopting the line sowing, imbalance and insufficient supply of nutrients (50:30:0 kg NPK/ha), submerged the paddy field throughout the crop season, one hand weeding between 30-40 days after transplanting (DAT) etc. Harvesting and threshing operation done manually; 5m × 3m plot harvested in 3 locations in each trial and average grain weight taken at 14% moisture. Similar procedure adopted on other treatments then grain weight converted into quintal per hectare (q/ha).

The conduction of on farm trials other steps like site selection, farmers selection, layout of treatments, farmers participation etc were followed as suggested by Choudhary (1999).Visits of farmers and extension functionaries were organized at experimental plots to disseminate the technology at large scale. Yield data was collected from all the treatments; cost of cultivation, net income and benefit cost ratio were computed and analyzed.

Results and Discussion

The yield performance, growth parameters and harvest index are presented in table-1. The data revealed that **T_2** produced the maximum average effective tillers (277 m^{-2}) followed by **T_3** (250 m^{-2}) and **T_1** (181 m^{-2}), the performance of paddy yield was found to be almost double under **T_2** (57.73 q/ha) than that under **T_1** *i.e.* FP (32.42 q/ha) followed by **T_3** (50.75 q/ha) during both the years (2014-15 & 2016-17). The yield of rice under **T_2** was recorded 57.57 and 57.90 q/ha during 2014-15 and 2015-16, respectively. The yield enhancement due to technological intervention was to the tune of 70 % and 87 %, respectively over FP. The cumulative effect of the technological intervention over two years, revealed on average yield of 57.53 q/ha, 79% higher over FP. The year to year fluctuations in yield and cost of cultivation can be explained on the basis of variations in prevailing social, economical and prevailing microclimatic condition of that particular village. Mukhargee (2003) has also reported that depending on identification and use of farming situation, specific intervention may have greater implications in enhancing systems productivity.

Table 1: Productivity, yield parameters, harvest index, as affected by different planting geometry under SRI system of rice production.

Year	Variety	Area (ha)	No. of farmers	No. of effective tillers/m^{-2}			Grain yield (q/ha)			% increase over FP		Straw yield (q/ha)			Harvest index (%)		
				T-1	T-2	T-3	T-1	T-2	T-3	T-2	T-3	T-1	T-2	T-3	T-1	T-2	T-3
2014-15	MTU-1010	4.0	10	179	272	251	33.85	57.57	50.20	70	48	54.2	78.9	70.2	38	42	42
2015-16	MTU-1010	19.6	49	183	281	248	31.0	57.90	51.30	87	65	53.7	76.80	68.0	37	43	43
Total/Mean	—	**23.6**	**59**	**181**	**277**	**250**	**32.42**	**57.73**	**50.75**	**79**	**57**	**53.95**	**77.85**	**69.10**	**37.5**	**42.5**	**42.5**

***T-1**=Spacing randomly planted, no proper spacing (Farmer's practice), **T-2**=Spacing 25 cm × 25 cm, **T-3**=Spacing 20 cm × 20cm

Table 2: Economics of rice production in SRI system as affected by different planting geometry.

Year	Gross expenditure (₹/ha)			Gross Monetary Returns, GMR (₹/ha)			Net Monetary Returns, NMR (₹/ha)			Additional Net FP Returns (Rs/ha) over		BC Ratio		
	T-1	T-2	T-3	T-1	T-2	T-3	T-1	T-2	T-3	T-2	T-3	T-1	T-2	T-3
2014-15	21547	24027	25327	46715	78786	68770	25168	54759	43443	29591	18275	2.16	3.27	2.71
2015-16	21547	24027	25327	46395	85479	79540	24848	61462	54213	36614	29365	2.15	3.55	3.14
Total/Mean	**21547**	**24027**	**25327**	**46555**	**82133**	**74155**	**25008**	**58111**	**48828**	**33103**	**23820**	**2.15**	**3.41**	**2.92**

***T-1**=Spacing randomly planted, no proper spacing (Farmer's practice), **T-2**=Spacing 25 cm × 25 cm, **T-3**=Spacing 20 cm × 20cm

Significantly higher seed and straw yield was noticed with a spacing of 25 cm × 25 cm compared to other spacing's. The optimum level of plant population coupled with better yield parameters might have resulted in higher seed and straw yield/ha under 25 cm × 25 cm spacing. These findings are in conformity with findings of Ceesay and Uphoff (2003), Zhang *et al.* (2004), Haque (2000) and Gurumukhi and Mishra (2003). The similar trends were found on straw yield and harvest index on the same treatments.

Economic indicators *i.e.* gross expenditure (−/ha), gross monetary returns (−/ha), net monetary returns (−/ha), additional net returns (−/ha) and B:C ratio of on farm trials are presented in table-2. The data clearly revealed that the net return from the $\mathbf{T_2}$ was substantially higher than $\mathbf{T_3}$ and $\mathbf{T_1}$ (FP) plots, respectively, during both the years of experimentation. Average net returns from $\mathbf{T_2}$ were observed to be Rs. 58111/ha followed by $\mathbf{T_3}$ of − 48828/ha and $\mathbf{T_1}$ of − 25008/ha. On an average − 33103/ha under $\mathbf{T_2}$ and − 23820/ha under $\mathbf{T_3}$ as additional income is attributed to the technological intervention provided in different spacing treatments of SRI system (Baloch *et al*. 2002). Economic analysis of the yield performance revealed that benefit cost ratio of $\mathbf{T_2}$ were observed significantly higher than $\mathbf{T_3}$ and $\mathbf{T_1}$ (FP). The benefit cost ratio of $\mathbf{T_2}$, $\mathbf{T_3}$ and $\mathbf{T_1}$ (FP) were 3.27, 3.55; 2.71, 3.14; and 2.16, 2.15 during 2014-15 and 2015-16, respectively. Hence favorable benefit cost ratios proved the economic viability of the intervention made under trials and convinced the farmers on the utility of intervention. The data clearly revealed that the maximum increase in yield and BC ratio observed was during 2015-16. The variation in benefit cost ratio during both the years of experimentation may mainly on account of yield performance and input output cost in that particular years (Baloch *et al*. 2002).

Conclusion

The result of on farm trials convincingly brought out that the yield of rice could be increased almost double with the intervention on varietal replacement *i.e.* HYV MTU-1010 in rice and SRI system of production in the Umaria district. To safeguard and sustain the food security in India, it is quite important to increase the productivity of rice under limited resources, especially water. Favorable benefit cost ratio is self explanatory of economic viability of the OFT and convinced the farmers for adoption of SRI system of rice production.

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