EFFECT OF DATE OF TRANSPLANTING AND METHOD OF CULTIVATION ON YIELD AND ECONOMICS OF *SALI* RICE *(ORYZA SATIVA)* IN ASSAM

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Abstract

A field experiment was carried out to evaluate effect of different dates of rice transplanting and methods of cultivation on productivity of *Sali* rice in a factorial randomized block design for the year 2014 and 2015. Three dates of transplanting *viz.*, 20 June, 5 July and 20 July and two methods of cultivation *viz.*, conventional and System of Rice Intensification (SRI) were considered. It has been observed that the rice transplanted on 20 June recorded higher yield attributes and grain yield of *Sali* rice than the later dates of transplanting. Whereas, panicle weight (6.08 and 5.96 g/panicle in 2014 and 2015, respectively) and grain yield (59.19 q/ha) on 20 June transplanting were significantly higher over the 20 July transplanting. The N, P and K uptake was found highest on 20 June rice transplanting as compared to other dates. In case of method of cultivation, SRI recorded significantly higher values in yield attributes and grain yield as compared to conventional method. Further, significantly higher uptake of total N, P and K were found under SRI method over the conventional method in both years. Transplanted rice on 20 June under SRI method was found highest benefit: cost ratio 3.06 and 3.01 in 2014 and 2015, respectively followed by rice transplanted on 5 July under SRI method.

Keywords: Date of Transplanting, Economics, Method of Cultivation, SRI, Rice, Yield

Introduction

Rice is the main staple food crop in Assam, occupying first position in respect of both acreage and production compared to other food crops. The area under rice is about 65 per cent of the total gross cropped area (38.43 lakh hectares) of Assam. In general, rice is grown in 3 different seasons, out rightly *Sali* rice covered about 18-19 lakh hectares (75 %) of land. It contributes 65.37 per cent of the total rice production in the state. The productivity of rice in the state is low (2061 kg/ha) as compared to the national average (2462 kg/ha) [Anon. 2014]. Among different rice cultivated the productivity of *Sali* rice is lower (2055 kg/ha) as compared to *boro* rice (2865 kg/ha). Moreover, most of the farmers of Assam are small and marginal having fragmented land holdings and practicing conventional method of rice cultivation. So, there is every possibility to increase the rice productivity considering the report of Rajakumar (2013), cited that system of rice intensification (SRI) method of rice cultivation has the opportunity to increase the productivity of rice per unit area by changing the management of rice plants, soil, water and nutrients. However, SRI method of rice cultivation is not evaluated for rain-fed condition (*kharif* rice) in Assam. Lakpale *et al*. (1994) reported that time of rice transplanting is also essential for increasing rice yield. Therefore, an experiment was laid out to evaluate different dates of transplanting and methods of cultivation to maximize the yield of *Sali* rice.

Materials and Methods

A field experiment was conducted during the *kharif* season 2014 and 2015 at Regional Agricultural Research Station, Shillongani, Nagaon-782002, Assam. The climate of this region is hot humid during summer and relatively dry and cold during winter. The crop experienced favourable weather conditions in both the years of experimentation. Total amount of rainfall received during the crop growth period were 1207.5 mm during 2014 and 1124.2 mm during 2015 with relative humidity from 82 to 95 % in the morning and from 64 to 85 % in the evening. In treatments mainly two factors were considered namely, date of transplanting and method of cultivation. Under dates of transplanting – three dates such as 20 June (D1), 5 July (D2) and 20 July (D3) similarly for cultivation – two methods namely, conventional (M1) and SRI (M2). The experiment was laid out in a Factorial Randomized Block Design with 6 treatment combinations *viz.*, D_1M_1, D_1M_2, D_2M_1, D_2M_2, D_3M_1 and D_3M2 in 4 replications.

In conventional method of cultivation, rice variety 'Ranjit' was sown in three different dates - 20 May, 5 June and 20 June. The seedlings of 30 days-old were transplanted on 20 June, 5 July and 20 July as per recommended package of practices (Anon., 2009a). Whereas, in SRI method of cultivation, same variety was sown on seedbed as per standard method (Anon., 2008) in three different dates - 10 June, 25 June and 10 July, where 10 days-old seedlings were transplanted on 20 June, 5 July and 20 July, respectively (Anon., 2009b) so that transplanting of seedlings were done on same date in both methods. In the conventional method of rice cultivation, 30 day-old seedlings were transplanted in spacing 20 x 20 cm row to row and plant to plant with two to three seedlings per hill whereas in SRI method, 10 day-old rice seedlings were transplanted with spacing 25 x 25 cm row to row and plant to plant with single seedling per hill.

The crops were harvested from net plot after crops reached at physiological maturity stage. The plant samples (both seed and stover) of rice were collected separately after threshing from each plot and dried in oven at 65^0 C for 72 hours. The oven-dried samples were finely ground and chemically analyzed for N, P and K content (%) (Jackson, 1973). Nutrient uptake by seed and stover was calculated as follows:

$$\text{Nutrient uptake (kg/ha)} = \frac{\text{Nutrient content (\%) X seed or stover yield (kg/ha)}}{100}$$

Economic analysis:

Gross return:

Gross return was the value of the economic yield calculated at prevailing market price.

Gross return = Economic yield x prevailing market price

Total cost of cultivation:

Total cost of cultivation was calculated out on hectare basis for each treatment combination by taking into account cost of inputs, labours and operations.

Net return:

Net return was calculated by subtracting the total cost of cultivation from gross return on per hectare basis.

Net return = Gross return – total cost of cultivation.

Benefit-cost ratio:

Benefit-cost ratio (B:C) was computed by dividing gross return by total cost of cultivation.

The data were analyzed by factorial RBD as per standard procedure described by Panse and Sukhatme (1985) and the significance or non-significance of the variances due to treatment effects was tested by ‘F’ test. Critical difference (CD) was calculated wherever ‘F’ test was found significant.

Results and Discussions

The data recorded under different parameters such as yield attributes, grain yield, total nutrients uptake were discussed below –

Yield attributes:

The different dates of transplanting had no significant effect on panicle length and 1000 grain weight in both the years (2014 & 2015). However, in first date of transplanting (20 June), panicle weight (6.08 and 5.96 g/panicle) and grain yield (59.61 and 58.79 q/ha) were found significantly higher over the last date of transplanting (20 July) for the years 2014 and 2015 respectively (Table 1). This was owing to production of higher number of filled grains/panicle due to availability of longer vegetative and reproductive growth period of rice in first date of transplanting (Yadav, 2007; Ashem *et al.*, 2010 and Changmai, 2015). The panicle length (28.17 cm and 27.89 cm in 2014 and 2015, respectively) was found significantly higher under SRI method over conventional method (Table 1). This is supported by the findings of Singh *et al*. (2013) and Uzzaman *et al*. (2015). Further, the panicle weight 6.32 and 6.30 g/panicle and 1000-grains weight 20.50 and 20.43 g during 2014 and 2015 respectively under SRI method of cultivation were also found significantly higher as compare to conventional method. Higher values of panicle weight were owing to higher number of filled grains/panicle in rice cultivated by SRI method (Sridevi, 1997). Higher value of 1000-grain weight in SRI might be due to better translocation of photosynthetates and dry-matter partitioning to the grains as compared to that of conventional method (Uzzaman *et al.*, 2015 and Ranjitha and Reddy, 2014).

Grain yield

It has been observed from Table 1& fig 1 that grain yield decreases with the delayed transplanting irrespective of years. Rice transplanting on 20 June recorded highest grain yield 59.19 q/ha which was found significantly higher over 20 July transplanting and at par with 5 July transplanting. Higher grain yield at early transplanting was owing to relatively early crop establishment and better yield attributes (Ashem *et al.*, 2010) and Changmai, 2015). The grain yield of rice (60.34 q/ha) under SRI method was found significantly higher than the conventional method. The increase in grain yield under SRI was due to vigorous root growth resulting in better N, P and K-uptake and thereby higher values of yield attributes leading to higher yield of rice. Similar results were also reported by Singh *et al*. (2013), Ranjitha and Reddy (2014) and Udayakumar (2005).

Table 1. Yield attributes and grain yield (q/ha) of rice as influenced by date of transplanting and method of cultivation of rice

Treatment	Panicle length (cm)		Panicle weight (g/panicle)		1000-grain weight (g)		Grain yield (q/ha)		
	Years		Years		Years		Years		Pooled
	2014	2015	2014	2015	2014	2015	2014	2015	
Date of transplanting (D)									
D1: 20th June	27.20	26.79	6.08	5.96	20.12	20.03	59.61	58.79	59.19
D2: 5th July	27.08	26.56	5.78	5.84	19.97	19.91	58.44	57.73	58.09
D3: 20th July	26.85	26.43	5.33	5.26	19.95	19.94	55.92	55.16	55.55
S. Em (±)	0.85	0.66	0.18	0.20	0.12	0.11	1.11	1.02	0.99
C.D. (P=0.05)	NS	NS	0.56	0.63	NS	NS	3.49	3.21	3.12
Method of cultivation (M)									
M1:Conventional	25.92	25.30	5.15	5.08	19.54	19.49	55.21	54.54	54.99
M2:SRI	28.17	27.89	6.32	6.30	20.50	20.43	60.77	59.91	60.34
S. Em (±)	0.69	0.54	0.14	0.17	0.10	0.09	1.04	0.96	0.88
C.D. (P = 0.05)	2.19	1.71	0.44	0.38	0.32	0.30	3.28	3.05	2.77
Interaction (D x M)									
S. Em (±)	1.20	0.94	0.27	0.39	0.17	0.16	1.98	1.87	1.79
C.D. (P = 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.V. (%)	8.35	8.24	12.08	13.63	6.99	6.95	8.69	8.53	8.25

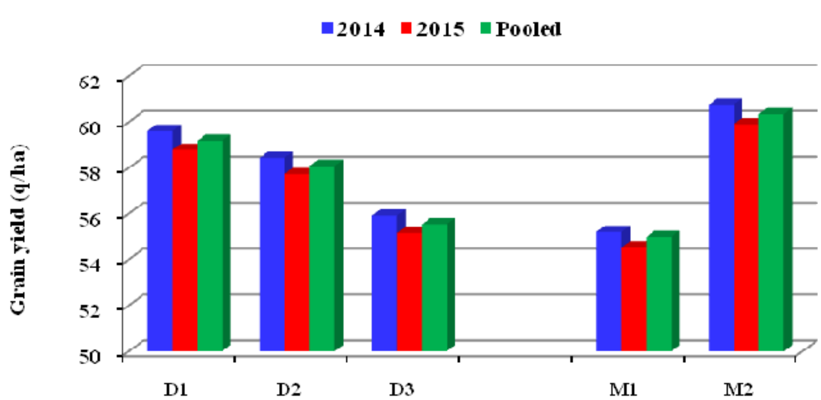

Fig.1: Grain yield (q/ha) of rice during 2014 and 2015

Total nutrient (NPK) uptake

During 2014 and 2015, there was no statistical difference in total N and K-uptake by rice due to different dates of transplanting. However, its effect on total P uptake was found significant (Table 2). The total P- uptake *i.e.*, 22.08 and 20.56 kg/ha recorded in 2014 and 2015, respectively on 20 June transplanting were found significantly higher over the 20 July transplanting for both the years. The total N, P and K-uptake by rice were found in decreasing trend with delay in transplanting dates (Fig. 2, 3 and 4). In 20 June transplanting, higher nutrients (N, P & K) uptake might be attributed to relatively early crop establishment, better root growth and longer growth period and thereby resulting in better absorption of nutrients and moisture from the soil (Pandey *et al*., 2001).

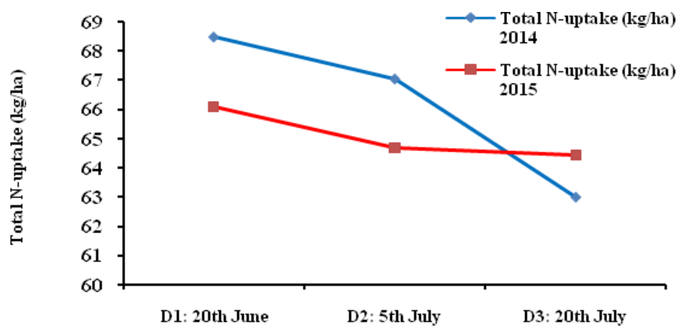

Fig 2. Uptake pattern of total N

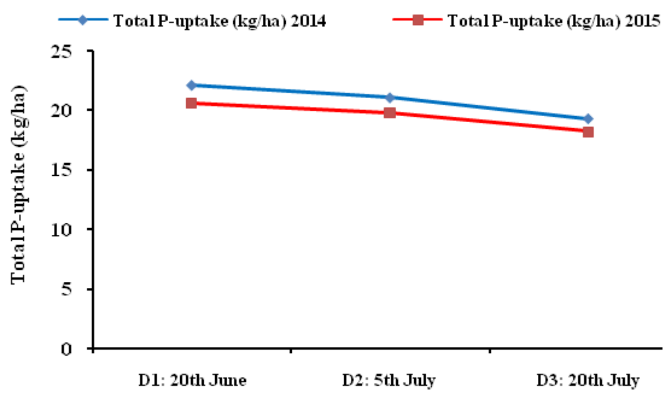

Fig 3. Uptake pattern of total P

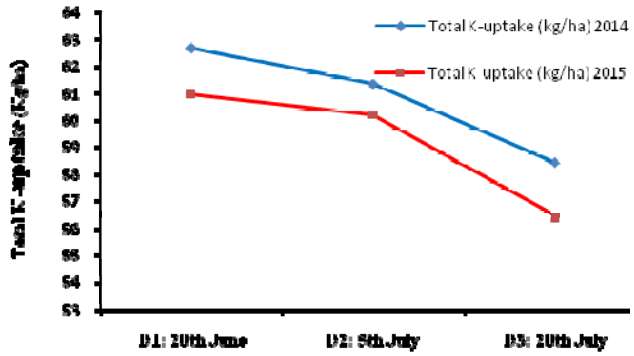

Fig 4. Uptake pattern of total K

In SRI method of cultivation, total N-uptake *i.e.*, 69.10 and 69.43 kg/ha, total P-uptake *i.e.*, 21.88 and 20.54 kg/ha and total K-uptake *i.e.*, 61.13 and 61.97 kg/ha for the year 2014 and 2015, respectively were found significantly higher as compared to the conventional method (Table 2). This was due to better vegetative and reproductive growth leading to production of more biomass. The results are in agreement with the findings of Vallois and Uphoff (2000) and Ranjitha and Reddy (2014). Besides, application of more organic manure along with inorganic fertilizers and incorporation of weeds into the soil by cono weeder increased release of nutrients to the soil, which led to enhanced crop growth and biomass production and ultimately resulted in more NPK uptake (Ranjitha and Reddy, 2014 and Barison, 2002).

Table 2. Total NPK-uptake by rice as influenced by date of transplanting and method of cultivation of rice (kg/ha)

Treatments	**Total N-uptake**		**Total P-uptake**		**Total K-uptake**	
	Years		**Years**		**Years**	
	2014	**2015**	**2014**	**2015**	**2014**	**2015**
Date of transplanting (D)						
D1: 20th June	68.49	66.08	22.08	20.56	62.69	60.96
D2: 5th July	67.05	64.68	21.03	19.77	61.34	60.21
D3: 20th July	62.99	64.43	19.26	18.19	58.40	56.42
S. Em (±)	2.21	1.63	0.55	0.35	1.62	1.63
C.D. (P=0.05)	NS	NS	1.75	1.09	NS	NS
Method of cultivation (M)						
M1:Conventional	63.26	60.69	19.71	18.47	58.49	56.43
M2:SRI	69.10	69.43	21.88	20.54	63.13	61.97
S. Em (±)	1.79	1.33	0.45	0.28	1.32	1.33
C.D. (P = 0.05)	5.66	4.19	1.43	0.89	4.18	4.19
Interaction (D x M)						
S. Em (±)	3.11	2.31	0.784	0.491	2.30	2.31
C.D. (P = 0.05)	NS	NS	NS	NS	NS	NS
C.V. (%)	8.96	9.44	9.84	8.69	7.36	7.98

Economic studies

Successful of crop production relates with the achievement of desired returns through optimal use and management of production resources as well as inputs. In the present study, economic comparison of the treatment combinations were done on the basis of gross return, net return and benefit - cost ratio.

The treatment combination D_1M_2 recorded the highest net return *i.e.*, Rs. 52,758/- and Rs. 51,608/-; and benefit - cost ratio *i.e.*, 3.06 and 3.01 in 2014 and 2015, respectively and it was followed by D_2M_2 (Table 3 and Fig. 5), which was due to higher gross return and lower cost of cultivation associated with SRI method of rice cultivation. The cost of cultivation in SRI was obtained nominal due to lower input as well as labour used. In SRI, the minimum units of inputs were incurred for nursery raising, transplanting and pests management. Similar results were also reported by Jayapalreddy and Shenoy (2013).

Table 3. Economics of *Sali* rice under different treatment combinations (Rs/ha)

Treatment combinations	Cost	Gross return Years		Net return Years		B:C	
		2014	2015	2014	2015	2014	2015
D_1M_1	26824	70700	69800	43876	42976	2.63	2.60
D_1M_2	25567	78325	77175	52758	51608	3.06	3.01
D_2M1	26824	69188	68375	42364	41551	2.57	2.54
D_2M_2	25567	76925	75950	51358	50383	3.00	2.97
D_3M_1	26824	67150	66363	40326	39539	2.50	2.47
D_3M2	25567	72663	71538	47096	45971	2.84	2.79

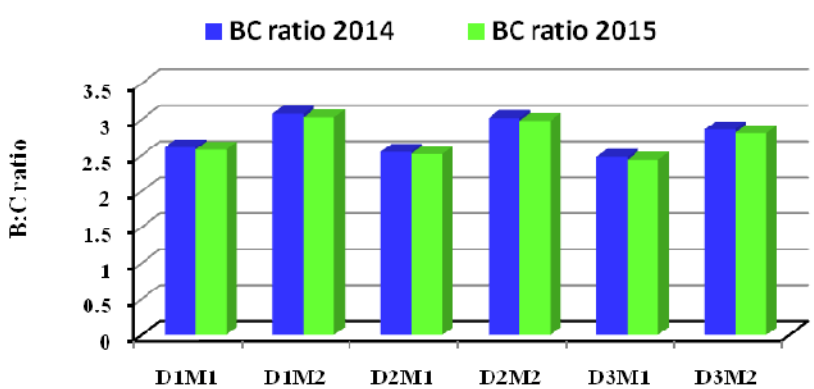

Fig 5. B: C ratio of *Sali* rice during 2014 & 2015

Conclusion

From this study, it may be concluded that dates of transplanting and method of rice cultivation have clear effect on yield of *Sali* rice and nutrients uptake by the crop. *Sali* rice transplanted on 20 June gave highest yield as well as uptake of nutrients as compared to other two dates. However, date of transplanting when combine with method of cultivation, it has been observed that 20 June rice transplanting under SRI method resulted in significantly higher yield, nutrients uptake and B:C ratio. Therefore, for yield maximization of *Sali* rice, SRI method with early transplanting around 20 June is advisable to make self sufficient in rice production in Assam in general.

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