Agric. Sci. Digest., 38 (1) 2018 : 40-43
Print ISSN:0253-150X / Online ISSN:0976-0547

AGRICULTURAL RESEARCH COMMUNICATION CENTRE
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Performance of direct seeded *sali* rice as influenced by sowing dates, sowing methods and nutrient management practices

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Received: 09-08-2017 Accepted: 05-02-2018 DOI: 10.18805/ag.D-4663

ABSTRACT

A field experiment was carried out at Instructional-cum-farm, Assam Agricultural University, Jorhatduring *kharif* 2015. The experiment was laid out in split-plot design replicated thrice with four sowing dates in main plots *viz*., 1May, 11 May, 21and 31May along with combination of two methods of sowing *viz.,* direct seeding and transplanting as well as with two nutrient management practices RDF and INM package in sub-plots. Results revealed that May 11date recorded significantly higher in almost all the growth and yield attributing parameters followed by May 1. The highest grain (40.24 q/ha) and straw (68.07 q/ha) yields were obtained in May 11 sown crop and was significantly superior to that of May 21and May 31. Between the two methods of sowing, transplantingresulted significantly superior in regards to almost all the growth, yield attributes and yield of *sali* rice. The increase in grain yield under transplanting over direct seeding was4.90 per cent. The corresponding increase in straw yield was 4.31 per cent In respect of nutrient management; INM resulted in higher grain and straw yieldsover RDF. From the economic point of view May 11 sown crop recorded the highest net return (₹. 57625.00/ ha) with B:C ratio of 1.57 whereas in case of methods of sowing and nutrient management practices, direct seeding and INM practice recorded the highest net return and B:C ratio.

Key words: Direct seeding, INM, RDF, Sali rice, Sowing dates, Transplanting.

INTRODUCTION

Among all the cereals, rice is the principal cereal crop grown in India, which plays a major role in Indian economy. Rice is the most important crop to millions of small farmers who grow it on millions of hectares throughout the region (IRRI, 2015). Moreover, with the present trend of growth in human population, the demand for food grains is increasing every year.

In Assam *sali* rice, transplanting method is mostly followed in case of *sali* (*kharif*) rice. At present, farmers are facing problems in timely preparing the land for transplanting, fertilizer application and sometimes in harvesting due to shortage of human labour. As compared to transplanting requirement of labour as well as growing time is comparatively less in direct seeded rice which is one of the scarce resources during peak*sali* season. Though fertilizer is undoubtedly the fastest way to boost up crop growth, yet long term use or total dependence on it could lead to deterioration of soil health (FAO, 1984). An integrated nutrient management system target at sustainable crop production involving minimum deterioration of soil health and least disturbance to the rice ecosystem. This is possible through combined use of inorganic fertilizers and organic manures and by promoting the inherent nutrient supplying capacity of soil through appropriate management practices.Keeping all these in view, the present investigation wasundertaken to study the performance of direct seeded *sali* rice under various sowing dates, methods of sowing as well as nutrient management practices under rainfed condition.

MATERIALS AND METHODS

A field experiment was conducted during *kharif* 2015 at Instructional-cum-Research (ICR) farm of Assam Agricultural University, with *sali* rice.The experiment was carried out in a split-plot design (Gomez and Gomez, 1984) with different treatments consisted of four dates of sowing in main plot *viz*., 1May, 11 May, 21 May and 31 May along with two methods of sowing *viz.,* direct seeding and transplanting and two nutrient management practices *viz.,* recommended doses of fertilizer (RDF) 60-20-40 N;P_2O_5;K_2O kg/ha and INM package (Organic manure @ 1 t/ha + mixed innocula of *Azospirillum*sp. and *Bacillus megaterium* P-5 @ 4 kg/ha, Rock Phosphate @ 10 kg P_2O_5/ ha, MOP @ 40 kg K_2O/ha) in sub-plots. In case ofRDF, nitrogen was applied in 3 split doses i.e., ½ of N at final ploughing, ¼ at active tillering stage and remaining ¼ at panicle initiation stage. All the phosphatic and potassic fertilizers were applied one day ahead of sowing. For INM treatments, organic manure, rock phosphate and MOP was also applied one day ahead of sowing as per treatment. The rice variety TTB 404 (Shraboni) was sown @ 75 kg/ha in the main field as per seeding dates at a row spacing of 20

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cm. The same date of seeding in nursery bed for transplanting method was maintained and 28 days of old seedlings were transplanted in respective dates at a spacing of 20 cm × 15 cm. The harvesting of rice at all the dates of sowing was 2-7 days earlier in case of direct seeding over transplanting method. The rainfall received during the whole crop growing season was 1619.7 mm.

RESULTS AND DISCUSSIONS

Growth and yield attributing parameters

Effect of dates of sowing: Higher plant height was found at May 11(107.72 cm) and May 1 (105.93 cm) sown crop and was statistically *at par*. This might be due to favourable weather conditions such as temperature and rainfall during the critical growth period which enabled the plant to improve its growth and development as compared to other sowing dates. These results were in line with Khakwani *et al*. (2006).Panicle/m^2, panicle length, filled grains/panicle, 1000- grain weight were found to be reduced due to delay in sowing, which might be due to congenial climatic condition during the early growth period that resulted in higher yield attributes than the later. The number of filled grains/panicle showed a better response with early sowing because in late sowing the plants might have suffered from moisture stress which ultimately resulted in drying of pollen; also late sowing shortened the growth period of the plant and therefore reduced the length of panicle and 1000-grain weight. Similar, findings were reported by Akram *et al.* (2007) and Khalifa (2009). Similar effects were found on plant population which decreased significantly with delay in sowing. The maximum number of plant population was recorded for May 11(305.87 /m^2) sowing and thereafter, a declining trend was observed. The increase in the number of plant population was attributed due to the favourable temperature and rainfall *viz.* environmental conditions because of proper sowing time which enabled the plant to increase the tiller numbers as compared to late sowing dates. These results were similar to that of Akbar *et al.* (2010). These indicated that early sowing dates produce more tillers/plant than late sowing dates.

Effect of methods of sowing: Between the two methods of sowing i.e., direct seeding and transplanting, transplanted rice showed significant effect as compared to direct seeded rice in growth characters like plant height and plant population/m^2 harvest. At harvest transplanted crop recorded significant effect in all the growth characters as compared to direct seeded which might bedue to optimum spacing that resulted in less intra-species competition between the plants, higher nutrient uptake, light interception and so, all the characters such as plant height, plant population/m^2 were more in transplanting condition (106.66 cm, 308.29/m^2 and 1201.64 g/m^2respectively) than direct seeding. These results were in conformity with the findings of Ehsanullah *et al.* (2007). Between the two methods of sowing, yield attributing characters, higher grain and straw yield had been found in the transplanted than direct seeded rice. Except panicle/m^2 all the parameters related to yield characters had been found non-significant. Panicle/m^2(216.68/m^2) in transplanting condition was more than that of direct seeding which might be due to higher number of effective tillers/m^2 due to proper spacing, light, high nutrient uptake and less intra and inter-species competition. These findings were similar with Aslam *et al*. (2008).

Effect of nutrient management: Between the two nutrient management practices i.e., RDF and INM, INM recorded significant effect as compared to RDF. Plant height, plant population/m^2 showed the highest value in INM practice that recorded 105.85 cm, 297.50/m^2 and 1161.00 g/m^2,

Table 1: Effect of dates of sowing, methods of sowing and nutrient management on growth and yield attributes of *sali*rice.

Treatment	Plant height (cm)	Plant population (number/m^2)	Panicles/m^2	Panicle length (cm)	Filled grains/ panicle	Test weight (g)
Dates of sowing						
1 May	105.93	299.93	205.93	22.43	103.36	22.10
11 May	107.72	305.87	217.77	24.42	106.48	22.76
21 May	102.30	288.52	197.85	22.03	100.55	21.98
31 May	96.16	286.53	193.53	21.73	99.59	21.69
S.Ed. (±)	2.02	5.65	5.84	0.98	1.06	0.16
C.D (P=0.05)	4.94	13.83	14.28	NS	2.60	0.38
Methods of sowing						
Direct Seeding	99.40	282.14	190.86	22.19	101.87	22.06
Transplanting	106.66	308.29	216.68	23.11	103.15	22.21
S.Ed. (±)	1.91	7.13	7.20	0.45	0.96	0.25
C.D (P=0.05)	3.94	14.72	14.85	NS	NS	NS
Nutrient management						
RDF	100.20	292.92	201.31	22.10	101.67	21.89
INM	105.85	297.50	206.23	23.21	103.35	22.38
S.Ed. (±)	1.91	7.13	7.20	0.45	0.96	0.25
C.D (P=0.05)	3.94	NS	NS	0.93	NS	NS

N.B: RDF: 60-20-40 N; P_2O_5; K_2O kg/ha ; INM package (Organic manure @ 1 t/ha + mixed innocula of *Azospirillum* sp. and *Bacillus megaterium* P-5 @ 4 kg/ha, Rock Phosphate @ 10 kg P_2O_5/ha, MOP @ 40 kg K_2O/ha)

respectively than RDF. In both the conditions *viz*., direct seeding and transplanting, INM showed significant results as compared to RDF which might be due to favourable soil condition, soil fertility improvement in INM due to the presence of organic matter that resulted in higher moisture holding capacity and favoured uptake of nutrients. These results were in line with Alagappanand Venkitaswamy, 2014 and Thiyagarajan (2003). Between the nutrient management practices, higher grain and straw yield and yield attributing characters had been found in the INM than the RDF practices. Except panicle length all the parameters related to yield characters had been found non-significant. Panicle length differed significantly in INM than that of RDF which might be due to enhanced and continuous supply of nutrients by the enriched organics leading to increased panicle length. These findings were similar with Mohandas and Appavu (2000).

Yield

Effect of dates of sowing: Grain and straw yield in rice were highly influenced by dates of sowing (Table 2). Among the yield components recorded, number of panicle per unit area in the above table was the most important yield contributing factor. This might be attributed to the cumulative effect of more number of productive tillers per unit area. Early sowing on May 11(217.77/m^2) and May 1(205.93/m^2) significantly produced higher panicles than that of May 31(193.53/m^2) sowing. Hence, considerable reduction in yield was observed due to the effect of sowing dates. Higher grain and straw yield were found in May 11(40.24 q/ha) sown crop which was highly significant to May 21(37.30 q/ha) and May 31 (37.22 q/ha). This might be due to increase in all the growth and yield attributing characters in May 11which ultimately contributed the yield of rice due to favourable climatic condition which might have resulted in higher uptake of nutrients as well as net assimilation of photosynthates in respect to other sowing dates. Both grain and straw yield were reduced due to delay in sowing in rice. Similar results were also reported by Rakesh and Sharma (2004).

Effects of methods of sowing: Higher grain (40.26 q/ha) and straw (68.12 q/ha) yield was found in transplanted condition than direct seeding which might be due to higher yield attributing characters and higher uptake of nutrients because of proper spacing for good management, photosynthetic activities, assimilate partitioning, thereby resulting in good yield in well-spaced rice fields. The results are quite in line with Maqsoos (1998) and Ali *el al.* (2013). No significant effect in harvest index had been observed between the two sowing methods. However, transplanting method gave the highest harvest index (37.18 %) as compared to direct seeding in rice which might be due to higher economic and biological yield as compared to direct seeding Ehsanullah *et al.* (2000).

Effects of nutrient management: Higher grain (39.75 q/ha) and straw (67.52 q/ha) yield had also been found in INM practices than RDF which might be due to higher yield attributing characters and higher uptake of nutrients because of the fact that physiologically proper partitioning might have occurred from source to sink, resulting in improved yield attributes. INM increased the nutrient supply capacity of the soil for a longer period as organic manure acts as a binding agent that will prevent the nutrients from loss and supply the nutrients to the crop continuously for longer time resulting better growth and development in yield attributes that ultimately had reflected in grain and straw yield (Alagappan *et al.,* 2014). INM recorded the highest harvest index (37.01 %) as compared to RDF in rice which might be due to higher economic and biological yield.

Table 2: Effect of dates of sowing, methods of sowing and nutrient management on yield (q/ha) and economics of *sali*rice

Treatment	Grain yield(q/ha)	Straw yield(q/ha)	Harvest index(%)	Net Return(₹./ha)	B: C Ratio
Dates of sowing					
1 May	38.78	65.76	37.04	54280.00	1.48
11 May	40.24	68.07	37.12	57625.00	1.57
21 May	37.30	64.33	36.72	51345.00	1.40
31 May	37.22	63.09	36.98	50605.00	1.38
S.Ed. (±)	0.92	1.35	0.83	-	-
C.D (P=0.05)	2.25	3.31	NS	-	-
Methods of sowing					
Direct Seeding	36.51	62.50	36.75	52355.00	1.55
Transplanting	40.26	68.12	37.18	54565.00	1.37
S.Ed. (±)	0.98	1.52	0.58	-	-
C.D (P=0.05)	2.01	3.14	NS	-	-
Nutrient management					
RDF	37.02	63.10	36.93	50265.00	1.34
INM	39.75	67.52	37.01	56675.00	1.58
S.Ed. (±)	0.98	1.52	0.58	-	-
C.D (P=0.05)	2.01	3.14	NS	-	-

N.B: RDF: 60-20-40 N; P_2O_5; K_2O kg/ha ; INM package (Organic manure @ 1 t/ha + mixed innocula of *Azospirillum* sp. and *Bacillus megaterium* P-5 @ 4 kg/ha, Rock Phosphate @ 10 kg P_2O_5/ha, MOP @ 40 kg K_2O/ha)

Economics

Economics was given on Table 2with only net return and benefit-cost ratioof different treatments. The input and output costs were taken as per the market price during the *kharif*2015 season. The highest net return (57625/ha) and B: C ratio (1.57) were recorded under 11May sown crop that of other dates. This corroborates the finding of Osman *et al.* (2015) who found that early sowing resulted in higher net return due to higher grain and straw yield. The B: C ratio increased in direct seeding which was 1.55 in spite of low grain and straw yield than transplanting. This might be due to less cost of cultivation in direct seeding due to the omission of operations such as nursery bed preparation, transplanting, puddling etc., which were required in transplanting. These findings were in close conformity with the findings of Kumar and Ladha (2011). The relative economic indices like gross return (92385/ha), net return (56675/ha) and benefit-cost ratio 1.58 increased with INM practices which might be attributed to higher grain and straw yield resulting from the higher uptake of nutrients in comparison with RDF. These findings were in close conformity with the findings of Bali and Wani (2004).

CONCLUSION

Early sowing dates resulted in increased in growth attributes such as plant height, number of plant population per unit area as compared to the late sowing which in turn might have affected the yield and its attributing characters of the rice plant. The sowing dates on 11May and 1May recorded the highest in all the above mentioned characters than May 21 and May 31, respectively. Higher grain and straw yield were also obtained in May 11 and May 1 sown crops as compared to others. So far methods of sowing was concerned, transplanting recorded the highest grain and straw yield and its attributes. Similar, effects were obtained in case of INM where grain and straw yield were recorded the highest than RDF. Economically, early sowing results in higher B:C ratio than others whereas in methods of sowing, direct seeding resulted in higher B:C ratio which may be due to less labour inputs. In nutrient management practices, INM recorded the highest B:C ratio than RDF. Hence, we can go for May 11 transplanting of *sali* rice with INM practice for obtaining higher yield and maximum utilization of the inputs applied.

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