SHORT COMMUNICATION

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Planting techniques on productivity of organically grown scented rice (*Oryza sativa* L.) in Assam

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ABSTRACT

A field experiment on scented (joha) rice var. 'Badshahbhog' was carried out in the organic block located at Instructional-cum Research Farm of Assam Agricultural University, Jorhat during kharif seasons of 2013 and 2014 to evaluate the effects of 3 planting patterns and 5 staggered planting with different types of seedling under rainfed condition. Among different planting patterns grain yield was recorded highest for rectangular planting (1.40 t/ha) followed by skip row planting (1.37 t/ha). Among different planting dates, transplanting on 10th September with 70 days old (35+35 days) double planted seedlings (DPS) produced the highest grain yield of 1.61t/ha with H.I of 37.25 per cent On the other hand, the straw yield was recorded lowest on 10 September planting with (35+35 days)double planted seedlings. The highest straw yield was recorded on 1 August planting using 30 days nursery seedling (DNS) and decreased with the advancement of planting dates. The increase in grain yield with 10th September planting over 1st,10th, 20th and 30th August planting was 7.83,17.39, 22.36 and 27.95 %. Total uptake of N, P and K by grain + straw recorded the highest when planting was done on 1st August using 30 DNS. The highest value in terms of net returns and benefit-cost ratio were recorded on 1 st August planting followed by 10th September planting.

Key words: *Planting techniques, productivity, scented rice*

The scented (*joha*) rice of Assam, India is known for its unique aroma, superfine kernel, good cooking quality and excellent palatability. The agriculture in Assam is still under the natural makeup without much degradation of ecosystem as crop pressure on soil is still less (142% cropping intensity) and use of agrochemicals are also below toxic levels. Presently, organic agriculture has come out to be the viable alternative for quality food production, eco sustainability, soil and human health issues along with other social and cultural issues. It is now established globally that organic farming can improve the quality of scented rice (Das *et al*. 2010). In Assam, more than 80% rice area is situated under high risk, ecologically handicapped rainfed ecosystem and due to vagaries of monsoon, particularly late receipt of monsoon showers during *kharif* season and early floods, farmers find it difficult to decide whether they would transplant with aged seedlings or grow new seedlings. Selection of rice variety for late transplanting with aged seedling is important for higher production (Choudhary *et al*. 1997, Kurmi *et al*. 1993; Nayak and Choudhary, 1997). The practice of double transplanting of rice avoids ill effects of over-aged seedlings in the nursery and it is also useful in seedling scarcity situations and can cover 8-10 times more area as compared to normal planting with nursery raised seedlings. In double transplanting practice, uprooting of seedlings is done carefully after 30-35 days from the first nursery and transplanting is done in second nursery at closer spacing (10cm x10cm) with 2 seedlings per hill after puddling. The hills from second nursery are uprooted again after 30-35 days. Tillers are separated out from the hills and planting is done in the main field as per recommended practice.

Some reports suggested that skip row planting produces as much rice yield as conventional planting

during the wet season. Also, border method may enable the farmers to economize fertilizer and seed by 25per cent by leaving every fourth row unsown and unfertilized (AICARP 1986). Rice is highly sensitive to diverse ecological situation, as such seedling age and specific row arrangement at transplanting play a crucial role in realizing the potential yield. No precise work on these aspects have been done so far in Assam. Hence, the present study was undertakento find out proper planting pattern in relation to planting date and performance of staggered planting on growth and yield of scented rice by manipulating planting pattern anddates of planting.

The field experiment was carried out in the organic block of Assam Agricultural University, Jorhat during *kharif* season of 2013 and 2014 under rainfed condition. The soil collected from 0-15 cm depth was sandy loam with pH 5.9, organic carbon 0.53%, available nitrogen 269.96 kg/ha, available phosphorus 23 kg/ha and available potassium 175.05 kg/ha. Total rainfall received during the crop growth period was 1171.43 and 1285.58 mm distributed in 68 and 72 rainy days during 2013 and 2014, respectively.

The seedlings of *joha* rice var. Badshahbhog were planted staggering under five dates of planting (1, 10, 20, 30 August and 10 September) with increasing age of seedlings, starting from 30 days of nursery seedling (DNS) up to 60 DNS at an interval of 10 days and subsequently to 70 days (35+35 days) using double planted seedling (DPS) on 10 September in three planting patterns *viz.*, rectangular (20×15 cm), square (20×20cm) and skip row (3:1, 20×15cm). The experiment was laid out in split-plot design, keeping planting patterns in main plot and staggered plantings with type of seedlingin sub-plot, with 3 replications. Plant height of randomly selected tillers from each treatment was recorded from soil level to the tip of flag leaf with the help of a meter scale. At maturity plant samples from each plot were harvested manually and separated into straw and panicles. The dry weight of straw was determined after oven drying at 70°C to constant weight. All agronomic parameters, yield and yield attributing characters were recorded following standard procedures (Kumar *et al*. 2016, 2017).

Effect of planting pattern

All the growth and yield attributing characters of scented (*joha*) rice were influenced significantly due to staggered planting, but remained unaffected with planting patterns (Table 1). All the yield attributes such as length of panicle, weight of panicle, filled grains per panicle and 1000 grains weight were not influenced significantly due to different planting patterns. However, the length of panicle, filled grains per panicle and 1000 grains weight were recorded higher in skipped row planting (3:1; 20×15 cm). On the other hand, weight of panicle was obtained higher in rectangular planting with

Table 1. Growth and yield attributing characters of scented rice as influenced by planting pattern and staggered planting with type of seedling (mean data of 2 years)

Treatment	Plant height (cm)	Flag leaf area(cm^2)		No. of tillers/ hill	Length of panicle (cm)	Weight of panicle(g)	No.of filled grains/ panicle	Per cent unfilled grains/ panicle	1000 grains weight (g)
Planting pattern		Flowering	Harvest						
Rectangular(20x15cm)	120.04	14.93	10.15	6.82	24.58	1.49	119.95	10.41	12.17
Square (20x20cm)	119.95	16.97	10.98	7.19	25.68	1.47	123.79	10.00	12.28
Skip row (3:1;20x15cm)	121.91	16.27	11.38	6.86	5.34	1.43	124.60	11.48	12.34
SEm ±	1.331	0.304	0.239	0.249	0.146	0.036	3.857	0.284	0.151
CD (P= 0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS
Staggered planting with type of seedling									
1 August (30 DNS)	124.25	17.01	11.44	7.64	24.76	1.42	117.24	9.36	12.08
10 August (40 DNS)	124.43	15.81	10.22	7.39	24.84	1.37	120.97	9.42	12.17
20 August (50 DNS)	119.66	15.67	10.57	7.03	24.53	1.30	117.49	11.07	12.13
30 August (60 DNS)	113.62	14.79	10.24	6.68	23.09	1.08	91.78	13.70	12.22
10 September (70 days DPS)	121.22	16.98	11.72	6.03	27.12	2.15	166.42	9.61	12.71
SEm ±	1.085	0.546	0.366	0.213	0.235	0.054	2.959	0.211	0.150
CD (P= 0.05)	3.17	1.59	1.07	0.62	0.68	0.16	8.64	0.62	0.4

*DNS: Days nursery seedling, DPS: Double planted seedling, NS: Non-Significant

a spacing of 20×15 cm. The higher yield attributes in closer spacing of 20×15 cm either in rectangular or skip row planting might be due to the fact that closer spacing produced less number of tillers per hill which may developed better and more stronger plants resulting better development of yield attributes. Among the three planting patterns, rectangular (20×15 cm) planting produced the highest grain and straw yields (Table 2) over the other planting patterns . The higher grain and straw yield in closer planting pattern of 20×15cm (rectangular) might be due to higher number of total tillers per unit area, more ear bearing shoots per m^2 and more number of functioning leaves per hill as well as better development of yield attributes. This might be also due to more number of hills per hectare (3.33 lakh) in rectangular planting as compared to other two planting patterns where 2.5 lakh hills/ha were accommodated. Similar findings have also been obtained by Balasubhramanian and Palaniappan (1991), Gupta and Sharma (1991), Padmaja and Reddy (1998), Patra and Nayak (2001) and Powar and Deshpande (2001). The residual available N, P and K contents and their uptake were not influenced significantly due to different planting patterns (Table 3).

Effect of staggered planting with type of seedling

Effect of different planting dates with type of seedling on growth and yield attributing characters of rice such as length of panicle, weight per panicle, number of filled grains per panicle and 1000-grain weight were significantly higher when 70 days old (35+35 days) double planted seedlings (DPS) were planted on 10 September than the 30, 40, 50 and 60 days nursery raised seedlings planted on 1,10, 20 and 30 August, respectively. All the yield attributing characters decreased with delay in transplanting dates and use of aged nursery seedlings for planting from 1st August to 30th August. Similar findings were also reported by Babu (1988).

The grain yield and harvest index were significantly higher in double planted seedling (DPS) transplanted on 10th September and lowest was on 30th August planting with 60 days nursery seedling. Increase in grain yield on 10 September planting with 70 days DPS over 1st,10th, 20th and 30th August planting with nursery raised seedling was 7.83,17.39, 22.36 and 27.95%. Advantage of double transplanting of late transplanted rice was also reported by Rautaray (2006) and Ashem *et al*. (2010). Higher grain yield with 70 days old DPS planted on 10th September might be due to significant increase in length of panicle, weight of panicle, number of filled grains per panicle, 1000-grain weight and decrease in per cent unfilled grains per panicle. Another reason might be due to thicker culm, better shoot and root growth thereby more food reserves in double planted seedlings in comparison to conventional seedlings. Again, double planted seedlings led to quick establishment and less mortality of seedlings in main field even in late planting. Higher flag leaf area recorded on 10th September and 1st August plantings might have some contribution towards the photosynthate production which helped in higher grain yield. The results

Table 2. Yield and economics of scented rice as influenced by planting pattern and staggered planting with type of seedling (mean data of 2 years)

Treatment	Grain yield (t/ha)	Straw yield (t/ha)	H.I (%)	Net return (Rs/ha)	Benefit-cost ratio
Planting pattern					
Rectangular(20x15cm)	1.40	3.55	28.57	47,281.00	1.79
Square (20x20cm)	1.33	3.37	28.30	44,281.00	1.72
Skip row (3:1;20x15cm)	1.37	3.35	28.18	45,781.00	1.78
SEm ±	0.017	0.072	0.493	-	-
CD (P= 0.05)	NS	NS	NS	-	-
Staggered planting with type of seedling					
1 August (30 DNS)	1.48	4.29	25.52	54,871.70	2.13
10 August (40 DNS)	1.33	4.02	24.98	47,521.70	1.84
20 August (50 DNS)	1.25	3.34	27.35	40,921.70	1.59
30 August (60 DNS)	1.16	2.75	30.38	34,371.70	1.33
10 September (70 days DPS)	1.61	2.70	37.25	51,001.70	1.90
SEm ±	0.060	0.117	0.673	-	-
CD (P= 0.05)	0.10	0.34	1.96	-	-

DNS: Days nursery seedling, DPS: Double planted seedling, NS: Non-Significant

Table 3. Organic carbon (%), residual available nutrient status in soil and nutrient uptake by scented rice as influenced by planting pattern and staggered planting with type of seedling (mean data of 2 years)

Treatment	Organic carbon (%)	Available nutrient (kg/ha)			Total uptake of nutrient(kg/ha)		
Planting pattern		N	P	K	N	P	K
Rectangular(20x15cm)	0.80	274.41	18.11	175.83	52.76	7.91	42.01
Square (20x20cm)	0.79	273.08	18.79	176.05	51.79	7.88	40.55
Skip row (3:1;20x15cm)	0.78	272.62	18.25	176.27	51.07	7.96	39.77
SEm ±	0.011	0.848	0.450	3.397	0.949	0.441	1.066
CD (P= 0.05)	NS	NS	NS	NS	NS	NS	NS
Staggered planting with type of seedling							51.24
1 August (30 DNS)	0.78	273.07	17.83	175.76	61.79	10.52	46.27
10 August (40 DNS)	0.78	273.06	18.61	176.03	56.77	8.67	38.41
20 August (50 DNS)	0.79	274.01	18.41	175.29	49.70	8.13	31.50
30 August (60 DNS)	0.80	272.35	18.34	176.53	41.47	5.95	36.34
10 September (70 days DPS)	0.79	274.35	18.70	176.14	49.64	6.31	0.868
SEm ±	0.007	1.420	0.381	0.953	1.132	0.402	2.53
CD (P= 0.05)	NS	NS	NS	NS	NS	NS	NS

DNS: Days nursery seedling, DPS: Double planted seedling, NS: Non-Significant

corroborate the findings of Bashar *et al*. (1995). Lower grain yield in late planting on 30 August might have exposed the crop to relatively more adverse environmental condition in terms of water stagnation at the tillering phase, low temperature at the reproductive phase and infestation of insect-pests (case worm) which might have pulled down the yield as compared to earlier plantings. However, straw yield decreased with delaying the planting dates from 1st August to 10th September which might be due to more taller plants and higher number of tillers per hill in early planting than the successive plantings. Early planting on 1st August favours better rooting density and better uptake of N, P and K and thereby increase in growth and yield attributing characters and ultimately reflected on straw yield.

Economics

The net return and benefit-cost ratio were recorded higher in rectangular planting than that of square and skipped row planting which was mainly due to higher grain and straw yields of rice. Among various dates of planting, 30 days nursery seedling (DNS) planted on 1st August recorded the highest value in terms of net return and benefit-cost ratio which was followed by 10th September with 70 days (35+35 days) DPS. This was due to the fact that 10 September and 1 August planting registered relatively higher value in respect of grain and straw yield, respectively. These findings are in align with that of Singh *et al*. (1997).

Overall, it can be concluded that rectangular planting spaced at 20 ×15 cm or skip row (3:1; 20 ×15 cm) planting with 30 days nursery seedling on 1st August or 70 days (35+35 days) double planted seedling on 10th September found to be the best for obtaining higher production as well as maximum economic returns.

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