EFFECT OF PLANTINGMETHODS AND SEEDLING AGE ON GROWTH, YIELD AND NUTRIENT UPTAKE IN RICE UNDER HIGH RAINFALL AREAS OF BAY ISLANDS

ABSTRACT

A field experiment was conducted in farmer's field during *Kharif*season at Badmaspaharvillage of South Andaman under National Innovation on Climate Resilient Agriculture (NICRA) to find out the influence of planting methods, seedling age on growth, productivity, profitability, nutrient uptake of rice under higher rainfall areas of Bay Islands. Among the method of planting and age of seedlings, square planting with 14 days old seedlings recorded the highest dry matter production of 63.2% higher dry matter production as compared to random planting with 28 days old seedlings. Maximum grain and straw yield of 4855 and 9460 kg/ha respectively was recorded square planting (20 x 20 cm) with 14 days old seedling which was 64.6, 45.6 and 71.7, 59.9% higher grain and straw yield as compared to random planting with 28 days old seedlings and same age of seedlings with line planting respectively.Higher gross return of Rs. 50920/ ha and net return ofRs. 32170/ ha with B: C ratio of 2.72 was recorded in square planting (20 x 20 cm) with 14 days old seedling. The higher N, P and K uptake of rice (78.7, 25.1 and 114.8 kg/ha, respectively) was recorded in square planting (20 x 20 cm) with 14 days old seedlings was comparable with line planting (20 x 15 cm) with 14 days old seedlings. Hence, it can be concluded that square planting (20 x 20cm) with 14 days old seedlings with stand lodging, produced more economic yield and net return for realizing efficient use of resources and productivity.

Keywords:rice nutrition, growing rice, rice plantingmethod, rice seedling age Planting method, seedling age, rice, yield, nutrient uptake, Bay Islands

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INTRODUCTION

Rice (*Oryza sativa* L.) is the staple food for nearly 3 billion people and demand continues to grow as population increases (Carriger and Vallee, 2007). In India, rice is cultivated round the year in one or the other part of the country, in diverse ecologies spread over 44.6 m ha (Mangala Rai, 2004) with a production of 132 mt of rice with average productivity of 2.96 t/ha. Rice production in India had increased in the past three decades continuously beginning with the green revolution, but has stagnated since 1999. Andaman and Nicobar Islands with 7650 ha of rain fed low lands under rice, have a great potential to improve the productivity through improved method of rice intensification. At present the average productivity of rice is only 2.3 to 2.7 t/ ha due to low level of input and poor management

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practices. Besides crop lodging due to intense rainfall and high winds during crop growth period especially at maturity stage results in complete loss of the produce and also still 60 % area of paddy cultivation is occupied by traditional photo sensitive, lodging prone long duration variety of C14-8 (180 days). Better crop stand establishment is one of the key pre-requisites for optimal use of resources like nutrients and other inputs and consequently for achieving desired level of production. Proper row arrangement and appropriate inter and intra row spacing are essential for improving the crop growth and yield.Modified planting techniques such as wider spacing and double seedlings have greater scope for development of more tillers thus intercepting higher solar radiation. Manipulation of planting method appears to have a promising potential for increasing the rice yield, as it is assumed to have pronounced effect on tillering, interception and utilization of light, which in turn influence the rice yield (Alexander *et al.*, 1988). Improved planting method needs to be compared with conventional method of planting in order to elucidate the parameters contributing for yield determination under modern planting method. Hence, the present investigation was contemplated on influence of planting method, seedling age on crop growth, productivity, profitability, nutrient uptake of rice under high rainfall areas of bay islands.

Comment [¨.4]: not parameters but factors, variables,i. g.

MATERIALS AND METHODS

Field experiment was carried out in the farmer's field during *Kharif* season of 2016-17 and 2017-18 at Badmaspaharvillage of South Andamandistrict of A & N Islands. The experimentalsites were geographically situated in 11^{o}38.452' N latitude and 92^{o} 39.844' E longitude at an altitude of 5.7 m above mean sea level.The soil was sandy clay loam in texture with pH 7.3, EC of 0.22 dS/m, medium organic carbon (0.58%), low in available nitrogen (173.5 kg/ha), medium in available phosphorus (14.2 kg/ha) and medium in available potassium (276.4 kg/ha). The experiments were laid out in randomized black design with six treatments with four replications. The treatments consists of T_1-Random planting with 14 days old seedlings, T_2-Random planting with 28 days seedlings (Farmers method), T_3-Line planting (20 x 15 cm) with 14 days old seedlings, T_4-Line planting (20 x 15 cm) with 28 days old seedlings, T_5-Square planting (20 x 20 cm) with 14 days old seedling, T_6-Square planting (20 x 20 cm) with 28 days old seedlings. The paddy variety of *Swarnadhan* with medium duration of 110 days was used for the study. The recommended dose of fertilizer (90: 60: 40 kg NPK/ha) was applied through urea, di-ammonium phosphate and Muriate of potash. Nitrogen was applied in four splits at 10 days after transplanting (DAT), active tillering, panicle initiation and flowering stage.While 100 % P and 50 % K were applied as basal. Remaining 50 %

potassium was applied at panicle initiation stage. Cono-weeder was used which resulted in incorporation of weeds with simultaneous stirring up of soil. It was operated between the rows in three times at 15, 30 and 45 days after transplanting (DAT) in square planting and line planting and left out weeds were removed by manual weeding.Need based plant protection measures were given whenever the incidences were more than economic threshold level. Lodging was quantified as the percentage reduction in canopy height relative to plants held erect at maturity stage in selected rows (Setter *et al*. 1997). Root characters *viz*., root length and root dry weight, individual hills along with roots in the sample rows were uprooted carefully, washed in clean water and measured root length from the base of the collar to the tip of the root. The root samples were dried in an oven at 70-80°C for 72 hours and weighed root dry weight expressed in g/hill. Growth and yield parameters were recorded as per standard procedures. Economics was calculated based on the input and output costs in local market. The percentage concentration of the nutrients was multiplied with the respective dry matter content and N, P, K uptake values were worked out. Soil samples collected after harvest of the crop was analyzed for soil available nutrient status of N, P and K. The data on various studies recorded during the investigation were subjected to statistical scrutiny as suggested by Gomez and Gomez (2010). Wherever the treatment differences were significant, least significant differences were worked out at 5 per cent probability level and the values were furnished. The treatment differences that were not significant were denoted as 'NS'.

Comment [¨.5]: factors. Parametercannot be confused with variables or factors

RESULTS AND DISCUSSION

Plant growth attributes

Plant methods and age of seedlings didn't influence on plant height (Table 1). Plant height ranged from 105.6 to 122.3 cm under all the treatments. Whereas, numerically higher plant height of 122.3 cm was recorded under square planting with 14 days old seedlings. Thisis clearly indicated that age of seedling had no adverse effect on plant height.Growth attributes of paddy is mainly governed by monitory inputs such as fertilizers, weed management *etc* which could be the reason for less influence of method of planting and age of seedlings on growth attributes. Planting method and age of seedlings showed significant influence on leaf area index, root length, root dry weight and dry matter production. Random planting with aged seedlings recorded the least leaf area index and root length as compared to other planting methods and age of seedlings. Whereas, all other treatments were on par with one another. The highest root dry weight of 13.43 g/hill recorded under square planting with 14 days old seedlings which was comparable with similar age of seedling with line planting. These

treatments were 59.3 and 52.2% higher root dry weight as compared to random planting with 28 days old seedlings. Wang *et al*. (2002) who has reported that system of rice intensification method has enhanced the root viability, contents of soluble sugar, non- protein nitrogen, proteins and malondialdehyde (MDA) in leaf, dry matter in vegetative organs, partitioning percentage of stored carbohydrate and nitrogen. Square planting with 14 days old seedlings recorded the highest dry matter production of 63.2% higher dry matter production as compared to random planting with 28 days old seedlings. It might be due to cono-weeder incorporated weeds insitu with simultaneous stirring up of soil which induced biological activities and aeration in the root zone and helped good vegetative growth of plants. This was followed by line planting (20 x 15 cm) with 14 days old seedlings.Ninad*et al*. (2017) reported that wider spacing allows a larger leaf area which increases net photosynthetic assimilates and helps for the vigorous plant growth.

Comment [¨.6]: contributes

Yield attributes and yield

Square planting (20 x 20 cm) with 14 days old seedling recorded the highest productive tillers of 283/m^2. This was on par with line planting (20 x 15 cm) with 14 days old seedlings (Table 2). These two treatments were 59.9, 43.7 and 51.4, 36.0% higher productive tillers as compared to Random planting with 28 days seedlings and line planting (20 x 15 cm) with 28 days old seedlings respectively. This might be due to use of young seedlings with wider spacing, roots have more room to grow and plant shoots have opportunity to intercept more light and other resources. It corroborates the findings of Devaranavadgi*et al*. (2003). Square planting (20 x 20 cm) with 14 days old seedling, Line planting (20 x 15 cm) with 14 days old seedlings, Random planting with 14 days old seedlings, square planting (20 x 20 cm) with 28 days old seedling recorded 6.2, 5.2,4.4 and 3.3cm higher panicle length as compared to random planting with 28 days seedlings.The highest no of filled grains/panicle (132.5) was recorded under square planting (20 x 20 cm) with 14 days old seedling. This was comparable with similar age of seedlings with line planting and random planting methods. Whereas, the highest sterility percentage of 21.9% was recorded in random planting with 28 days seedlings. This was followed by line planting (20 x 15 cm) with 28 days old seedlings was comparable with square planting (20 x 20 cm) with 28 days old seedling. The spikelet sterility percentage of 8.6% registered under square planting (20 x 20 cm) with 14 days old seedling. The similar results are in accordance with previously reported by Anwari *et al*. (2019). Test grain weight is by and large heritable and therefore, different planting methods and age of seedlings failed to expert marked variation on test weight of rice.Planting method and age of seedlings

significantly influenced by lodging. The highest lodging ratio of 73.8% was observed in random planting with 28 days seedlings. This might be due to poor root growth which led to reduction of straw strength and excessive lengthening of the internode. Whereas, the least lodging was observed under square planting with 14 days old seedlings which may be due to the compact hill with more tillers, deep root system and more culm strength . The similar findings was reported by Gustafson (2003).Among the method of plantings and seedlingage, square planting (20 x 20 cm) with 14 days old seedling recorded maximum grain and straw yield of 4855 and 9460 kg/ha respectively which was followed by same age of seedlings with line planting (20 x 15 cm) in grain yield. However, in straw yield, these two treatments were on par with each other. The reduction of grain yield and straw yield to the tune of 64.6and 71.7% recorded in 28 days old seedlings with random planting. It might be due to better utilization of space and other inputs in which heavy and healthy panicles are produced. The similar findings was reported by Haque e*t al.* (2012).

Economics

Higher gross return of Rs. 50920/ ha and net return of Rs. 32170/ ha with B: C ratio of 2.72 was recorded in square planting (20 x 20 cm) with 14 days old seedling (Table 3). Slightly higher number of productive tillers/m^2 and number of filled grains/panicle leading to numerically higher grain and straw yield could be attributed for higher net returns and B: C ratio. Damodaran*et al.* (2015) reported that economic efficiency of early planting of system which was attributed to higher yield and net return. The lower gross return, net return and B: C ratio was registered under random planting with 28 days seedlings.

Cop nutrient uptake

Method of planting and seedling age significantly influenced the nutrient uptake of nitrogen, phosphorus and potash (Table 4). The higher N, P and K uptake of rice (78.7, 25.1 and 114.8 kg/ha respectively) was recorded in square planting (20 x 20 cm) with 14 days old seedlings was comparable with line planting (20 x 15 cm) with 14 days old seedlings. It might be due to conoweeder has enhances root growth, plant has more opportunity to absorb moisture and nutrient from different soil layers which facilitate to withstand moisture stress during drought in later stages of rice. This is in conformity with the findings of Bommayasamy*et al.* (2010). The lower nutrient uptake of N, P and K was recorded under random planting with 28 days seedlings which may be due to more competition among the plant for nutrients.

Soil available nutrient status

Soil nutrient status also significantly influenced by method of planting with seedlingage(Table 4). Though random planting with 28 days seedlings had resulted in higher soil available N (174.9 kg/ha), P (14.7 kg/ha) and K (251.9 kg/ha) status which might be due to lower uptake of nutrients. This was at par with line planting (20 x 15 cm) with 28 days old seedlings. The lower available nutrient status registered under square planting (20 x 20 cm) with 14 days old seedlings. Baloch *et al.* (2006); Bommayasamy*et al.* (2010) who have reported that available nutrient status gets depleted as a consequence of biomass production under best combination of non-monetary inputs.

CONCLUSION

Thus, it can be concluded that square planting (20 x 20cm) with 14 days old seedlings performed better with stand lodging,produced more economic yield and net return for realizing efficient use of resources and productivity.

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Table 1. Influence of planting methods and seedling age on growth of rice under high rainfall areas of Bay Islands

Treatments	Plant height (cm)	LAI	Root length (cm)	Root dry weight (g/hill)	DMP (t/ha)
T_1-Random planting with 14 days old seedlings	117.5	5.76	23.2	11.77	11.66
T_2-Random planting with 28 days seedlings (Farmers method)	105.6	4.90	19.2	8.43	8.46

T_3-Line planting (20 x 15 cm) with 14 days old seedlings	120.1	5.83	22.5	12.83	13.11
T_4-Line planting (20 x 15 cm) with 28 days old seedlings	113.7	5.40	20.5	9.29	8.88
T_5-Square planting (20 x 20 cm) with 14 days old seedling	122.3	5.95	24.1	13.43	13.81
T_6-Square planting (20 x 20 cm) with 28 days old seedling	115.2	5.48	21.7	10.02	10.02
SEm±	3.5	0.20	0.9	0.40	0.33
LSD (P=0.05)	NS	0.60	2.8	1.21	0.98

Table 2. Influence of planting methods and seedling age on yield attributes and lodging ratio of rice under high rainfall areas of Bay Islands

Treatments	No of productive tillers/m^2	Panicle length(cm)	No of filled grains/ panicle	Spikelet Sterility (%)	Test grain weight(g)	Lodging ratio
T_1-Random planting with 14 days old seedlings	251	22.6	121.6	14.6	19.6	32.7
T_2-Random planting with 28 days seedlings (Farmers method)	177	18.2	98.7	21.9	18.0	73.8

T_3-Line planting (20 x 15 cm) with 14 days old seedlings	268	23.4	124.1	11.0	20.0	27.4
T_4-Line planting (20 x 15 cm) with 28 days old seedlings	197	20.1	110.5	16.6	19.0	45.1
T_5-Square planting (20 x 20 cm) with 14 days old seedling	283	24.4	132.5	8.6	20.4	16.9
T_6-Square planting (20 x 20 cm) with 28 days old seedling	243	21.5	115.3	15.8	19.2	39.7
SEm±	9.9	1.0	4.0	0.6	0.8	1.6
LSD (P=0.05)	31	3.0	12.2	1.7	NS	4.7

Table 3. Influence of planting methods and seedling age on yield and economics of rice under high rainfall areas of Bay Islands

Treatments	Grain yield (kg/ha)	Straw yield (kg/ha)	Economics (Rs./ha)		
			Gross return (Rs./ha)	Net return (Rs./ha)	B:C ratio
T_1-Random planting with 14 days old seedlings	3975	7686	41670	24770	2.47
T_2-Random planting with 28 days seedlings (Farmers method)	2950	5511	30150	13250	1.78

T_3-Line planting (20 x 15 cm) with 14 days old seedlings	4295	8811	44650	27150	2.55
T_4-Line planting (20 x 15 cm) with 28 days old seedlings	3150	5733	32930	15430	1.88
T_5-Square planting (20 x 20 cm) with 14 days old seedling	4855	9460	50920	32170	2.72
T_6-Square planting (20 x 20 cm) with 28 days old seedling	3541	6455	37030	18280	1.97
SEm±	164.8	295.4	-	-	-
LSD (P=0.05)	496.7	890.6	-	-	-

Table 4. Influence of planting methods and seedling age on nutrient uptake of rice and post- harvest soil nutrient status under high rainfall areas of Bay Islands

Treatments	Crop nutrient uptake (kg/ha)			Soil available nutrients (kg/ha)		
	N	**P**	**K**	**N**	**P**	**K**
T_1-Random planting with 14 days old seedlings	70.8	22.9	106.4	161.5	12.8	221.8
T_2-Random planting with 28 days seedlings (Farmers method)	65.3	18.9	77.4	174.9	14.7	251.9
T_3-Line planting (20 x 15 cm) with 14 days old	72.9	23.4	110.8	156.8	12.4	218.1

seedlings						
T_4-Line planting (20 x 15 cm) with 28 days old seedlings	65.1	19.5	84.3	166.5	14.1	244.7
T_5-Square planting (20 x 20 cm) with 14 days old seedling	78.7	25.1	114.8	146.5	11.8	215.5
T_6-Square planting (20 x 20 cm) with 28 days old seedling	68.4	20.6	91.1	164.0	13.5	224.0
SEm±	2.1	0.7	3.1	4.5	0.6	6.9
LSD (P=0.05)	6.3	2.1	9.4	13.7	1.6	20.8