

EVALUATION OF LONG DURATION RICE VARIETIES FOR ENHANCING PRODUCTIVITY AND PROFITABILITY UNDER ISLAND ECOSYSTEM

T. Subramani, R. Raja, S.K. Ambast, N. Ravishankar, S.K. Zamir Ahmed, V. Damodaran and N. Bommayasamy

Central Island Agricultural Research Institute, Port Blair, Andaman and Nicobar Islands - 744 101

ABSTRACT

The field experiments were conducted at the field crop research farm, Bloomsdale of Central Island Agricultural Research Institute, Port Blair during wet seasons of 2006 - 09. Four high yielding long duration rice varieties viz., Ranjit (155-160 days), Savitri (150 days) Varshadhan (160 days) and Gayatri (160 days) obtained from Central Rice Research Institute (CRRI), Cuttack along with traditional photosensitive lodging prone long duration variety C14-8 (170 days) and medium duration variety Taichung sen Yu (120 days) were evaluated at research farm and farmer's fields. Among the rice varieties, Varshadhan recorded higher plant height (177 cm) and dry matter production (10.33 t ha⁻¹) followed by Ranjit and Savithri both at research farm and farmer's field. However, Ranjit recorded significantly higher ear bearing tillers (15 hill⁻¹) and filled grains (750 grains) followed by Savithri and Varshadhan in both the locations. The local check, Taichung sen Yu and C 14-8 recorded significantly lower growth and yield attributes as compared to improved long duration rice varieties. Ranjit registered highest grain yield (3 975 kg ha⁻¹) followed by Savithri (3 114 kg ha⁻¹) and Varshadhan (3 096 kg ha⁻¹) at research farm where as Ranjit recorded higher yield of 2 829 kg ha⁻¹ followed by Varshadhan (2 773 kg ha⁻¹), Savitri (2 382 kg ha⁻¹) and Gayatri (2 427 kg ha⁻¹) at farmer's fields. Traditional variety C 14 - 8 recorded lower yield both at research farm and farmer's field. Ranjit recorded higher net return (Rs.23 341 ha⁻¹) and B: C ratio (2.57) followed by Varshadhan and Savithri in research farm. However, at farmer's fields, both Ranjit and Varshadhan performed well and recorded higher net return and B: C ratio. Similar to the economics, Ranjit registered higher energy productivity and lower specific energy.

Key words: Long duration rice varieties, traditional varieties, yield

INTRODUCTION

Paddy is the lifeline cereal of Andaman and Nicobar islands grown in 8 549 ha of low-lying valley areas. Presently, the annual production of rice in the Islands is 26, 249 t and the average yield is only 2.2 t ha⁻¹ necessitating an import of about 27,188 t of rice from the mainland India. The low yield of rice is mainly due to cultivation of long duration, traditional photosensitive lodging prone rice variety C 14-8 which occupies about 70 % of the rice cultivated area of islands. Though farmers are habituated with mono cropping of traditional rice variety (C 14-8) with low or no input management, there is ample scope for increasing the rice productivity by growing improved high yielding long duration varieties with appropriate agronomic management practices. The Islands receives 3080 mm of annual rainfall distributed during May to

December causing water logging in low-lying areas for which rice cultivation is the only option. This means an effective growing period of about seven months is available for rice cultivation. In addition, the popular high yielding varieties like Jaya, Bhavani, Taichang Sen Yu and Quing Livan 1 are of short or medium duration in nature and utilize only 50 to 60 per cent of the effective growing period. Double cropping of rice is having the limitation as there is not enough rain free days between the two rice crops for harvesting, threshing and drying of first crop. Also, extended dry spells during low rainfall years delays the transplanting of second rice crop and exposing the crop to water stress at the maturity stage. In order to address the constraints in rice cultivation and increasing productivity and profitability from rice farming, on station and on farm experiments were conducted with selected high yielding long duration varieties.

MATERIAL AND METHODS

The field experiments were conducted at the field crop research farm, Bloomsdale of Central Island Agricultural Research Institute, Port Blair during wet season of 2006 - 09 (3 years). The study site is geographically situated at 11° 38 N latitude and 92°39 E longitude with an altitude of 8 m above mean sea level. Climate is an equatorial hot humid tropical having medium temperature (23 to 30°C) and high relative humidity (71 to 85 %). The soil is sandy loam in texture, acidic in reaction with a pH of 5.8, medium in organic carbon (0.72 %) available nitrogen (290 kg ha⁻¹), P₂O₅ (13.5 kg ha⁻¹) and low in available K₂O (85 kg ha⁻¹). Five high yielding long duration rice varieties viz., Ranjit (155-160 days), Savitri (145 days) Varshadhan (160 days) and Gayatri (160 days) and C 14-8 (170 days) along with medium duration rice variety Taichung sen Yu (120 days) were evaluated at research farm and farmer's field. Ranjit, Savitri, Varshadhan and Gayatri having potential yield of 4.5, 4.2, 4.0 and 3.5 t ha⁻¹, respectively were obtained from CRRI, Cuttack while C14-8 and Taichung sen Yu are local checks having the yield potential of 2.5 and 2.2 t ha⁻¹.

Improved agro techniques like application of green leaf manures @ 6.25 t ha⁻¹ in the main field, weeding with cono weeder, line transplanting and recommended dose of fertilizer application @ 90:60:60 kg NPK ha⁻¹ for medium duration variety and 120:60:60 kg NPK ha⁻¹ for long duration variety in the form of urea, Single Super Phosphate (SSP) and muriate of potash (MOP) were applied. Full doses of phosphorus and potassium were applied as basal while N was applied in 3 splits as 50% basal, 25 % each at active tillering and flowering for both medium and long duration varieties. Need based plant protection measures have been carried out. Improved agronomic practices were adopted under onstation, while in onfarm condition, only minimal management practices (application of farm yard manure, urea and pesticides) were adopted by farmers. Observations on growth, yield attributes and yield were recorded under on station and on farm conditions. Economics were calculated based on management practices adopted under on station while the cost of cultivation under on farm was calculated only by taking minimal management practices adopted

by farmers. Energetics was also calculated for both the conditions using the method suggested by Mittal *et al.*, (1988). All the data were statistically scrutinized using standard procedures.

RESULTS AND DISCUSSION

Growth and yield attributes

Among the long duration rice varieties evaluated at on station, Varshadhan has recorded taller plant (177 cm) having higher dry matter production (10 334 kg ha⁻¹) followed by Ranjit and Savithri. Similarly in the farmers field, Varshadhan recorded higher plant height (144 cm) and dry matter production (7 987 kg ha⁻¹) followed by Ranjit and Savithri. This is in conformity with the findings of Subudhi and Dikshit (2009). However, as for as yield attributes are concerned, Ranjit recorded more ear bearing tillers per hill (15 tillers hill⁻¹) and filled grains per hill (750 grains hill⁻¹) followed by Savithri and Varshadhan at on station. Similarly at on farm, Ranjit recorded more ear bearing tillers per hill (11 tillers hill⁻¹) and filled grains per hill (539 grains hill⁻¹) followed by Savithri and Varshadhan. The grains of Varshadhan are long slender which leads to higher 1000 grain weight at both the places as already reported by Subudhi and Dikshit (2009). The local check, Taichung sen Yu is of medium stature and recorded less DMP, ear bearing tillers per hill and filled grains per hill at on station. The local check, C 14 - 8 is tall, however recorded less DMP, ear bearing tillers per hill and filled grains per hill at on farm.

Yields

Ranjit recorded significantly higher grain yield (3 975 kg ha⁻¹) followed by Savithri (3, 114 kg ha⁻¹) and Varshadhan (3, 096 kg ha⁻¹) as compared to other varieties at on station (Table 3). Swain *et al.*, (2005) also reported that Long duration cultivar Ranjit registered higher yield as compared medium duration cultivar under rain-fed agro-ecosystem. The local check, Taichung sen Yu recorded lesser yield. The higher yield of Ranjit could be attributed to its better growth and yield attributes over other varieties. At on farm, long duration varieties produced significantly higher grain yield (Ranjit, 2,829 kg ha⁻¹; Varshadhan, 2,773 kg ha⁻¹; Savitri, 2,382 kg ha⁻¹;

Table 1. Growth, yield attributes, yield and economics of long duration rice varieties at on tation (Average of three years)

Varieties	Height (cm)	DMP at harvest (t ha ⁻¹)	Ear bearing tillers/hill	Filled Grains/hill	1000 grain weight (g)	Grain yield (kg ha ⁻¹)	Straw yield (kg ha ⁻¹)	Gross income (Rs ha ⁻¹)	Net income (Rs ha ⁻¹)	B:C Ratio	Returns /day (Rs.)
Ranjit	145.7	9.7	15.3	750	21.6	3 975	4 443	38 235	23 341	2.57	146
Savitri	133.3	9.1	14.2	664	22.9	3 114	4 079	30 548	15 654	2.05	108
Varshadhan	176.7	10.3	14.2	614	25.1	3 096	4 551	30 867	15 973	2.07	100
Gayatri	128.6	8.4	12.4	611	22.3	2 696	4 298	27 211	12 317	1.83	77
TSY	111.7	7.7	9.9	456	23.4	2 805	3 578	27 420	12 526	1.84	104
SEm±	5.0	0.3	0.7	21.9	0.6	138.6	190.9	-	-	-	-
CD (P=0.05)	15.8	0.9	2.3	69	1.7	439	604	-	-	-	-

Gayatri, 2 427 kg ha⁻¹) than traditional variety C 14 - 8 (1992 kg ha⁻¹) in spite of minimal management practices adopted by the farmer during the crop growth period (Table 4). However, Varshadhan recorded higher straw yield in both at on station and on farm. In general, the variety Ranjit was found superior to other varieties producing higher yield as reported by Borkakati *et al.*, (2000). The crop growth simulation model ORYZA 1N also recommended long duration variety Ranjit for adoption by the farmers in non water stressed rainfed lowlands (Swain *et al.*, 2007). Improved agro techniques influenced on yield having yield advantage of 26 % over the farmers practice. However, it was more in the case of Ranjit than Varshadhan, Taichung Sen Yu and C 14 - 8. This clearly indicates that the inadequate

management practices of the farmers are the major causes of lower rice productivity.

Economics

The increased yield of long duration varieties over the local checks under on-station and on-farm conditions has resulted in increased gross and net income per hectare and in turn resulted in higher B: C ratio. Among the long duration varieties, Ranjit recorded higher net return (Rs.23,341 ha⁻¹) and B: C ratio (2.57) followed by Varshadhan and Savithri. Gayathri and TSY recorded lesser net return and B: C ratio. However, at farmer's field, both Ranjit and Varshadhan performed equally better and recorded higher net return and B: C ratio. Higher net returns and B: C ratio might be influenced by higher yield of long duration varieties at both the places.

Table 2. Growth, yield attributes, yield and economics of long duration rice varieties in Farmer's field (Average of three years)

Varieties	Height (cm)	DMP at harvest (t ha ⁻¹)	Ear bearing tillers/hill	Filled Grains/hill	1000 grain weight (g)	Grain yield (kg/ha)	Straw yield (kg/ha)	Gross income (Rs/ha)	Net income (Rs/ha)	B:C ratio	Returns / day (Rs.)
Ranjit	112.0	7.1	11.1	539	21.5	2 829	3 813	27 860	13 833	1.99	86
Savitri	113.5	7.4	11.0	447	22.4	2 382	3 581	23 825	9 798	1.70	68
Varshadhan	144.5	8.0	9.8	416	25.3	2 773	4 196	27 767	13 740	1.98	86
Gayatri	107.0	6.9	11.9	390	22.5	2 427	3 685	24 318	10 291	1.73	64
C 14-8	141.5	6.8	9.7	378	25.5	1 992	3 805	20 734	6 707	1.48	45
SEm±	4.5	0.1	0.4	17.7	0.7	99.0	157.7	-	-	-	-
CD (P=0.05)	14.2	0.5	1.1	56	2.3	313	484	-	-	-	-

Energetics

Increasing energy input-output ratio is important particularly in the face of the current energy crisis. Energy was same for all the varieties. Total energy input at on station was relatively higher as compared to on farm. Output energy was more in Ranjit followed by Varshadhan due to higher yield while Savithri, Gayathri and Taichung Sen Yu recorded lesser output energy both in research farm and farmer's field. Higher energy ratio by Ranjit was due to the higher output energy resulting from higher grain and straw yields. Specific energy was lowest for Ranjit at both the locations indicating lesser energy required by this variety over other varieties for

producing each kg of grain. Lower specific energy might be due to higher output energy with respect to unit quantity of input energy. Din *et. al.* (2008) also confirms the findings. Energy productivity in terms of output/input ratio also indicates higher energy efficiency by Ranjit due to its ability to produce more at the same energy level. The amount of energy required to produce one kg of grain is more for C 14 - 8 as reported earlier by Ravishankar *et. al.* (2008).

Thus it can be concluded that Ranjit, Savithri and Varshadhan can be advocated under island ecosystem for rice cultivation in place of C 14-8 to increase the productivity, profitability and energy efficient rice farming and to utilize the available growing period efficiently.

Table 3. Energetics of long duration rice varieties at on station and on farm (Average of three years)

Varieties	Input energy (MJ/ha)		Output energy (MJ/ha)		Energy ratio		Specific energy(MJ/kg)	
	On station	On farm	On station	On farm	On station	On farm	On station	On farm
Ranjit	14 316	8 590	113979	89 249	7.96	10.35	3.60	3.04
Savitri	14 316	8 590	96763	79 778	6.76	9.29	4.60	3.61
Varshadhan	14 316	8 590	102399	93 213	9.15	10.85	4.62	3.10
Gayatri	14 316	8 590	93351	81 739	6.52	9.52	5.31	3.54
TSY	14 316	-	85954	-	6.00	-	5.10	-
C 14-8	-	8 590	-	76 845	-	8.95	-	4.31

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