Evaluating high yielding rice varieties for high rainfall zone of Tamil Nadu

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ABSTRACT

An attempt was made to identify suitable high yielding rice varieties through farmers' participatory on-farm trials for late Samba (September-January) season for high rainfall zone of Tamil Nadu. Results revealed that rice variety TRY 3 produced significantly more number of tillers, productive tillers and grain yield (6,960 kg/ha) which was significantly superior over the existing ruling variety (TPS 3) and also TNAU Rice ADT 50. Higher gross return (Rs 1,11,480/ha), net return (Rs 55,553/ha) and benefit-cost ratio (1.99) were also recorded in TRY 3 variety compared to other two varieties. Farmers were also satisfied with the grain quality and straw yield. Hence considering the above facts TRY 3 rice variety would be a better option to the farming community for enhancing the productivity during late Samba season in high rainfall zone of Tamil Nadu.

Keywords: High rainfall zone; late Samba season; rice varieties; TRY 3

INTRODUCTION

Rice is the most important food crop of India and Tamil Nadu. In India it is being cultivated in an area of 43.5 Mha with the production and productivity of 104 MT and 2,390 kg/ha respectively. Tamil Nadu alone contributes 3.9 per cent of the national rice production from an area of 2.0 Mha with a production of 4.1 MT (www.indiastat.com). High rainfall zone of Tamil Nadu comprises Kanyakumari district where rice is grown on an area of around 17,307 ha and produces 85,352 tonne of rice. The productivity of rice in Kanyakumari district is far higher (4,932 kg/ha) than India's and Tamil Nadu's average but considering the potential yield level, it can be further enhanced.

Kuruvai (June-September) and late Samba (September-January) are the two prime rice seasons in the district. Area under latter is higher than the former season. Farmers of this zone prefer only bold type of varieties either for consumption or for marketing to Kerala. Generally the farmers have been growing CR 1009 rice variety which is bold and high yielding but long duration in nature (155-165 days). Sometimes it gets affected due to stopping of water release from the dams in February month during the time the variety may be in maturity phase. To avoid that the farmers prefer medium duration variety which could complete its life-cycle before the end of January that also coincides with the termination of water release.

However TPS 3 has been the only variety in their option for the past two decades and due to its continuous cultivation its yield level has declined. The farmers wanted new varieties with better yield potential and hence the recently released varieties TRY 3 and TNAU Rice ADT 50 were planned to test-verify in the farmers' fields as on-farm testing with the farmers' participation.

MATERIAL and METHODS

On-farm testing was conducted by the ICAR-KrishiVigyan Kendra at the farmers' fields of Ramapuram village (Agastheeswaram block) of Kanyakumari district, Tamil Nadu. Kanyakumari is the southern-most part of India located at 08.09^{o}N latitude and 77.54^{o}E longitude at an elevation of 37 m amsl. The district receives rainfall not only during the monsoon periods viz southwest monsoon (June-September) and northeast monsoon (October-December) but also during winter (January-February) and summer (March-May) seasons and hence is demarked as high rainfall zone of Tamil Nadu with average rainfall of 1,369 mm.

The on-farm testing area having canal irrigation facilities during June-January months was chosen for the testing. The soil of the testing fields was clay loam in texture, slightly alkaline in reaction (7.9), low in organic carbon (0.21-0.42%) and available nitrogen (156-242 kg/ha) and high in available phosphorus (28.2-34.5 kg/ha) and potassium (388-512 kg/ha).

Five farmers were selected for the testing who had at least one acre of land. One acre of the land was bifurcated into three almost equal fields to test the varieties. The performance of farmers' ruling variety (TPS 3) was compared with the test varieties TRY 3 and TNAU Rice ADT 50. The varietal characters of these are given in Table 1. All the recommended package of practices was followed to raise the crop (Anon 2012). The crop was harvested during the second fortnight of January to the first fortnight of February. For the convenience of statistical analysis each varietal field was divided into two halves to get ten plots (5 farmers with each two plots) which served as replications.

The observations on growth parameters, yield attributes and yield were recorded. Plant height at maturity was measured from the base of stem to the tip of the panicle with the help of metre scale. The total number of tillers/m^2 and productive tillers/m^2 was counted at maturity stage from five randomly marked hills in the net plot area. The conversion efficiency of tillers was worked out as follows.

$$\text{Tiller conversion efficiency (\%)} = \frac{\text{Number of productive tillers/m}^2}{\text{Total number of tillers/m}^2} \times 100$$

The panicle length was measured from the base to the tip of the panicle obtained from the marked five hills. The panicles were collected from the five tagged plants at maturity and counted for total number of grains and filled grains/panicle. From the grains and filled grains, grains conversion efficiency was worked out by using the following formula:

$$\text{Grain conversion efficiency (\%)} = \frac{\text{Number of filled grains/panicle}}{\text{Total number of grains/panicle}} \times 100$$

The crop was harvested after maturity. After that it was threshed and cleaned manually. The dry weight of grain and straw yield were recorded after proper sun drying. Harvest index was calculated by using the following formula:

$$\text{Harvest index (\%)} = \frac{\text{Economic (grain) yield (kg/ha)}}{\text{Biological (grain + straw) yield (kg/ha)}} \times 100$$

The economics of different varieties was calculated by converting the total yield of the plot in to money value. The cost of cultivation was estimated on the basis of prevailing market rate of expenditure. The gross return was calculated by adding the cost of grain and cost of paddy straw according to prevailing market rates.

Gross return (Rs/ha)= Cost of grain (Rs/ha) + cost of paddy straw (Rs/ha)

Net return was obtained by subtracting the cost of cultivation from gross return:

Net return (Rs/ha)= Gross return (Rs/ha) - total cost of cultivation (Rs/ha)

B-C ratio was calculated as per formula given below:

$$\text{Return per rupees invested (B-C ratio)} = \frac{\text{Gross return (Rs/ha)}}{\text{Total cost of cultivation (Rs/ha)}}$$

The data were subjected to statistical analysis (Gomez and Gomez 2010).

Table 1. Varietal characters of rice

Character	TPS 3	TRY 3	TNAU Rice ADT 50
Parentage	RP 31-492/LMN	ADT 43/Jeeraga Samba	BPT 5204/CR 1009
Year of release	1993	2010	2012
Maturity duration (days)	135-140	135	149
Grain yield (kg/ha)	6,100	5,833	5,945
Seasons suitable	Late Samba	Samba/Late Samba/Thaladi	Samba/Late Samba
1000-grain weight (g)	23.2	22.8	15.9
Grain type	Short bold	Medium bold	Medium slender
Habit	Semi dwarf, erect	Semi dwarf, erect	Semi dwarf, erect
Panicle	Long	Long	Compact
Husk colour	Straw	Straw	Straw
Rice colour	White	White	White
Special features	Resistant to blast and leaf folder; suitable for water logging condition	Highly suitable for Idly making; moderately tolerant to sodicity; resistant to leaf folder, stem borer and brown plant hopper; resistant to blast, brown spot, sheath rot and sheath blight	Resistant to leaf folder, moderately resistant to stem borer and moderately susceptible to green leaf hopper; moderately resistant to brown spot, blast and RTD

RESULTS and DISCUSSION

Data on plant height and tillering behaviour of different varieties are given in Table 2.

Plant height: The variety TRY 3 grew significantly taller (132.5 cm) over TNAU Rice ADT 50 but the former was on par with the local cultivar (TPS 3). Significant variation in plant height among the varieties may be due to their genetic variability and the influence of environmental factors might be the least. Among TPS 3 and TRY 3 varieties the numerical difference was due to the length of panicle alone but not the haulm. Ullah et al (2016) also reported variation in plant height due to different rice varieties.

Number of tillers: Rice variety TRY 3 produced significantly higher number of tillers (16.9/hill and 562.8/m^2) compared to TNAU Rice ADT 50. The existing ruling variety (TPS 3) also produced tillers statistically similar to TRY 3. Number of tillers per hill is a genetic character but number of tillers/unit area can be altered by the environmental conditions such as spacing given, age of seedlings, soil fertility, irrigation level (quantity and quality) and also other management practices adopted. Similar results were also reported by Baskar et al (2012, 2013).

Number of productive tillers: TRY 3 produced significantly more productive tillers (495.0/m^2) compared to TNAU Rice ADT 50 (369.6/m^2) and TPS 3 (448.8/m^2). Though the number of tillers was similar in TPS 3 and TRY 3 varieties conversion of tillers to productive tillers (tiller conversion efficiency) was higher in case of TRY 3 (88.8%). Baskar et al (2013) also reported similar results.

The data related to yield attributes and yield of different rice varieties are given in Table 3.

Panicle length: Longer panicles of 34.0 cm were recorded in TRY 3 rice variety compared to other two

Table 2. Plant height and tillering behaviour of different rice varieties

Treatment	Plant height (cm)	Number of tillers /hill	Number of tillers/m^2	Number of productive tillers/hill	Number of productive tillers/m^2	Tiller conversion efficiency (%)
T_1: TPS 3	122.3	16.0	532.8	13.6	448.8	85.0
T_2: TRY 3	132.5	16.9	562.8	15.0	495.0	88.8
T_3: TNAU Rice ADT 50	104.3	15.0	499.5	11.2	369.6	74.7
SEd	9.3	0.7	28.0	0.6	20.3	-
$CD_{0.05}$	20.2	1.5	60.8	1.3	44.1	-

varieties under testing. Length of panicle is genetically-made character under optimal environmental conditions. Here also all three varieties had been exposed to similar environmental conditions and hence genetic characters might have expressed the results. Baskar et al (2012) observed variation among cultivars of rice when grown under similar environment.

Number of grains and filled grains: The rice variety TRY 3 resulted in higher number of grains (170.9/ panicle) compared to TPS 3 (150.2/panicle) and former was at par with TNAU Rice ADT 50 (160.3/panicle). Number of grains per panicle is mainly influenced by the genetic nature of the variety. But environmental characters also have influence on number of grains per panicle. Baskar et al (2012) and Ullah et al (2016) also reported the variation in number of rice grains due to cultivars.

The TRY 3 produced significantly higher number of filled grains per panicle (138.4) which was followed by TNAU Rice ADT 50 and the least numbers was noticed in the local check (TPS 3). There was not much change in the conversion efficiency from grains to filled grains and thus it had not changed the trend of filled grains per panicle also. Though the genetic nature of variety influences the filled grains, availability of water and fertility in soil and also timely management practices are also some of the other management practices which decide the number of filled grains per panicle.

Grain yield: Rice variety TRY 3 (T_2) registered significantly higher grain yield (6,960 kg/ha) than other two varieties under testing. Though there was no significant variation among TRY 3 and TPS 3 in number of tillers and productive tillers, production of higher number of grains and filled grains per panicle in TRY 3 over TPS 3 made significant difference among these two. TNAU Rice ADT 50 produced lower number of tillers and productive tillers that in turn reduced the grain yield also. Saravanakumar and Alagesan (2017) also found that better variety with improved package of practices lead to increase in yield as compared to the local variety.

Straw yield: TRY 3 variety resulted in significantly higher straw yield (10,280 kg/ha) over other two varieties. The lowest straw yield (8,840 kg/ha) was found in TNAU Rice ADT 50 being significantly lower to local (TPS 3) and TRY 3 varieties. Taller plants and longer panicle length along with better tillering ability may have contributed for the production of more straw yield in TRY 3 over others. On the other hand minimum straw yield in TNAU Rice ADT 50 could be mainly due to shorter plants and also poor tillering ability. Baskar et al (2012) also reported varying straw yield among rice varieties.

Harvest index: The harvest index (HI) of rice was found non-significant among varieties under test. Though there was a variation among varieties on grain and straw yields the deviation was in similar trend (ie TRY 3 >TPS > TNAU Rice ADT 50) on both grain and straw yields ultimately leading to non-significant results.

Economic studies

The data on economic analysis consisting of cost of cultivation, gross return, net return and benefit-cost ratio are presented in Table 4.

Cost of cultivation: Among three varieties tested the expenditure incurred on cultivation was higher on TNAU Rice ADT 50 (Rs 62,764/ha) as compared to other two varieties (TRY 3 and TPS 3). Farmers expressed that incidence of insect pests and frequent pesticide spraying increased the cost of cultivation.

Table 3. Yield attributes and yield of different rice varieties

Treatment	Panicle length (cm)	Number of grains /panicle	Number of filled grains /panicle	Grain conversion efficiency (%)	Grain yield (kg/ha)	Straw yield (kg/ha)	Harvest index (%)
T_1: TPS 3	25.3	150.2	122.4	81.5	6,090	9,130	40.0
T_2: TRY 3	34.0	170.9	138.4	81.0	6,960	10,280	40.4
T_3: TNAU Rice ADT 50	26.5	160.3	128.0	80.0	5,440	8,840	38.1
SEd	1.3	8.3	6.4	-	334	484	1.5
$CD_{0.05}$	2.8	17.9	13.8	-	725	1,050	NS

Table 4. Economic parameters of different varieties of blackgram in rice-fallow condition

Treatment	Gross return (Rs/ha)	Cost of cultivation (Rs/ha)	Net return (Rs/ha)	B-C ratio
T_1: TPS 3	97,343	55,726	41,617	1.75
T_2: TRY 3	1,11,480	55,927	55,553	1.99
T_3: TNAU Rice ADT 50	66,156	62,764	3,392	1.05

Data not analysed statistically

Gross return: Among the different varieties TRY 3 resulted in highest gross return (Rs 1,11,480/ha) followed by local variety (TPS 3). The minimum gross return was obtained in case of TNAU Rice ADT 50 (Rs 66,156/ha). Higher gross return recorded in case of TRY 3 was mainly due to higher grain yield and straw yield obtained over others. Both grain and straw yields were lower in TNAU Rice ADT 50 which led to lower gross return.

Net return: Higher gross return was noted in TRY 3 variety with almost equal cost of cultivation with local (TPS 3) variety that led to higher net return (Rs 55,553/ ha). The rice variety TPS 3 stood next to TRY 3 and the least was noted in TNAU Rice ADT 50 which was mainly due to higher cost of cultivation incurred for pesticides spraying.

B-C ratio: The maximum benefit-cost ratio (1.99) was found in TRY 3 variety followed by TPS 3 (1.75). The minimum benefit-cost ratio was recorded in TNAU Rice ADT 50 variety (1.05). Lower gross return and higher cost of cultivation in the TNAU rice ADT 50 resulted in lower B-C ratio over other two varieties.

CONCLUSION

From the results obtained from the on-farm testing it was concluded that the rice variety TRY 3 was suitable for Kanyakumari district of Tamil Nadu along with the existing ruling variety TPS 3. Between these two, TRY 3 variety was better for obtaining higher grain yield with better economic parameters. Thus rice variety TRY 3 was best suited for late Samba season of high rainfall zone of Tamil Nadu.

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