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On farm assessment of short duration rice variety Satyabhama in mid-central table land zone of Odisha

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ABSTRACT

The trial was carried out through on farm testing during kharif season of 2014 and 2015 under mid central table land zone of Odisha with an objective to evaluate the performances of newly released short duration rice variety Satyabhama as compared to the farmer's practice (Khandagiri). Satyabhama matured at 112.3 days, recorded higher plant height (101.3 cm), effective tillers hill^{-1}(16.2), panicle length (24.1 cm), filled grains panicle^{-1}(142.3) with spikelet fertility (94.79 %), 1000- grain weight (23.4 g), crop growth rate at 40-65 DAS (12.78 g m^{-2} day^{-1}) and 65-90 DAS (8.60 g m^{-2} day^{-1}) than Khandagiri. The same also produced grain yield 4.44 t ha^{-1} which is 55.79 % higher than Khandagiri with harvest index (47.06 %). The variety gave higher net return ` 32720.40 ha$^{-1}$ with a benefit- cost ratio 2.00 and monetary productivity ` 582.53 ha^{-1}day^{-1} as compared to farmers practice and thus the existing variety Khandagiri can be replaced by Satyabhama for higher productivity and income.

Key words: *Crop growth rate, economics, effective tillers, harvest index, on farm testing, rice*

Rice is the predominant crop of Odisha with a total coverage of 4.2 million hectare which is about 36 % of the total cultivable area of the state. Area under rice crop in Angul district of the state is 0.08 million hectare with a productivity of 19.3 q ha^{-1} which is at par with state (Anonymus, 2014). Achieving self-sufficiency in rice production and maintaining price stability are important political objectives in low-income countries because of the importance of this crop in providing national food security and generating employment and income for low-income people (Ghosh et al., 2009). There are several factors responsible for the low productivity of rice, but the most important ones is the non adoption of high yielding varieties and improved production technology. Moreover, crop is also assured if it does not coincide with flash floods and heavy rainfall at the time of maturity or at harvest (Singh et al., 2009).

Developing drought tolerant rice cultivars is considered to be one of the most effective and economic approaches to ensuring food security (Verma and Srivastava, 2004). About 70 % of area under rice in India is drought prone rainfed, but it has not been exploited to full potential due to lack of suitable drought tolerant or resistant varieties (Kumar et al., 2012).It is difficult to replace the rice crop considering the precipitation of less than 1500 mm rainfall during the monsoon season. However, multiple cropping system using short duration rice varieties and intensive input management may enhance the land use efficiency and increase the production level if sowing of *rabi* crops are made in time (Khanda et al., 2005). Hence, there remains a scope to introduce a short duration high yielding rice variety in existing rice-based cropping system in mid central table land zone of Odisha. If the farmers are able to harvest their *kharif* rice 25-30 days earlier than usual harvesting time then they could able to sow their next crop in time during *rabi*. The new

improved technologies will eventually lead to the farmers to discontinue the old varieties and to adopt new variety. Similar results were reported by Sharma et al. (2011).

Keeping in view such problems and after detailed survey the KVK, Angul made an attempt with an objective to evaluate growth and yield parameters of newly released promising high yielding variety rice *cv.* Satyabhama through on farm testing for its suitability in the existing farming situation of mid central table land zone of Odisha for substitution of old variety (Khandagiri) with higher productivity and income.

The study was carried out through on farm testing during *kharif* season of 2014 and 2015 at Sandhapal village in Angul district under mid central table land zone of Odisha with an objective to evaluate the performances of short duration rice cv. Satyabhama as compared to the farmers practice (Khandagiri). The experimental site lies in 84^0 58' 13.39" E longitude and $20^0$59' 19.18" N latitude and average elevation of 300 m above sea level. Climate of the region is fairly hot and humid monsoon and the average rainfall in both the year during the study period from June to September was 1008 mm against a normal rainfall of 1147.8 mm. The mean maximum and mean minimum temperature registered in the years was 34.2^0C and 20.8^0C, respectively. The soil of the experimental site was slightly acidic in reaction (pH-5.4 to 5.9), sandy loam texture with medium organic carbon content (0.53 to 0.66 %), medium in nitrogen (263 to 298 kg ha^{-1}), low in phosphorus (8.8 to 10.7 kg ha^{-1}) and medium in potassium (164 to 174 kg ha^{-1}) contents . The tested high yielding variety "Satyabhama" was released from ICAR-NRRI in 2012 can be suitably direct sown or transplanted in rainfed upland ecosystem and has vegetative and reproductive stage drought tolerance, non-lodging, early threshability and is resistant to stem borer, leaf folder and whorl maggot; moderately tolerant to leaf blast, rice tungo virus (NRRI, 2015). The trial was conducted with taking treatments Satyabhama (T_1), Sahabhagidhan (T_2) and Khandagiri (T_3) replicated ten times in a randomized block design. The crops were directly sown during 3rd week of June and harvested during 4th week of September. Ten different farmers each having 0.025 hectare of land cultivated the varieties with recommended package of practices. Observations on different growth and yield parameters were taken and economic analysis was done by calculating cost of cultivation, gross return, net return and B:C ratio. Available soil nutrients as content were determined following the standard procedures (Jackson, 1973).

Final crop yield (grain and straw) were recorded and the gross return were calculated on the basis of prevailing market price of the produce. Harvest index is the relationship between economic yield and biological yield (Gardner et al., 1985). It was calculated by using the following formula;

$$\text{Harvest index (\%)} = \frac{\text{Economic yield}}{\text{Biological yield}} \text{ x } 100$$

The aerial biomass at different stages of crops were taken by reaping the plants at ground level and the plant samples were separated and dried in a hot air oven at 70^0C for 48 hours and weight of dried samples were taken. The soil fertility status was analyzed by standard methods. Crop growth rate (CGR) was determined with the formula:

$$\text{Crop growth rate (CGR)} = \frac{W_1 - W_2}{t_2 - t_1}$$

Where W_1 and W_2 were dry weight of plants at time t_1 and t_2, respectively.

The datas were statistically analyzed applying the techniques of analysis of variance and the significance of different sources of variations were tested by error mean square of Fisher Snedecor's 'F' test at probability level 0.05 (Cochran and Cox, 1977).

The study revealed that among the short duration rice varieties Satyabhama found to be matured in 112.3 days owing to delay in flowering (83.2 days) in comparison to local check Khandagiri. Similar observations were found in short duration rice variety PR 115 by Sidhu et al. (2014). Analysis of data (Table 1) indicated that higher plant height (101.3 cm), tillers $hill^{-1}$ (20.4), effective tillers $hill^{-1}$ (16.2) were recorded in Satyabhama followed by Sahabhagidhan where as lower effectivity of tillers (69.44%) was observed in Khandagiri (Table 1) attributing to their genetic variability, varietal difference and environmental adaptability. The differential response of tillering in the genotype could be attributed to its genetic potentiality. These results are in agreement with Sarker et al. (2013).

Table 1. Plant height, tiller hill^{-1}, effective tiller hill^{-1} , days to flowering and days to maturity of different treatments (pooled data of 2 years).

Treatments	Plant height (cm)	Tiller hill^{-1}	Effective tiller hill^{-1}	Effectivity of tiller(%)	Days to flowering	Days to maturity
Khandagiri	83.37	12.40	8.60	69.44	64.80	96.39
Sahabhagidhan	88.50	18.20	14.10	77.69	72.20	100.30
Satyabhama	101.30	20.40	16.20	79.39	83.20	112.30
CD(P<0.05)	1.99	0.91	0.764	1.06	0.229	0.95

Table 2. Dry matter accumulation and crop growth rate of different treatments (pooled data of 2 years).

Treatments	Dry matter accumulation (g m^{-2})			Crop growth rate (g m^{-2} day^{-1})	
	40 days	65 days	90 days	40-65 DAS	65-90 DAS
Khandagiri	267.27	537.53	734.04	10.81	7.86
Sahabhagidhan	280.63	572.30	778.30	11.63	8.24
Satyabhama	318.94	638.40	853.54	12.78	8.60
CD(P<0.05)	3.078	5.198	16.857	0.116	0.548

DAS-Days after sowing

Data on dry matter accumulation (Table 2) clearly witnessed that total dry matter accumulation in different varieties gradually increased with crop growth stage and attained maximum at maturity. At 90 DAS, among the different rice varieties Satyabhama achieved the maximum biomass (853.54 g m^{-2}) followed by Sahabhagidhan and Khandagiri was the least efficient in biomass production (734.04 g m^{-2}). Kumari et al. (2014) also observed similar findings. The observation might be due to the increase of metabolically active tissue and as obtained less to the plant growth. The crop growth rate (CGR) was higher during early growth period (40-65 DAS) and declined slowly during 65-90 DAS. During 40-65 DAS, the rice varieties had CGR values between 10.81 to 12.78 g m^{-2} day^{-1}. During 65-90 DAS, Satyabhama had the top rank of CGR value (8.60 g m^{-2} day^{-1}) and was equivalent with Sahabhagidhan where as Khandagiri had minimum growth rate (7.86 g m^{-2} day^{-1}). Similar findings on crop growth rate for rice were reported by Mondal et al. (2013).

The yield attributing characters varied significantly with variety. The longer panicle (24.10 cm) and higher 1000-grain weight (23.40 g) were produced from Satyabhama. The same treatment also recorded higher number of filled grains panicle^{-1} (142.30) and spikelet fertility (94.79 %) owing to reduced no. of unfilled spikelet (7.83) than the local check (Table 3). Analysis of data revealed that significantly the maximum grain yield was recorded with variety Satyabhama (4.44 t ha^{-1}) followed by Sahabhagidhan (3.81 t ha^{-1}) which were 33.68 and 55.79 % yield advantage over the local check Khandagiri. Among the varieties, Satyabhama produced higher straw yield (5.0 t ha^{-1}) with harvest index (47.06 %). This may be attributed to high vegetative biomass production, large panicles and high tillering capacity in some cases (CRRI, 2013). Sujathamma et al. (2015) also recorded higher grain yield over farmer's practices owing to better yield attributes.

An analysis on economics (Table 4) revealed that variety Satyabhama recorded higher gross return of Rs. 65355.40 ha^{-1} with a benefit- cost ratio of 2.00 and additional net return of Rs.21527.52 ha^{-1} as compared to farmer's practice which gave the net return (Rs. 11192.88 ha^{-1}) and benefit-cost ratio(1.35). The same variety also recorded the maximum monetary productivity (Rs. 582.53 ha^{-1}day^{-1}) followed by Sahabhagidhan. Mitra et al. (2014) also observed the increase in net return and benefit-cost ratio due to variation in price of produce in newly introduced variety

Table 3. Yield attributes, grain, straw yield and harvest index of different treatments (pooled data of 2 years).

Treatments	Panicle length (cm)	Filled grains panicle^{-1}	Unfilled grains panicle^{-1}	Spikelet fertility (%)	1000 grain weight (g)	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Increase in grain yield over FP(%)	Harvest index (%)
Khandagiri	22.60	120.10	11.28	91.43	21.58	2.85	3.83	-	42.69
Sahabhagidhan	23.20	134.60	10.20	92.96	22.60	3.81	4.70	33.68	44.78
Satyabhama	24.10	142.30	7.83	94.79	23.40	4.44	5.00	55.79	47.06
CD(P<0.05)	0.26	1.398	1.193	0.309	0.201	0.205	0.238		0.022

FP-Farmer's practice

Table 4. Cost of cultivation, gross return, net return, benefit cost ratio and monetary productivity of different treatments (pooled data of 2 years).

Treatments	Cost of cultivation (Rs. ha^{-1})	Gross return (Rs. ha^{-1})	Net return (Rs. ha^{-1})	Benefit cost ratio	Monetary productivity (Rs. $ha^{-1}day^{-1}$)
Khandagiri	31450	42642.87	11192.88	1.35	442.52
Sahabhagidhan	32540	56520.50	23980.50	1.74	563.55
Satyabhama	32635	65355.40	32720.40	2.00	582.53
CD(P<0.05)	31.19	3019.9	3009.76	0.091	28.984

Grain, Rs. 13600 t^{-1}; straw Rs.1000 t^{-1}

(IET 17430) over traditional variety. These finding are also similar with the findings of Nirmala and Muthuramam (2009).

Based on the study, it may be concluded that short duration rice variety Satyabhama was superior to varieties Sahabhagidhan and Khandagiri and also it had been appreciated by the farmers due to its drought tolerance, higher tillering capacity and higher yield. Thus, Satyabhama variety can replace the local check since it fits to the existing farming situation for higher productivity and income.

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