Economic and Yield gap analysis of high yielding Ragi varieties under rainfed situations of Tiruvallur district of Tamil Nadu

ABSTRACT

Ragi is an important millet crop cultivated in about 82919 ha in Tamil Nadu and accounts for 77% of the total millet cultivated area. It is rich in protein, dietary fibre, minerals like calcium and iron and has been recommended for diabetes and heart diseases. Ragi is being cultivated in an area of 350ha in Tiruvallur district of Tamil Nadu and has a potential to be expanded in terms of cultivable area under this major rice growing district owing to the changing climatic situations. Farmers of the district could realize only low yields and gross returns due to cultivation of local varieties and non adoption of improved package of practices. Hence the present study was undertaken by Krishi Vigyan Kendra, Tiruvallur situated in Tirur village in order to assess the performance of high yielding ragi varieties and to perform the yield gap and economic analysis under improved management practices and to motivate the farmers in cultivating high yielding ragi varieties. The improved varieties ML 365 and CO (Ra) 15 performed better than the local cultivar Balamani and gave higher yields, net returns and BC ratio. However the technology gap noticed under the demonstration could be abridged by improving the soil nutrient status and following improved package of practices. ML 365 recorded higher yield and returns and has high effective gain in comparison to CO (Ra) 15 and hence could be recommended for cultivation in Tiruvallur district.

Key words: Economic analysis, Yield gap, Net returns, Technology index, Effective gain, Ragi.

INTRODUCTION

Ragi is an important millet crop cultivated in around 82919 ha in Tamil Nadu with an annual production of 2,88,627 tonnes and ranks second in India in production after Karnataka (Ministry of Consumer Affairs, Food & Public Distribution, 2023). Globally, 12% of the total millet area is under finger millet cultivation, covering more than 25 countries of Africa and Asia. Finger millet (*Eluesine coracana* L.) is a minor millet crop belonging to the family Gramineae. It is native to Ethiopia and widely cultivated in tropical and sub tropical regions of Africa and Asia. Ragi would have probably first brought to south or southwest coasts of India which became a secondary center of diversity and distribution (Hilu *et al.,* 1979). Ragi shows adaptation to wider range of environments like tropical, semi arid, sub tropical regions and withstands substantial amount of salinity, drought and water logged conditions. It can grow under edaphic conditions ranging from rich loamy soil to poor upland shallow soils, topography of sea level to 2300 m, can tolerate salinity levels of 11-12 ds/m with a rainfall requirement of 50-60cm (Kumar *et al*., 2018; Satish *et al*., 2016). It is also a crop which is easy for management under irrigated and rain fed conditions, pest and disease tolerant and gives comparatively higher grain and straw yield than other minor millet crops. The post harvest management of Ragi is also simple and easy as compared to other minor millets.

Ragi is a rich source of Calcium, Iron, fibre, proteins and amino acids. Ragi contains 5-8% protein, 15-20% dietary fibres, 2.5-3.5% minerals, 0.38% calcium (344mg/g), 65-75% carbohydrates, 0.48% phytates, 0.61 % tannins, 0.3-3% phenolic compounds and trypsin inhibitors (Sripriya *et al.*1996; Chettan and Malleshi, 2007; Shobana *et al.* 2013) and hence it is considered as antidiabetic, anti inflammatory, anti-diarhheal, anti oxiadant and anti tumerogenic (Chandra *et al.* 2016). Fingermilletisalsousefulinmanagementofvariousphysiologicaldisorderssuchasdiabetesmellitus,hypertension,vascular fragility,hypercholesterolemia,preventionofoxidationoflowdensitylipoproteins(LDLs)andalsoimprovesgastrointestinal health (Scalbert *et al.,* 2005). Moreover, it is also arich sourceof thiamine, riboflavin,iron, methionine, isoleucine, leucine,phenylalanine and other essential amino acids (Chandra *et al.* 2016; Kumar *et al*., 2016).

Ragi can be included in the dietary pattern as other major cereals since more value added products *viz*., flour, semolina, noodles, health mix, puttu mix, dosa and adai mixes are available. More over extruded products, sweets and savouries go well with Ragi flour as comparable with rice flour. Owing to the health, nutritional and therapeutic benefits, wider adaptation to different edaphic and climatic conditions, Ragi is being promoted as a supplementary crop to Rice in areas of water shortages as well as alternate crop in crop rotation in Tamil Nadu and Karnataka. Karnataka ranks first in area and production among the States of India and stands well ahead of Tamil Nadu and other Ragi producing states and contributes to 63.23 % of total Annual Ragi production in India (Sankaran, 2017).

The low production and productivity of Ragi in Tamil Nadu could be attributed to the use of local varieties with low yield potential, pest and disease resistance and grain quality and non adoption of improved management practices. Tamil Nadu Agricultural University has taken up research activities in development of high yielding varieties in Ragi and has come up with good varieties *viz*., CO (Ra) 14, CO (Ra) 15 and ATL 1 with high yield potential. In Tiruvallur District, though ragi is cultivated in an area of 350 ha it can be promoted in a larger scale as an alternate to Paddy during Sornavari season (April- May) in blocks of Kadambattur, Poondi, Ellapuram, Tiruttani, R.K.Pet and Tiruvalangadu. Hence with a view to improve the yield potential of Ragi and to boost up the Ragi production and area, the present study was undertaken in Tiruvallur District of Tamil Nadu to assess the performance or high yielding ragi varieties.

MATERIALS AND METHODS

The study consisted of two improved high yielding varieties *viz*., CO (Ra) 15 and ML 365 as compared with local cultivar Balamani of Tiruvallur district. The characteristics of the varieties are given in Table 1. The three varieties were tested in 10 farmers fields over a period of two years during 2020 and 2021for assessing the yield potential, disease tolerance and economic benefits. The varieties were raised during Sornavari (April-May) season of Tiruvallur district under rainfed situations in Kadambattur, Ellapuram, Tiruttani, Tiruvalangadu and R.K. Pet Blocks in an area of one acre each. The improved package of practices as recommended by the Tamil Nadu Agricultural University was provided to the farmers as pamphlets and were given on campus and off campus trainings to imbibe the knowledge and skill of improved practices. The yield attributes *viz*., days to maturity, plant height, no. of productive tillers/plant, no. of fingers/ earhead, earhead length, grain yield/ ha were recorded and the Net returns and benefit cost ratio were worked out based on the cost of cultivation and gross returns. Yield gap analysis was conducted based on the yield under demonstration, farmers' practice and potential yield and technology gap, extension gap and technology index were calculated. Economic analysis was conducted based on thecost of cultivation, net returns and arrived at the benefit cost ratio, cost saving and effective gainas in similar studies conducted by Kumar *et al.,* 2021 and Meena *et al.,* 2021.

Yield Gap analysis

Extension Gap = Demonstration Yield- Yield in Farmer's practice
Technology Gap = Potential Yield – Demonstration Yield
Technology Index = {(Potential Yield-Demonstration Yield)/ Potential Yield} x 100

Economic analysis

Net Returns = Gross Income – Gross cost
Benefit cost ratio = Gross Income / Gross cost
Cost saving = Cost of cultivation in Farmer's practice – Cost of cultivation in demonstration
Effective gain = Additional Net Income + Saving in Cost

RESULTS AND DISCUSSION

The Analysis of variance for the genotypes and the traits under study are presented in Table 2 and showed significant differences among the genotypes for all the characters.

The mean performance of genotypes for the yield parameters are given in Table 3. Among the Ragi varieties CO (Ra) 15 was found to be medium in duration with average days to maturity of 124.6 compared to ML 365 with a maturity duration of 109.9 days and the local cultivar Balamani with 104.7 days. The local cultivar Balamani was taller (124.9 cm) than the other two high yielding varieties *viz*., ML 365 (94.25cm) and CO (Ra) 14 (106.7 cm). No. of productive tillers /plant was highest in ML 365 (8.9) followed by CO (Ra) 15 (6.7) among the three varieties while Earhead length and No. of fingers / ear head were higher in CO (Ra) 15 (9.0 cm and 8.5 no. respectively) compared to ML 365 (6.6cm and 6.5 no. respectively) and Balamani (5.2 cm and 5.5 no. respectively). Per cent Blast incidence was lowest in CO (Ra) 15 (3.4%) and highest in Balamani (12.1%). ML 365 recorded the maximum grain yield of 4610 kg/ha followed by CO (Ra) 15 with 4250 kg/ha and Balamani with 3335 kg/ha. The higher grain yield in ML 365 may be attributed to its higher no. of productive tillers/plant. Khatiyar e*t al*., 2017 also reported improved productivity of demonstrated bottle gourd, cauliflower and chilli varieties over the local check varieties under advanced technologies.

The Net returns and Benefit cost ratio obtained by cultivating ML 365 was the maximum with Rs.46500 and 2.02 respectively followed by CO (Ra) 15 (Rs. 39250 and 1.86). The cost of cultivation was the highest for the local cultivar Balamani compared to CO (Ra) 15 and ML 365 (Table 4). The yield advantage of 38.2 per cent was obtained for ML 365 and 27.4 per for CO (Ra) 15 over the farmers local cultivar Balamani. The yield obtained in the on farm testing was compared with the potential yield and farmers practice to perform the yield gap analysis. ML 365 recorded a technology gap of 390 kg/ha while CO (Ra) 15 had a technology gap of 750 kg/ha which shows a potential of increasing the yield of these varieties by following the recommended package of practices. Dhandhalya *et al*., 2009 opined that several attributing soil and weather conditions *viz*., dissimilarity in soil fertility status, rainfall and temperature have an impact on the performance of varieties which reflects in the gap in technology and enriching soil nutrient especially with organic manure may have a positive effect in the performance of varieties under varied weather conditions. Depending on identification and use of farming situation, specific interventions may have greater implications in enhancing system productivity (Mukharjee, 2003). The extension gap depicts the difference between the yield of varieties under demonstration compared with the farmers variety by adopting the same package of practices and hence shows the yield improvement obtained by the farmers by adopting the high yielding varieties through extension activities. ML 365 registered more Extension gap of 1275 kg/ha as compared to CO (Ra) 15 (750 kg/ha). Hiremath and Nagaraju, 2009 performed yield gap analysis in onion and indicated higher extension gap of onion varieties under demonstration over the local check variety.

The technology index depicts the difference between the potential and the actual Yield obtained by the varieties under demonstration on a percent scale. ML 365 showed a lesser value of 7.8% compared to CO (Ra) 15 (15%). Similar results were obtained by Lakshmi et al., 2017, Saikia et al. 2018 and Jha et al., 2020. The feasibility of the demonstrated technology could be improved by reducing the technology index thereby improving the expression potentiality of the technology (Meena *et al.,* 2021). Pawar *et al*., 2018 opined that the lower the technology index, the more the feasibility of the technology. The effective gain obtained by cultivating ML 365 is Rs. 27100 /ha, and CO (Ra) 15 is Rs. 19750/ha. Hence, ML 365 is more remunerative to the farmers when compared to CO (Ra) 15 and the farmers' practice (Table 5). The results conform to the findings of Saravanakumar, 2018.

CONCLUSION

Among the two high yielding varieties of Ragi assessed under on farm trial in farmers' fields of Tiruvallur District under rainfed situations, the variety ML 365 gave higher grain yield and Net returns compared to CO (Ra) 15 and was found to be more remunerative. The saving in cost and effective gain was also higher in ML 365 than CO (Ra) 15. The Technology Gap and Technology index were lesser in ML 365 showing its potentiality in expression under farmer's fields. The higher yield in ML 365 may be attributed to its higher no. of productive tillers /plant. Given suitable management practices by way of giving additional manures and better weed control, CO (Ra) 15 could also produce better yields in farmer's fields. This could be noticed from its higher Technology gap and technology index compared to ML 365.Hence ML 365 could be recommended for cultivation in Tiruvallur district owing to its higher yield potential, Benefit Cost ratio and Effective gain over the farmer's practice and the other variety CO (Ra) 15.

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Table 1. Characteristics of Ragi varieties used in the study

Varieties	Duration	Special features
CO (Ra) 15	120-125 days	• Long duration, bold grain, non-shattering, non-lodging, blast resistant with preferable grain quality with nutritious fodder characteristics • Grain yield of 2950 kg/ha under rainfed condition • Released by Tamil Nadu Agricultural University in 2013
ML 365	110-115 days	• Medium height, semi compact ears with tip incurved fingers, Resistant to neck blast and tolerant to drought • Profuse tillering, high yielding, Average grain yield: 50 – 55 q/ha • Developed and released by University of Agricultural Sciences, Bangalore in 2008
Local cultivar (Balamani)	110-115 days	• Short duration, top incurved, medium compact panicle, tolerant to drought • Yield 2200 kg/ha

Table 2. Analysis of variance for Ragi varieties

Particulars	df	Mean Sum of Squares						
		DM	PH	PTP	EL	NFE	PBI	GY
Genotypes	2	1065.2*	2385.9*	43.72*	37.63*	23.33*	195.3*	4.31*
Replications	9	13.17	36.39	0.89	0.33	0.31	2.98	0.16
Error	18	10.16	50.6	0.61	0.43	0.37	1.86	0.13

Where DM- Days to maturity, PH-Plant height, PTP-Productive tillers/plant, EL-Earhead length, NFP-No. of fingers/Earhead, PBI- Per cent Blast Incidence, GY- Grain yield

Table 3. Mean performance of genotypes for different yield parameters

Genotypes	Characters						
	DM (days)	PH (cm)	PTP (no.)	EL (cm)	NFE (no.)	PBI (%)	GY (t/ha)
CO (Ra) 15	124.600	106.700	6.720	9.030	8.500	3.400	4.250
ML 365	109.900	94.250	8.930	6.580	6.500	9.100	4.610
Local cultivar (Balamani)	104.700	124.960	4.750	5.200	5.500	12.100	3.335
SEd	1.43	3.18	0.35	0.29	0.27	0.61	0.16
CD	3.02	6.74	0.74	0.62	0.58	1.29	0.34
CV (0.05%)	2.82	6.55	11.52	9.41	8.91	16.61	8.88

Where DM- Days to maturity, PH-Plant height, PTP-Productive tillers/plant, EL-Earhead length, NFP-No. of fingers/Earhead, PBI- Per cent Blast Incidence, GY- Grain yield

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Table 4. Economic parameters of Ragi varieties

Genotypes	Cost of Cultivation (Rs.)	Gross Returns (Rs.)	Net Returns (Rs.)	Benefit cost ratio
CO (Ra) 15	45750	85000	39250	1.86
ML 365	45700	92200	46500	2.02
Local cultivar	46500	66700	20200	1.43

(Balamani)				

Table 5. Economic and Yield Gap analysis for the Ragi varieties

Genotypes	Per cent Yield Increase over check (%)	Extension Gap (kg)	Technology Gap (kg)	Technology index (%)	Cost saving (Rs.)	Effective gain (Rs.)
CO (Ra) 15	27.4	915	750	15	750	19750
ML 365	38.2	1275	390	7.8	800	27100