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On-farm evaluation of traditional varieties and landraces of finger millet (*Eleusine coracana* (L.) Gaertnr.) using morpho-biochemical characters

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Abstract
The study was conducted with 22 finger millet accessions which include nine traditional varieties of Karnataka and 13 landraces of Tamil Nadu. Data were collected on plant morphology and biochemical characters. Analysis of Variance showed significant variation for yield attributing characters and for protein and mineral contents. Sharavathi ragi performed better for yield attributing traits like Number of fingers per head (8.37), finger width (3.34cm) and length of the flag leaf (35.41cm). the traditional varieties at farmer's hands are to be collected, conserved and explored for crop improvement in near future.

Keywords: *Eleusine coracana,* finger millet, ragi, landraces

1. Introduction
The finger millet (*Eleusine coracana* (L.) Gaertnr.), now cultivated as a staple food in the parts of eastern Africa and many parts of southern India is an important cereal crop amongst the small millets and it ranks third in cultivation and productivity after sorghum and pearl millet. This bird's foot millet is typically a rain fed crop and well suited for dry farming systems. Its unthreshed ears can be stored up to 10 years without any deterioration in genetic and phenotypic expressions (Kochaar S.L., 2008) [1]. Its adoptability to wide range of geographical and agro-ecological regions makes it more versatile crop among the rain fed farmers. For its high nutritional value, the Ministry of Agriculture and Farmers welfare, Government of India recognized ragi as a nutria-cereal (https://nutricereals.dac.gov.in/fingermillet.aspx). However, it still remains as an unexploited and neglected millet due to its autogamous nature. Creation of variation through recombination of genes, i.e., hybridization is not an advisable task in ragi as tiny flowers and low percentage of seed set on crossing limit the success of hybridization in finger millet. The availability of genomic resources are also limited and not comparable with other cereals. Hence, exploitation and utilization of already existing diversity in finger millet is the option-on-hand for plant breeders to enhance this crop genetically (Joshi *et al*., 2020) [9]
Assessment of genetic diversity is a prerequisite for development of new cultivars and also to conserve the biodiversity in any crop. It is evident that the landraces, the pivotal component of gene pool serve as the reservoir for biotic and abiotic stress resistant genes but needs attention as these valuable genetic resources are poorly utilized in genetic improvement programmes of finger millet (Keerthana *et al*., 2019) [12] Thus this study was initiated with an objective to collect, evaluate and assess the diversity present among the landraces and traditional varieties of finger millet. Since, Karnataka and Tamil Nadu are the leading states in finger millet production, these two states were selected as the collection (Anteneh *et al.,* 2019) [4]. The ethnic people are the true conservators of these most valuable indigenous varieties and landraces hence, the tribal villages of Karnataka and Tamil Nadu, where indigenous ragi varieties are being cultivated to date were selected as collection site **(**Table.1).

2. Materials and Methods
2.1 Evaluation at farm level: The landraces collected from 12 locations of Tamil Nadu were sown along with nine traditional ragi varieties collected from Mandya region of Karnataka. These 21 genotypes form the resource material for carrying out the diversity analysis. The materials were sown in Randomized Block Design with three replications at north farm of Karunya Institute of Technology and Sciences, Nallur Vayal, Coimbatore.

Each material was sown in three rows of 2.0 m length with 20cm between rows and 10cm between plants. The experimental plot was managed as per farmers' practice. The performances of resource materials were evaluated and compared with the finger millet variety Co1 5 which was also sown along with the experimental materials as check. The observations on eight characters *viz.*, days to 50% heading, days to 80% maturity, ear exertion (cm), plant height (cm), number of fingers per head, finger width (mm), length of flag leaf (cm) and yield per plant (gm) were recorded. These traits were considered for evaluating the yield potential of finger millet genotypes.

2.2 Analysis of On-Farm data

Data on traits were subjected to statistical analysis. The statistical package used for analysis was Genstat Discovery Edition 4.0 at 0.05 level of significance. The mean performances of landraces are summarized in Table.2.

Table 1: List of local landraces and traditional varieties and their site of collection

S No.	Name of landraces / traditional varieties	Site of collection	Seed colour
1	Gai ragi	Seengampathi, Coimbatore	Brown
2	Ney ragi	Sembukkarai, Coimbatore	Brown
3	Chadivayal ragi	Chadivayalpathi, Coimbatore	Brown
4	Mullangadu ragi	Mullangadu, Coimbatore	Brown
5	Kovilpatti Local	Kovilpatti, Tuticorin	Brownish red
6	Aruppukottai Local	Aruppukkottai, Virudhunagar	Brownish red
7	Thangachimadam sivappu ragi	Thangachimadam, Ramanathapuram	Red
8	Thiruchuzhi keppai	Thiruchuzhi, Virudhunagar	white
9	Palavanatham Local	Palavanatham, Virudhunagar	Brownish red
10	Kariapatti kezhvaragu	Kariapatti, Virudhunagar	Red
11	Kollimala ragi	Jamunamarathur, Thiruvannamalai	Red
12	Paramakudi Local	Paramakudi, Ramanathapuram	Brown
13	Edagu ragi	Mandya, Karnataka	red
14	Sharavathi ragi	Mandya, Karnataka	Brown
15	Ragalli	Mandya, Karnataka	Brown
16	Shivalli ragi	Mandya, Karnataka	Brown
17	Bonda ragi	Mandya, Karnataka	Brown
18	Kempu ragi	Mandya, Karnataka	Brown
19	Billigada ragi	Mandya, Karnataka	Brown
20	Bennemudde ragi	Mandya, Karnataka	Brown
21	Hasirukaddi ragi	Mandya, Karnataka	Brown

Table 2: Mean performances of landraces, traditional varieties and check of finger millet at Karunya Farm, Nallur Vayal, Coiimbatore

Genotype	DFH	DEM	EE	PH	NF/H	FW	LFL	Single. Plant. Yield (gm)	Protein %	Calcium %	Phosphorus %	Potassium %
Gai ragi	80.2	112.33	8	87.32	6.4	2.34	23.71	1.44	6.2	7.27	4.6	8.19
Ney Ragi	81.3	111.53	8.07	59.43	4.38	2.47	34.51	1.45	6.13	6.6	3.8	7.86
Chadivayalragi	74.97	98.77	8.53	80.61	6.64	2.35	32.65	2.29	6.31	7.67	5.1	6.97
Mullangaduragi	74.57	98.33	7.8	82.18	4.63	2.5	32.84	1.46	6.6	9.27	4.3	8.05
Kovilpatti Local	72.83	96.87	7.47	81.31	5.51	2.55	27.44	1.69	7.47	9.46	4.3	6.47
Aruppukottai Local	75.67	101.5	8.37	85.2	5.76	2.72	35.34	0.67	6.63	4.7	5.7	7.57
Thangachimadam sivappuragi	73.67	100.73	8.37	80.62	6.1	2.73	33.6	1.36	6.36	6.15	6	8.25
Thiruchuzhi keppai	79.23	106.77	7.9	84.74	7.64	3.39	31.99	0.72	6.57	5.56	3.1	6.49
Palavanatham Local	76.33	103.67	7.6	81.28	5.45	3.15	37.3	2.35	6.88	6.47	3.7	7.69
Kariapatti kezhvaragu	75.03	103.13	8.47	82.01	4.59	3.38	33.62	1.35	6.15	6.38	4.3	8.7
Kollimala ragi	74.3	98.03	8.4	85.24	6.48	3.32	39.01	2.18	6.45	5.46	5.3	7.36
Paramakudi Local	76.93	114.97	8.27	79.47	5.45	3.11	32.89	1.3	6.53	5.35	5.6	8.65
Edagu ragi	72.77	97.03	8.33	81.67	6.45	3.34	34.85	1.78	6.99	5.96	4.8	6.38
Sharavathi ragi	71.63	96.17	7.93	80.51	8.37	3.35	35.41	2.58	6.64	5.23	4.3	7.46
Ragalli	76.43	99.23	7.4	80.38	7.51	2.87	36.2	2.56	6.21	5.57	4.7	8.25
Shivalli ragi	73.83	95.37	8.47	80.82	6.66	3.25	35.31	2.37	6.37	5.43	3.1	6.26
Bonda ragi	74.43	102.97	8.3	79.99	5.34	3.27	39.35	1.65	6.57	5.95	4.4	6.79
Kempu ragi	76.97	105.6	8.03	82.02	5.59	2.79	29.29	1.5	6.76	5.78	4.8	7.16
Billigada ragi	74.27	102.87	8.33	80.26	6.47	2.78	33.55	1.43	6.14	7.36	3.8	8.15
Bennemudde ragi	73.53	102.5	8.07	81.85	7.37	2.32	33.64	1.67	6.95	4.56	6.5	6.66
Hasirukaddi ragi	76.03	101.93	7.97	79.49	5.56	2.39	33.78	1.73	6.83	5.47	5.5	7.75
Co15	77.83	105.57	7.3	84.14	7.38	2.72	27.68	1.42	6.7	6.57	5.3	8.17
Mean	75.58	102.54	8.06	80.93	6.17	2.87	33.36	1.68	6.57	6.28	4.68	7.51
Minimum	71.63	95.37	7.3	59.43	4.38	2.32	23.71	0.67	6.13	4.56	3.1	6.26
Maximum	81.3	114.97	8.53	87.32	8.37	3.39	39.35	2.58	7.47	9.46	6.5	8.7
SE(d)	0.52	1.13	0.08	1.12	0.23	0.08	0.79	0.11	0.07	0.27	0.19	0.16
CV %	0.03	0.05	0.05	0.06	0.17	0.14	0.11	0.31	0.05	0.20	0.19	0.10

Note: DFH- Days to 50% Heading, DEM: Days to 80% Maturity, EE: Ear Exertion(cm), PH: Plant Height(cm), NF/H- Number of Fingers/Head(cm), FW- Finger Width(cm), LFL- Length of Flag Leaf (cm)

3. Results and Discussion

All the experimental materials showed erect growth habit. The mean values of quantitative and qualitative characters of finger millet are given in Table.2. The results of the experiment showed that all the traits were statistically significant except Plant height (cm) and Days to maturity. Shortest plants were observed in Ney ragi and highest plants in Gai ragi. The plant height of materials studied ranged between 59.43cm to 87.32cm and days to 50% heading 71.63 days to 81.3 days. The shortest ear exertion was observed in Co15 (7.3cm) to the longest of 8.53cm in Chadivayal ragi. Sharavathi ragi took shortest span for 50% heading (71.6days) and long spell for the same trait was observed in Ney ragi (81.3days). Sharavathi ragi performed better for yield attributing traits like Number of fingers per head (8.37), finger width (3.34cm) and length of the flag leaf (35.41cm). Shivalli ragi was the earliest in duration with 95.37 days for days to 80% maturity and Paramakudi Local had the longest life span of 114.97 days. The lowest number of fingers per head was registered by Ney Ragi (4.38) and highest was recorded by Sharavathi ragi (8.37). Tiny fingers were seen in Bennemudde ragi with a width of 2.32cm. The highest protein content was observed in Kovilpatti Local (7.47%) followed by Edagu ragi (6.99%) and Bennemudde ragi (6.95%). The calcium content was higher in Kovilpatti Local (9.46%) and poor calcium possessor was Bennemudde ragi (4.56%). Higher phosphorus content (6.5%) was observed in Bennemudde ragi (6.5%) and high potassium was recorded by *Kariapatti kezhvaragu* (8.7%). Highest single plant yield was recorded by sharavathi ragi with 2.58gm. The maximum number of fingers per head contributed for single plant yield. These finding was in accordance with the results of Lule *et al*., (2012) [2] and Patil (2019) [3]. The accessions which were rich in minerals can be utilized as parental lines in quality breeding programmes and the variety Sharavathi can be used in hybridization programmes to increase the yield.

4. Conclusion

The current study revealed that theirs is greater scope for exploiting the variation present among the traditional varieties of Karnataka and landraces of Tamil Nadu. As the millets getting their place in the center of meals now a days, the collection and conservation of germplasm is the need of the hour. Trait targeted finger millet improvement programmes may be undertaken in future by utilizing the data generated from this experiment.

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