



Journal of Biotechnology and Agricultural Research (JBAR)

Nutritional and Agronomic Genetic Variability among Finger Millet (*Eleusine coracana* L. Gaertn) Accessions in Northern Nigeria

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DOI: <https://doi.org/10.70382/ajbar.v11i1.022>

Abstract

Finger millet (*Eleusine coracana* (L.) Gaertn) is an underutilized but nutritionally rich cereal crop with strong adaptation to marginal environments. This study evaluated the nutritional and agronomic genetic variability among eleven finger millet accessions collected from Northern Nigeria during the 2024 and 2025 cropping seasons at the Federal Polytechnic Damaturu Training Research Farm. A Randomized Complete Block Design (RCBD) was employed, and pooled mean data were subjected to ANOVA, genetic parameter estimation, and cluster analysis. Significant ($p < 0.05$) differences were observed among accessions for most agro-morphological and nutritional traits, indicating substantial genetic variability. Grain yield ranged from 729.00 to 1989.33 kg ha⁻¹, with Ex-Yabak outperforming others. Broad-sense heritability estimates were high for leaf length (89.15%), plant height (83.38%), finger length (78.06%), and grain yield (67.40%), suggesting predominance of additive gene action. High genetic advance coupled with moderate to high heritability for grain yield and leaf length indicates good prospects for selection. Nutritional analysis revealed significant variation in Fe, Zn, Cu, Mn, P, and crude protein content. Crude protein ranged from 3.86% to 7.99%, while iron ranged from 3.87 to 7.46 mg/100 g. Cluster analysis grouped accessions into distinct clusters, reflecting genetic divergence useful for breeding. The results demonstrate considerable genetic variability in Northern Nigerian finger millet germplasm, highlighting its potential for yield improvement and nutritional enhancement. Strategic selection and hybridization among divergent accessions could accelerate breeding programs aimed at improving food security and combating malnutrition in semi-arid regions.

Key Words: Genetic variability, Finger millet, Heritability.

Introduction

Finger millet (*Eleusine coracana* L. Gaertn.), “tamba” in Hausa language, a staple food crop in the arid and semi-arid tropics of South Asia and Africa (Hussaini *et al.*, 2020). It is a minor cereal crop that belongs to the *Orchideceae* subfamily (Hussaini *et al.*, 2020) and one of the most important small grain cereal crops grown in large areas of the developing world especially Africa and Asia. Epidemiological evidence showed that the crop is widespread and well adapted to diverse regions of the world (Umar and Kwon-Ndung, 2014). Finger millet has the ability to produce higher yield than other cereal crops under multiple stresses such as drought, soil acidity and land marginality (Upadhyaya *et al.*, 2006; Aradhna *et al.*, 2019; Ankit Kumar *et al.*, 2019). It has the ability to survive very well in different agro-climatic conditions where there is as low as 400 mm of rainfall, temperature above 15°C and can be grown throughout the year (Malinda *et al.*, 2015). The crop can be grown for weed control on poor soils (Ibrahim *et al.*, 2018). Moreover, it has low pest problem and excellent storage qualities (Hussaini *et al.*, 2020).

Germplasm identification in finger millet plant is an important link between conservation and utilization of plant genetic resources (Umar and Kwon-Ndung, 2014). The usefulness of germplasm in the study of plant genetic resources could play an important role in the generation of new hybrids and high yielding crop varieties with disease resistant traits to cope with adverse

challenges associated with biotic and abiotic stress (Murray *et al.*, 2008). The phenotypic characterization could reveal the genetic relatedness within these species and is useful in the conservation of new species and understanding of the genetic diversity (Umar and Kwon-Ndung, 2014). This may provide information on the plant taxonomy as well as ecology of the plant.

Finger millet is more nutritious than other cereal grains and hence called nutrition millet in India (Bekele *et al.*, 2016; Sandhya *et al.*, 2017). The seeds are rich source of carbohydrates (65-70%), dietary fibre (2.5-3.5%), fat (1- 1.5%), minerals (2.5-3%) and proteins (5-8%) (Ankit Kumar *et al.*, 2019b). Its protein is rich in essential amino acids such as, tryptophan, threonine, lysine, methionine, valine and isoleucine (FAO, 1998). The crop is also reported to have hypoglycemic, hypocholesterolemic and antiulcerative properties (Panwar *et al.*, 2010), and has been promoted as part of a solution to malnutrition (Singh and Raghuvanshi, 2012). It is a good remedy for diet-related ailments, nourishment for infants and its straw is a valuable fodder for ruminant livestock (Bekele *et al.*, 2016; Sandhya *et al.*, 2017).

Finger millet has been reported to be one of the most neglected crops in the world (Shinggu *et al.*, 2016) and thus neglected by national and international research organizations and major donors to Agricultural research particularly in Africa compared to the research grants given to rice

and maize in this region (Umar and Kwon-Ndung, 2014; Shinggu *et al.*, 2016). In Nigeria, finger millet is a completely neglected and underutilized crop. Its production is left in the hands of peasant farmers. It remains unknown and unstudied in Nigeria which led to difficulties encountered during its production resulting in low yield and it's becoming extinct (Shinggu *et al.*, 2016). This backdrop constituted a great impediment in effective utilization of the crop genetic resources in breeding programmes for sustainable agriculture. The gap has also restricted against adequate identification and utilization of specific finger millet accessions with superior nutritional profiles for addressing malnutrition and promoting human health especially in young children. Against this backdrop, this study assessed the nutritional and agronomic genetic variability among finger millet (*Eleusine coracana* L. Gaertn) accessions in Northern Nigeria.

METHODOLOGY

Survey and Germplasm Collections: Field survey and sample collections were conducted between January and March 2024. The germplasms were collected from local farmers in consultation with the Agricultural Development Programme (ADP) and farmer group heads in five northern states; Bauchi, Gombe, Katsina, Niger and Kaduna state. The samples collected were coded according to its community names.

Experimental Sites: The two field experiments were conducted at the Research and Training Farm, Federal Polytechnic Damaturu during 2024 and 2025 cropping seasons.

Cultural Practice

Land Preparation: The experiment used recommended crop management approaches for millet by Ajeigbe *et al.* (2020). Experimental sites were adequately cleared from weeds and debris, harrowed and ridged manually at a spacing of 0.75m between rows, thereafter marked into plots.

Experimental Design: The accessions were tested using Randomized Complete Block Design (RCBD). A total of 10 seeds per stand were sown for each germplasm on a single ridge of 300 cm long with twelve stands per ridge, at a spacing of 75 × 25 cm. The seedlings were thinned to 3 plants per stand at two weeks after germination, given a total of 36 plants per plot and 108 plants per germplasm.

Fertilizer application: Recommended fertilizer dose for millets of 60:30:30 kg (N: P₂O₅: K₂O ha⁻¹) was applied. A basal dose of half quantity of N and full quantity of P₂O₅ and K₂O were applied and the remaining half of N was applied 3WAS by side-dressing (Pramila and Shukla, 2020).

Weeding: The weeding treatments were carried out manually with hoe at 2 and 4 WAS in order to remove unwanted plants (Upadhyaya *et al.*, 2008).

Harvesting: Ears were harvested using sickle at physiological i.e. when the top half of the fingers have turned brown and lower portion is no longer green maturity, sundried and weighed to record panicle yield, and then threshed to measure grain yield.

Data Collection

Morphological Traits: Data on agro-morphological traits such as Plant height (PH), stem girth (SG), Leaf length (LL), Effective tillers per plant (ETPP), internodes per plant (INTDPP), days to anthesis (DTA), Fingers per ear (FPE), Finger length (FL), Grain yield per hectare (GYD), 1000-seed weight (1000SW),. Days to anthesis was noted on single plot basis and grain yield per plot was recorded for each plot and extrapolated per hectare basis, while the remaining characters were recorded on 10 randomly chosen plants per plot.

Grain Nutritional Quality Traits: grain nutritional quality which include some micro and macro minerals and protein were analysed in accordance with standard laboratory procedure by AOAC (2005) as described by Shahin et al. (2018)

Data Analysis: The pooled mean data obtained on both agro-morphological and quality traits were subjected to analysis of variance (ANOVA) to determine the level of significance among the germplasms while the post hoc test was carried out using Duncan's Multiple Range Test (DMRT) to separate the means where necessary using SPSS software version 20. Genotypic, phenotypic and environmental component of variances were estimated for all morphological traits following Burton methods (1952) as adopted by Abubakar et al. (2019). The broad sense heritability (H^2_b) was also estimated for morphological characters as the ratio of genotypic variance to total or phenotypic variance. The heritability values were considered as low (<30%), moderate (30 – 60%) and high (60%) as adopted by Abubakar et al. (2019). Cluster analysis was also done based on euclidean distance matrix in a hierarchical using both the agro-morphological and nutritional quality traits was performed SPSS software version 20.

Agro-Morphological Performance

Significant differences ($p < 0.05$) were observed among the eleven accessions for all agro-morphological traits evaluated (Table 1), indicating substantial genetic variability. Grain yield (GYD) varied widely from 729.00 kg ha⁻¹ (Ex-zalau) to 1989.33 kg ha⁻¹ (Ex-Yabak), with a mean of 1102.49 kg ha⁻¹. The superior performance of Ex-Yabak may be attributed to its higher number of fingers per ear (11.74), effective tillers per plant (6.00), and relatively early anthesis (87 days). Yield variability among finger millet genotypes has been widely reported and is mainly influenced by yield-contributing traits such as productive tillers and finger number (Upadhyaya *et al.*, 2006; Dida *et al.*, 2007).

Plant height ranged from 49.55 to 64.40 cm, with Ex-Zonkwa being tallest. Taller genotypes often exhibit higher biomass accumulation but may be prone to lodging; however, moderate plant height combined with thicker stem girth, as observed in Ex-Ribadu, may enhance lodging resistance (Mgonja, 2005). Leaf length showed considerable variation (37.03–58.86 cm), suggesting differences in photosynthetic capacity. Longer leaves may enhance light interception, contributing to improved assimilate production and yield (Aradhna *et al.*, 2019). Days to anthesis ranged from 86.00 to 124.67 days, indicating both early and late maturing accessions. Early maturing types such as Ex-Ribadu and Ex-Yabak are desirable in semi-arid

Northern Nigeria where rainfall is limited and erratic. Early flowering is an important drought escape mechanism in finger millet (Ankit Kumar *et al.*, 2019).

The high variability observed agrees with earlier reports that finger millet possesses wide phenotypic diversity useful for selection and crop improvement (Umar & Kwon-Ndung, 2014).

Table 1: Comparison of Pooled Mean Values of Agro-Morphological Traits of Finger Millet Accessions Cultivated in Northern Nigeria Across the 2024 and 2025 Cropping Seasons.

Genotype	PH (cm)	SG (cm)	LL (cm)	INTDPP	FPE	FL (cm)	ETPP	DTA	1000SW (g)	GYD (kg/ha)
Ex-Gora	51.20d	9.39cd	42.51 ^{cd}	9.06 ^c	5.97 ^c	21.33 ^c	3.33 ^{bcd}	93.33 ^{cf}	7.17 ^{abc}	809.67 ^g
Ex-Maska	60.85b	11.20ab	57.97 ^a	11.08 ^a	7.88 ^c	23.00 ^{de}	3.31 ^{bcd}	99.00 ^{de}	4.03 ^{fg}	835.33 ^{fg}
Ex-Kusa	56.90c	10.19bc	51.30 ^{abc}	10.27 ^{ab}	9.87 ^b	30.33 ^{abc}	2.67 ^{cd}	105.67 ^{cd}	3.61 ^g	1155.67 ^d
Ex-Ribadu	58.56bc	12.17a	46.10 ^{bcd}	8.75 ^{cd}	7.75 ^c	30.33 ^{abc}	4.33 ^b	86.00 ^f	4.00 ^{fg}	1585.67 ^c
Ex-Biliri	57.70bc	9.43cd	57.56 ^a	8.62 ^{cd}	10.53 ^b	34.33 ^a	5.67 ^a	98.33 ^{de}	6.65 ^{cd}	1716.67 ^b
Ex-Wagir	58.97bc	8.37de	52.25 ^{abc}	9.28 ^{bc}	6.18 ^{de}	20.67 ^c	2.33 ^d	112.00 ^{bc}	7.69 ^a	793.00 ^{gh}
Ex-Zonkwa	64.40a	10.35bc	55.22 ^{ab}	11.38 ^a	10.03 ^b	33.33 ^a	4.33 ^b	92.00 ^{ef}	6.78 ^{bcd}	1631.00 ^c
Ex-Yabak	57.74bc	10.12bc	37.03 ^d	6.80 ^f	11.74 ^a	28.00 ^{bc}	6.00 ^a	87.00 ^f	7.26 ^{ab}	1989.33 ^a
Ex-Takanai	56.68c	8.51de	40.60 ^d	8.73 ^{cd}	7.01 ^{cd}	32.34 ^{ab}	3.67 ^{bc}	116.67 ^b	5.14 ^e	891.00 ^f
Ex-Tafawa	58.49bc	11.66a	58.86 ^a	7.52 ^{ef}	7.83 ^c	26.00 ^{cd}	3.66 ^{bc}	104.67 ^{cd}	6.26 ^d	970.33 ^c
Ex-Means	49.55d	7.79e	38.30 ^d	7.72 ^{def}	5.59 ^c	18.67 ^c	2.67 ^{cd}	124.67 ^a	4.20 ^f	729.00 ^h
S.D.	4.33	1.51	12.02	1.51	2.03	5.82	1.26	12.60	1.51	439.98
SEM	1.23*	0.46*	3.67*	0.42*	0.33*	1.63*	0.36*	2.75*	0.22*	28.74*

PH - plant height, SG - stem girth, LL - leaf length, INTDPP – internodes per plant, FPE – fingers per ear, FL – finger length, ETPP – effective tillers per plant, DTA – days to anthesis, 1000SW – 1000 seed weight, GYD – grain yield

Nutritional Quality Traits

Significant differences ($p < 0.05$) were observed among accessions for Cu, Fe, Mn, P, Zn, and crude protein (Table 2), while Ca, Mg, K, and S showed non-significant variation. Iron content ranged from 3.87 to 7.46 mg/100 g, with Ex-zalau recording the highest value. Iron-rich accessions are important for combating iron-deficiency anemia, a major nutritional problem in developing countries (Singh & Raghuvanshi, 2012).

Zinc ranged from 0.87 to 3.54 mg/100 g, with Ex-Gora recording the highest value. Zinc plays a vital role in immune function and growth (FAO, 1998). Crude protein varied significantly from 3.86% (Ex-Maska) to 7.99% (Ex-zalau). These values align with previous reports that finger millet grain protein ranges between 5–8% (Ankit Kumar *et al.*, 2019a). The presence of high-protein accessions supports the claim that finger millet is a nutritionally superior cereal (Bekele *et al.*, 2016). The significant variation in micronutrients suggests the presence of

exploitable genetic diversity for biofortification breeding programs aimed at improving mineral density in finger millet.

Table 2: Pooled mean comparison of grain micro and macro nutrient content (mg/100 g) and protein (% wt) content in finger millet accessions grown in northern Nigeria, for two cropping seasons (2024 and 2025)

Genotype	Ca	Cu	Fe	Mg	Mn	P	K	S	Zn	Crude Protein
Ex-Gora	297.14	0.28 ^{cd}	5.10 ^h	114.64	12.42b	186.97e	464.19	86.97	3.54 ^a	5.43d
Ex-Maska	300.47	0.27 ^d	5.77 ^{de}	115.64	11.00d	215.71bc	478.98	86.62	2.52 ^c	3.86g
Ex-Kusa	296.46	0.32 ^b	7.15 ^{ab}	113.74	9.19ef	207.81d	477.01	85.58	1.48 ^f	4.63ef
Ex-Ribadu	288.39	0.26 ^c	4.51 ^h	115.31	10.79d	192.66e	482.86	82.85	1.79 ^c	5.89bc
Ex-Biliri	293.52	0.38 ^a	5.59 ^{ef}	116.08	10.58d	222.15a	485.12	85.19	0.92 ^h	6.33b
Ex-Wagir	291.75	0.33 ^b	4.53 ^{gh}	114.16	8.76f	214.43bcd	486.24	85.35	1.24 ^{fg}	4.39fg
Ex-Zonkwa	287.48	0.27 ^d	6.27 ^{cd}	113.21	13.14a	188.36e	473.23	86.31	0.87 ^h	5.16e
Ex-Yabak	295.57	0.23 ^c	6.80 ^{bc}	113.70	9.84e	212.33cd	480.31	84.17	1.07 ^{gh}	5.22d
Ex-Takanai	297.05	0.31 ^{bc}	3.87 ⁱ	115.31	8.76f	219.36ab	471.44	83.17	2.07 ^d	5.78bc
Ex-Tafawa	292.16	0.39 ^a	5.14 ^{fi}	116.55	12.29bc	215.20bc	482.34	83.84	2.83 ^b	6.02b
Ex-zalau	289.52	0.26 ^d	7.46 ^a	114.29	11.70c	190.16e	478.29	83.69	2.07 ^d	7.99a
Means	294.16	0.30	5.65	114.84	10.77	187.66	478.18	84.88	1.85	5.52
S.D.	6.55	0.05	1.18	4.49	1.51	7.34	12.68	3.57	0.84	1.11
SEM	3.95 ^{ns}	0.01 [*]	0.23 [*]	3.03 ^{ns}	0.25 [*]	2.25 [*]	7.66 ^{ns}	2.30 ^{ns}	0.09 [*]	0.21 [*]

Values followed by the same letter(s) along the column are not significantly different at $p < 0.05$

Genetic Parameters

Genotypic variance (GV) was generally lower than phenotypic variance (PV) for all traits (Table 3), indicating environmental influence on trait expression. However, high broad-sense heritability (H^2b) estimates were observed for leaf length (89.15%), plant height (83.38%), finger length (78.06%), and grain yield (67.40%). High heritability indicates that phenotypic performance reliably reflects genetic potential (Burton, 1952).

Grain yield exhibited high genotypic coefficient of variation (38.10%) and moderate-to-high heritability (67.40%) coupled with high genetic advance (64.42%), suggesting additive gene action and effectiveness of direct selection. Similar findings were reported by Abubakar et al. (2019), who emphasized that traits with high heritability and high genetic advance are suitable targets for improvement through selection.

Moderate heritability observed for stem girth and number of fingers suggests both genetic and environmental influences. Traits with moderate heritability may require progeny testing or multi-location trials for effective selection (Falconer & Mackay, 1996).

Table 3: Genetic parameters estimate for agro-morphological traits in 11 finger millet accessions

Traits	Mean	GV	PV	EV	GCV	PCV	H ² b	GA
PH	57.37	15.60	18.71	3.11	6.88	7.53	83.38	12.95
SG	9.93	1.53	2.78	1.25	12.46	16.79	55.03	19.03
LL	48.88	119.58	134.13	14.55	22.37	23.69	89.15	43.51
NINTD	9.02	1.28	3.61	2.33	12.54	21.06	35.46	15.30
NF	7.51	3.29	5.94	2.65	24.15	32.45	55.39	37.02
FL	27.12	27.80	35.51	7.81	19.44	22.00	78.06	35.40
NEFTL	3.57	1.08	2.06	0.98	29.11	40.20	52.43	43.41
DTA	101.76	117.70	222.81	105.11	10.66	14.67	52.83	15.00
1000SW	5.71	1.45	4.16	2.71	21.09	35.72	34.86	25.39
YD	1102.49	176422.04	261732.29	84751.25	38.10	46.40	67.40	64.42

GV – Genotypic Variance, PV – Phenotypic Variance, EV – Environmental Variance, GCV – Genotypic Coefficient Variance, PCV – Phenotypic Coefficient Variance, H²b – Broad Sense Heritability, GA – Genetic Advanced

Cluster Analysis

The dendrogram (Figure 1) grouped the accessions into two distinct clusters based on agro-morphological and nutritional traits. Cluster I contain about The clustering pattern indicates genetic divergence among accessions. Genetically distant parents are desirable in hybridization programs to maximize heterosis and recombination (Murray et al., 2008). The clustering observed in this study confirms substantial variability within Northern Nigerian germplasm, which can be exploited for breeding.

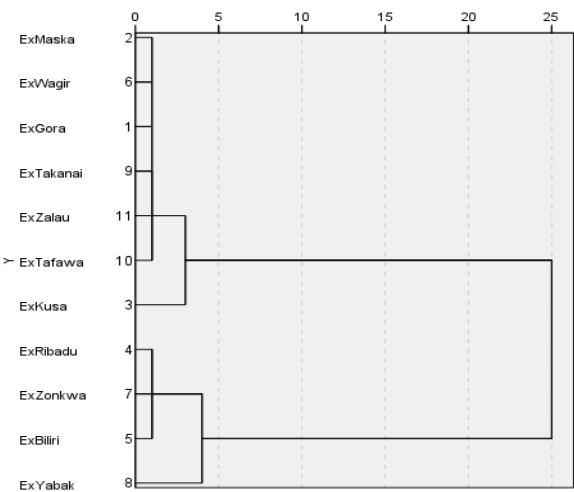


Fig.1. Dendrogram of Agro-morphological characters showing the linkages among ten accessions of finger millet grown in Northern Nigeria for 2024 and 2025 cropping seasons.

CONCLUSION

The study revealed significant agro-morphological and nutritional variability among finger millet accessions in Northern Nigeria. High heritability and genetic advance for grain yield, leaf

length, and finger length suggest good prospects for genetic improvement through selection. Nutritional variability, particularly in iron, zinc, and protein content, highlights the crop's potential for addressing micronutrient deficiencies. The identified superior accessions such as Ex-Yabak (high yield) and Ex-zalau (high protein and iron) could serve as promising parental lines in breeding programs.

ACKNOWLEDGEMENT

Authors acknowledged the management of Tertiary Education Trust Fund (TETFund) Nigeria for providing the financial support to carry out the research.

REFERENCE

- Abubakar, A., Aliero, A. A., & Usman, A. (2019). Genetic variability and heritability studies in finger millet. *African Journal of Agricultural Research*, 14(5), 210–218.
- Ankit Kumar, A., Meti, N., & Babu, N. (2019a). Nutritional importance and genetic variability in finger millet (*Eleusine coracana*). *Journal of Cereal Research*, 11(2), 120–128.
- Ankit Kumar, Chawla H. S., Jeena A. S. and Rohit (2019b). Morphological Characterization of Finger Millet Germplasm Collected from Utrakhland Hills for Qualitative Traits. *International Journal of Current Microbiology and Applied Sciences*, 8(9): 2105-2109. doi: <https://doi.org/10.20546/ijcmas.2019.809.243>
- Aradhna Suman, SS Surin and Ekhlague Ahmad (2019). Finger millet germplasm characterization and evaluation using principal component analysis. *International Journal of Chemical Studies*, 7(2): 1002-1005.
- Aradhna, K., Sharma, R., & Singh, S. (2019). Genetic diversity analysis in finger millet. *International Journal of Current Microbiology and Applied Sciences*, 8(4), 1567–1575.
- Bekele AF, Gelahun DW, Deneje AB (2016). Determination of Optimum Rates of Nitrogen and Phosphorus Fertilization for Finger Millet (*Eleusine coracana* L. Garten) Production at Asossa Zone, in Benishangul – Cuimaz Region of Ethiopia. *Advances in Sciences and Humanities*, 2(1):1-6.
- Bekele, A., Fikre, A., & Negash, G. (2016). Nutritional and health benefits of finger millet. *Food Science and Quality Management*, 52, 34–41.
- Burton, G. W. (1952). Quantitative inheritance in grasses. *Proceedings of the 6th International Grassland Congress*, 1, 277–283.
- Dida, M. M., Srinivasachary, Ramakrishnan, S., & Bennetzen, J. L. (2007). The genetic map of finger millet. *Theoretical and Applied Genetics*, 114, 321–332.
- Falconer, D. S., & Mackay, T. F. C. (1996). *Introduction to quantitative genetics* (4th ed.). Longman.
- FAO. (1998). *Underutilized grains for food and nutrition security*. Food and Agriculture Organization.
- Hussaini, I.D., Mohammed, A., Bassi, A.N., Hassan, I. and Aliyu, M.A. (2020). Growth and yield of finger millet (*Eleusine coracana* L.) (Garten) as affected by varying nitrogen levels at Mubi, Adamawa State, Nigeria. *African Journal of Agricultural Research*, 16(7): 947-951.
- Ibrahim AK, Vancir N, Usman A (2018). Influence of Incorporated Legumes, NPK 20-10-10 and their combination on Yield and Yield Attributes of Pearl Millet (*Pennisetum glaucum* L.). *International Journal of Plant and Soil Science* 21(2):1-7
- Malinda S, Thilakarathna, Manish NR (2015). A Review of Nutrient Management Studies involving Finger Millet in the Semi-Arid Tropics of Asia and Africa. *Agronomy* 5:262-290
- Mgonja, M. A. (2005). Finger millet research and development in Africa. *African Crop Science Journal*, 13(2), 135–142.
- Murray S., Sharma A., Rooney W. and Klein P. (2008) Genetic improvement of sorghum as biofuel feedstock, *Crop Science* 48: 2165-2179.

- Murray, S. C., Rooney, W. L., & Hamblin, M. T. (2008). Genetic diversity and breeding applications in millets. *Crop Science*, 48(2), 464–475.
- Panwar, P., Saini, R.K., Sharma, N., Yadav, D. and Kumar, A. (2010). Efficiency of RAPD, SSR and cytochrome P450 gene-based markers in accessing genetic variability amongst finger millet (*Eleusine coracana*) accessions. *Molecular Biology Reports*, 37(8): 4075–4082.
- Sandhya Rami Y, Trveni U, Patro TSSK and Anuradha N (2017). Effect of Nutrient Management on Yield and Quality of Finger Millet (*Eleusinecoracana* L. Garten). *International Journal of Chemical Studies* 5(6):1211-1216.
- Shinggu C.P., Tunwari B.A. and Gani M. (2016). Finger millet (*Eleusine coracana* (L.) Gaertn) in sustainable food security in Nigeria: a review. *FUW Trends in Science & Technology Journal*, Vol. 1(2): 332 - 336
- Singh, P. and Raghuvanshi, R.S. (2012). Finger millet for food and nutritional security. *African Journal of Food Science*, 6(4): 77–85.
- Singh, P., and Raghuvanshi, R. S. (2012). Finger millet for food and nutritional security. *African Journal of Food Science*, 6(4), 77–84.
- Umar I.D., and Kwon-Ndung E.H. (2014). Assessment of variability of finger millet (*Eleusine coracana* (L) Gaertn) landraces germplasm in Northern Nigeria. *Nigerian Journal of Genetics*, 28: 48 – 51. <http://dx.doi.org/10.1016/j.nigig.2015.09.005>
- Upadhyaya, H.D., Gowda, C.L.L., Pundir, R.P.S., Reddy, V.G., and Singh, S. (2006). Development of core subset of finger millet germplasm using geographical origin and data on 14 quantitative traits. *Genetic Resources and Crop Evolution*. 2006; 53:679.