International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2025): 5.29
IJABR 2025; SP-9(11): 538-540
www.biochemjournal.com
Received: 25-08-2025
Accepted: 29-09-2025

Bhanuwanti
Ph.D. Scholar, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir Wadura, Sopore, Jammu & Kashmir, India

Dr. AA Saad
Professor, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir Wadura, Sopore, Jammu & Kashmir, India

Dr. Lal Singh
Professor, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir Wadura, Sopore, Jammu & Kashmir, India

Dr. Mohammad Ayub Bhat
Professor, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir Wadura, Sopore, Jammu & Kashmir, India

Dr. Fehim Jeelani Wani
Professor, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir Wadura, Sopore, Jammu & Kashmir, India

Utakarsh Rai
Professor, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir Wadura, Sopore, Jammu & Kashmir, India

Aroosa Khatoon
Professor, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir Wadura, Sopore, Jammu & Kashmir, India

Corresponding Author:
Bhanuwanti
Ph.D. Scholar, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir Wadura, Sopore, Jammu & Kashmir, India

Impact of sowing date and nitrogen levels on proximate composition and essential mineral profile of finger millet grains

Bhanuwanti, AA Saad, Lal Singh, Mohammad Ayub Bhat, Fehim Jeelani Wani, Utakarsh Rai and Aroosa Khatoon

DOI: https://www.doi.org/10.33545/26174693.2025.v9.i11Sg.6278

Abstract
A field investigation was carried out during 2023 and 2024 at the Agronomy Research Farm, Faculty of Agriculture, SKUAST-K, wadura, Sopore to evaluate the influence of four sowing windows (20th, 22nd, 24th, and 26th Standard Meteorological Weeks—SMW) and five nitrogen levels (0, 20, 40, 60, and 80 kg N ha^{-1}) on proximate composition, mineral profile, and amino acid content in finger millet grains under split plot design. Sowing during the 24th SMW significantly improved crude protein, key minerals (Ca, K, P), and essential amino acids compared to earlier and delayed sowing dates. Nitrogen application exhibited a positive and significant effect, with the highest dose (80 kg N ha^{-1}) recording the maximum crude protein (6.33%), crude fat (1.33%), lysine (181.00 mg), methionine (217.67 mg), tryptophan (160.50 mg), calcium (343.25 mg), and potassium (410.25 mg). Conversely, delayed sowing (26 SMW) and the control treatment (0 kg N ha^{-1}) resulted in the lowest nutritional attributes. The findings demonstrate that sowing at the 24th SMW coupled with 80 kg N ha^{-1} is the most effective strategy to enhance biochemical composition, mineral enrichment, and amino acid content in finger millet grains.

Keywords: Finger millet, nitrogen levels, sowing date, biochemical quality, amino acids, proximate composition, minerals

Introduction
Finger millet (*Eleusine coracana* L.), also known as ragi, is one of the most important small millets grown in semi-arid regions of Asia and Africa. The crop has received increasing attention in recent years due to its high nutritional value, climate resilience and suitability for vulnerable farming ecosystems. Finger millet is rich in minerals, especially calcium and also provides quality proteins, dietary fibre, essential amino acids and antioxidants. Because of its slow digestibility and low glycemic response, it is widely promoted as a grain that supports diabetic and bone-health diets. It can help address issues of malnutrition in rural communities (Devi *et al.*, 2014) [1]. The nutritional composition of finger millet is not only determined by genetically but is also strongly influenced by crop management practices. In particular, time of sowing and nutrient supply play a crucial role in determining grain quality (Prasad *et al.*, 2015) [2]. Nitrogen is a key nutrient involved in chlorophyll development, protein synthesis and nitrogenous compound formation in plants. Proper nitrogen fertilization has been shown to improve grain protein content, amino-acid balance and mineral accumulation in cereals, whereas inadequate nitrogen reduces photosynthetic efficiency and nutrient mobilization. Likewise, sowing time determines the temperature and light regime during critical growth periods, which affects vegetative growth, grain filling, and nutrient translocation into the seeds (Channappagoudar *et al.*, 2008) [3]. Although finger millet is traditionally grown with minimal inputs, there is increasing recognition that optimized agronomic practices are necessary to enhance its nutritional value, particularly in the context of biofortified and health-oriented food systems. Limited studies are available on how sowing schedule and nitrogen levels interact to influence quality traits such as crude protein, essential minerals, and amino acids in finger millet grain. Therefore, the present study was conducted to evaluate the combined effect of different sowing dates and nitrogen levels on key quality parameters of finger millet, with the objective of identifying agronomic practices that

improve grain nutritional quality (Basha *et al.*, 2019) [4].

Materials and Methods

The field experiment was carried out during the *kharif* 2023 and 2024 at the Agronomy Research Farm, Faculty of Agriculture, SKUAST-K, wadura, Sopore. The location of the field experiment is geographically situated at 34º34' N and 74º30 E, having an elevation of 1580 above mean sea level. In 2023, the experimental site received a total seasonal rainfall of 296.5 mm. The mean maximum temperature was 15.6 °C and the mean minimum temperature was 31 °C. The mean maximum relative humidity 94.71 and mean minimum relative humidity 47.3. In 2024, the experimental site received a total seasonal rainfall 108.5 mm. The maximum temperature was 30.82 °C and minimum temperature was 15.19 °C. The mean maximum relative humidity 93.73 and mean minimum relative humidity was 48.02. The field experiment was laid out in split plot design with three replications consisting of 20 treatment combinations. The main plot treatments comprised four dates of sowing 20 Standard Meteorological Week (SMW), 22 SMW, 24 SMW, 26 SMW while the subplot treatment consisted of five nitrogen levels 0, 20, 40, 60 and 80 kg ha^{-1}. Nitrogen was supplied through urea in split applications-half at sowing and remaining half at tillering stage. At maturity, grains were harvested, cleaned, sun-dried, and ground for laboratory analysis. Crude protein content was estimated using the Kjeldahl procedure with a conversion factor of 6.25, fat was determined by Soxhlet extraction, and total carbohydrates were calculated by the difference method as outlined by AOAC standards (AOAC, 2016) [5]. Essential minerals (calcium, phosphorus, and potassium) were measured using wet digestion followed by colorimetric and flame photometric readings and amino acids including lysine, methionine, and tryptophan were quantified using standard spectrophotometric techniques (Rao *et al.*, 2016) [6]. The experimental data were subjected to analysis of variance appropriate for a split-plot layout and significance of means was tested at the 5% probability level (Gomez *et al.*, 1984) [7].

Results and Discussion

The quality attributes of finger millet were significantly influenced by sowing dates and nitrogen levels. Across both years, crude protein content increased progressively when sowing was delayed from 20 to 24 SMW, beyond which a reduction was observed under 26 SMW. The highest protein level was recorded at 24 SMW (5.47% in 2023 and 5.81% in 2024), whereas the earliest and latest sowing dates showed comparatively lower protein concentration. This suggests that the crop accumulated more nitrogen-rich compounds when grown under more favorable thermal and moisture regimes around 24 SMW. Similar findings were reported by Geetha and Padmaja (2020) [8], who noted superior protein accumulation under optimum sowing windows. Nitrogen fertilization also showed a clear positive effect on nutritional quality. Progressive increments in crude protein were recorded with increasing nitrogen doses, with the maximum values observed under 80 kg N ha^{-1} (5.91% in 2023 and 6.33% in 2024). This improvement can be attributed to enhanced nitrogen assimilation and protein synthesis pathways in finger millet under nutrient-rich conditions. Comparable outcomes have been reported earlier, highlighting nitrogen as a limiting factor for grain protein enrichment in millets (Upadhyay & Gupta, 2018; Singh *et al.*, 2021) [9, 10]. Crude fat and carbohydrate contents also followed a similar improving trend with increasing nitrogen levels and optimum sowing time, although the magnitude of variation was relatively small, demonstrating the stable biochemical composition of finger millet. Mineral concentration showed a modest but consistent improvement under 22-24 SMW sowing and higher nitrogen application. Calcium and potassium contents increased marginally at 24 SMW and under 80 kg N ha^{-1}, while phosphorus recorded notable improvement with nitrogen supplementation, reaching 251.25 mg and 250.83 mg under 80 kg N ha^{-1} in 2023 and 2024, respectively. These results are in agreement with earlier evidence indicating that nitrogen fertilization enhances nutrient uptake and translocation to developing grains (Rao & Murthy, 2016) [6]. Amino acid profiles followed a similar trend to protein content. Lysine, methionine and tryptophan levels were highest at 24 SMW and 80 kg N ha^{-1}, suggesting a synergistic influence of optimum sowing window and adequate nitrogen supply on amino acid biosynthesis. The highest lysine values were observed at 80 kg N ha^{-1} (180.17 mg in 2023 and 181.00 mg in 2024), with a corresponding improvement in methionine and tryptophan. Earlier studies have also emphasized the role of balanced nitrogen nutrition in enhancing amino acid quality in millets (Chandra *et al.*, 2016) [11]. It is noteworthy that sowing beyond the optimum period (26 SMW) resulted in slight declines in protein and amino acid content, possibly due to sub-optimal plant metabolic activity under delayed environmental conditions. Overall, the study clearly indicates that sowing around 24 SMW, combined with 80 kg N/ha, results in superior grain quality in terms of protein, essential amino acids and minerals. These findings align with previous research showing that both agronomic timing and nutrient management are crucial determinants of biochemical composition in finger millet (Geetha & Padmaja, 2020; Upadhyay & Gupta, 2018) [8, 9]. The consistent trends across two years further strengthen the reliability of these observations.

	Crude protein (%)		**Crude fat (%)**		**Carbohydrates (%)**	
DOS	**2023**	**2024**	**2023**	**2024**	**2023**	**2024**
20 SMW	5.13	5.23	1.28	1.29	70.38	70.58
22 SMW	5.30	5.48	1.29	1.29	70.53	70.77
24 SMW	5.47	5.81	1.29	1.30	70.79	71.03
26 SMW	5.08	4.94	1.27	1.28	70.21	70.29
SEm(±)	0.03	0.04	0.00	0.01	0.03	0.03
CD (P = 0.05)	0.09	0.15	NS	NS	0.10	0.09
N Level						
0 kg ha^{-1}	4.57	4.63	1.23	1.24	67.99	68.28
20 kg ha^{-1}	4.91	4.95	1.27	1.28	69.85	70.03
40 kg ha^{-1}	5.25	5.29	1.29	1.30	70.67	70.80
60 kg ha^{-1}	5.57	5.62	1.31	1.32	71.45	71.68
80 kg ha^{-1}	5.91	6.33	1.32	1.33	72.43	72.53
SEm(±)	0.02	0.05	0.002	0.00	0.10	0.10
CD (P = 0.05)	0.06	0.14	0.004	0.01	0.30	0.28

Minerals composition

Minerals composition						
	Calcium (mg)		potassium (mg)		Phosphorus (mg)	
DOS	2023	2024	2023	2024	2023	2024
20 SMW	339.47	340.27	404.73	407.00	247.93	248.53
22 SMW	340.20	340.53	405.20	407.33	248.47	248.73
24 SMW	340.53	341.00	405.33	407.87	248.60	248.53
26 SMW	339.00	339.40	404.60	406.33	247.40	247.27
SEm(±)	0.36	0.15	0.17	0.19	0.42	0.39
CD (P = 0.05)	NS	0.51	NS	0.65	NS	NS
N Level						
0 kg ha^{-1}	335.83	336.25	401.42	402.75	243.67	244.33
20 kg ha^{-1}	338.75	339.33	404.08	406.58	246.83	247.25
40 kg ha^{-1}	340.25	340.75	405.75	407.33	248.75	248.83
60 kg ha^{-1}	341.42	341.92	406.50	408.75	250.00	250.08
80 kg ha^{-1}	342.75	343.25	407.08	410.25	251.25	250.83
SEm(±)	0.14	0.18	0.15	0.20	0.15	0.16
CD (P = 0.05)	0.40	0.53	0.43	0.59	0.45	0.47

Amino acid composition

Amino acid composition						
	Lysine (mg)		Methionine (mg)		Tryptophan (mg)	
DOS	2023	2024	2023	2024	2023	2024
20 SMW	176.13	177.27	215.47	215.53	156.76	157.27
22 SMW	177.13	178.20	215.58	215.80	157.31	157.73
24 SMW	177.60	178.53	215.64	215.93	157.75	158.27
26 SMW	175.60	176.47	214.99	215.13	156.18	156.93
SEm(±)	0.12	0.18	0.28	0.18	0.33	0.24
CD (P = 0.05)	0.41	0.61	NS	NS	NS	0.83
N Level						
0 kg ha^{-1}	170.08	170.83	210.98	211.67	151.87	153.08
20 kg ha^{-1}	176.00	176.75	214.75	215.08	155.90	156.75
40 kg ha^{-1}	177.83	179.25	216.64	216.42	157.61	158.08
60 kg ha^{-1}	179.00	180.25	217.28	217.17	159.24	159.33
80 kg ha^{-1}	180.17	181.00	217.46	217.67	160.39	160.50
SEm(±)	0.14	0.20	0.13	0.13	0.16	0.15
CD (P = 0.05)	0.42	0.57	0.38	0.37	0.45	0.43

Conclusion

The study confirmed that sowing time and nitrogen nutrition significantly influence the nutritional quality of finger millet. Sowing during the 24th SMW combined with 80 kg N/ha resulted in the highest crude protein, amino acids, and mineral content, while early and late sowing with lower nitrogen levels produced inferior quality grains. Therefore, 24 SMW sowing and 80 kg N/ha is recommended for maximizing grain nutritional value in finger millet under similar agro-climatic conditions.

References

1. Devi PB, Vijayabharathi R, Sathyabama S, *et al.* Health benefits and nutritional significance of finger millet: A review. Food Sci Hum Wellness. 2014;3(4):149-155.
2. Prasad R, Shivay YS, Kumar D. Current status, challenges, and opportunities in nitrogen management for sustainable crop production. Indian J Agron. 2015;60(3):299-309.
3. Channappagoudar BB, Biradar NR, *et al.* Effect of nitrogen levels on growth, yield and quality of finger millet. Karnataka J Agric Sci. 2008;21(2):233-238.
4. Basha SJ, Rai KP, *et al.* Effect of sowing dates and nutrient levels on growth and productivity of finger millet under rainfed conditions. Int J Agric Sci. 2019;11(2):914-918.
5. AOAC. Official Methods of Analysis of the Association of Official Analytical Chemists. 20th ed. Washington (DC): AOAC International; 2016.
6. Rao DE, Murthy KV. Amino acid and mineral profiling of finger millet as influenced by nutrient management. Indian J Agric Biochem. 2016;29(2):154-160.
7. Gomez KA, Gomez AA. Statistical Procedures for Agricultural Research. 2nd ed. New York: John Wiley & Sons; 1984.
8. Geetha G, Padmaja G. Influence of nitrogen fertilization on nutritional quality and grain yield of finger millet (*Eleusine coracana* L.). Int J Adv Biochem Res**.** 2020;4(2):5-10.
9. Upadhyay RG, Gupta AK. Evaluation of biochemical composition of finger millet genotypes as influenced by agronomic practices. Int J Adv Biochem Res**.** 2018;2(1):14-20.
10. Singh KP, Pradhan A, Yadav RS. Effect of sowing dates and nitrogen levels on growth and grain quality of finger millet in semi-arid conditions. Int J Chem Stud**.** 2021;9(2):147-152.
11. Chandra D, Chandra S, Sharma AK. Review of finger millet nutritional properties and processing innovations. J Food Sci Technol**.** 2016;53(1):102-118.