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Impact of different foliar nutrient applications on growth and yield parameters of finger millet (*Eleusine coracana* L.)

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Abstract

A field experiment was therefore conducted during *Kharif* 2024 at College of Agriculture, Kolhapur of Mahatma Phule Krushi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra, India using a randomized block design with 13 treatments and 3 replications. The study aimed to assess the effects of foliar nutrient sprays on the growth and yield parameters and economics of finger millet. The plant height (124.82 cm), number of tillers per running meter (57.74), dry matter accumulation plant⁻¹ (72.70 g) were significantly higher with an application of two foliar sprays of 19:19:19 @ 2% and were on par with the application of two foliar sprays of MPKV'S Phule liquid micro grade II @ 1%. The application of two foliar sprays of 19:19:19 @ 2% recorded significantly higher yield attributing characters viz., number of earhead plant⁻¹ (4.04), number of finger earhead⁻¹ (7.5), weight of earhead (23.14 g) and Weight of grain earhead⁻¹ (11.23 g). However, they were on par with application of two foliar sprays of MPKV'S Phule liquid micro grade II @ 1%.

Keywords: Finger millet, micro grade, foliar nutrient applications, growth and yield parameters

Introduction

Millets are a group of nutrient-rich, small-seeded grasses traditionally grown in arid and semi-arid regions, particularly across Asia and Africa. In India, various millets like finger millet, pearl millet, barnyard millet, and foxtail millet are widely cultivated due to their adaptability and nutritional value (Bhatt *et al.*, 2003; Shobana *et al.*, 2013) [2, 14]. Finger millet (locally known as *ragi*, *nachani*, or *nagli*) is especially valued for its high calcium, dietary fiber, essential amino acids, and gluten-free properties—making it ideal for individuals with gluten intolerance, diabetes, or those pursuing a health-conscious diet (Chandrasekara and Shahidi, 2010; Senthilkumar and Gokul (2020) [4, 13]. It plays a prominent role in traditional and modern diets, being used in products such as baby foods, snacks, and desserts. India leads global millet production, with finger millet accounting for 85% of the minor millets cultivated. Karnataka is the top-producing state, followed by Tamil Nadu, Maharashtra, and Uttarakhand. The crop's resilience to drought, adaptability to poor soils, and suitability for rainfed farming make it a crucial component of food and nutritional security, especially in dryland regions (Reddy and Reddy, 2010; Shobana *et al.*, 2013; Senthilkumar and Gokul (2020) [12, 14, 13].

Post-pandemic shifts in dietary preferences have further elevated the importance of finger millet due to its antioxidant, anti-aging, and metabolic health benefits. Nutritionally, it contains 72–79.5% carbohydrates, 12% dietary fiber, 7.3% protein, and exceptionally high calcium (344 mg/100g), supporting bone health. Beyond nutrition, its agronomic strengths include drought tolerance, rapid recovery from stress, and compatibility with multiple cropping systems. Given its increasing relevance, the Government of India declared 2018 as the National Year of Millets, and the UN recognized 2023 as the International Year of Millets. Millets are now referred to as “Nutricereals” or “*Shreeanna*” to reflect their health benefits and cultural importance (Jadhav *et al.*, 2024 [5].

To enhance productivity and maintain soil health, integrating inorganic and organic nutrient sources is essential, particularly in regions like the sub-montane areas of Maharashtra where finger millet is grown on steep slopes with high rainfall. Soil erosion and nutrient leaching are key concerns here. Foliar application of macro- (NPK) and micro-nutrients (Zn, Fe, Mn, Cu, Mo, B), such as those found in formulations like Phule Liquid Micro Grade II, helps improve nutrient uptake, correct deficiencies quickly, and increase yield and crop quality. Foliar feeding enhances nutrient use efficiency (NUE), often achieving up to 90% uptake efficiency and reducing nutrient losses from volatilization and leaching. It also allows the combined application of nutrients and plant protection chemicals, supporting sustainable and efficient agriculture. Studies show that foliar nutrient applications significantly improve plant metabolism, stress tolerance, and productivity, making it a valuable strategy for modern crop management.

Materials and Methods

A field experiment was conducted during *kharif* 2024 at research farm, Agronomy Section, RCSM College of Agriculture, Kolhapur. It is located on 16° 41' N latitude, 74° 14' longitude. The experimental site was fairly uniform and levelled. Soil at the experiment field was clay loamy with available nitrogen (272.5 kg/ha), phosphorous (24 kg/ha), potassium (234.1 kg/ha), organic carbon (0.56%) and chemical properties including EC (0.15 d Sm⁻¹) and pH (7.8). Sowing of Finger millet (*Phule Kasari*) was done on 7th June, 2024 with spacing 30 cm (Line sowing) and the harvesting was completed by 1st October 2024. Prior to sowing, basal dose of 60:30:30 (N: P₂O₅: K₂O kg ha⁻¹) was uniformly applied to experimental plots. The gross and net plot sizes were 4.5 m x 3 m and 3.3 m x 2.4 m, respectively. The experiment followed a randomized block design, comprising thirteen treatments with three replications. thirteen treatments were as follows: absolute control (water spray) (T₁), Two foliar sprays of 19:19:19 @ 1% (T₂), Two foliar sprays of 19:19:19 @ 2% (T₃), Two foliar sprays of MPKV'S Phule liquid micro grade II @ 0.5% (T₄), Two foliar sprays of MPKV'S Phule liquid micro grade II @ 1% (T₅), Two foliar sprays of Vermiwash @ 5% (T₆), Two foliar sprays of Vermiwash @ 10% (T₇), Two foliar sprays of DAP @ 1% (T₈), Two foliar sprays of DAP @ 2% (T₉), Two foliar sprays of Cow urine @ 5% (T₁₀), Two foliar sprays of Cow urine @ 10% (T₁₁), Two foliar sprays of Urea @ 1% (T₁₂) and Two foliar sprays of Urea @ 2% (T₁₃). Foliar

application was done at tillering and flowering stage at 45 DAS and 60 DAS respectively for each treatment. Observations were recorded at an interval of 30 days and at harvest. Tri-acid digestion method was followed for the estimation of phosphorous and potassium and for nitrogen estimation Kjeldahl method was followed. The data obtained by the investigation then subjected to Statistical analysis as per the standard procedure by using the techniques of analysis of variance and test of significance was carried out as given by Panse and Sukhatme (1967) [9]. In the tabular data C.D. values have been given for the comparison only where 'F' test was significant. The statistical analysis was carried out by computer.

Results and Discussion

Plant Height: At harvest the tallest plants were seen in T₃ (124.82 cm), followed by T₅ (123.56 cm) and T₂ (121.40 cm). These treatments significantly outperformed the control (T₁: 105.21 cm) and other organic-based foliar treatments. Notably, treatments T₈ (DAP @ 1%), T₁₂ (Urea @ 1%) and T₁₀ (Cow urine @ 5%) recorded shorter plant heights compared to other treatments, yet remained superior to the absolute control, indicating some benefit from nutrient supplementation, albeit less than that of balanced synthetic fertilizers. Similar research findings were earlier reported by Anburani (2018) [1], Bulbule *et al.*, (2018) [3], Jadhav *et al.*, (2024) [5].

Mean Number of Tillers: Among the treatments, two foliar sprays of 19:19:19 @ 2% (T₃) recorded the highest number of tillers (57.74 tillers/m), followed by Two foliar sprays of MPKV's Phule Liquid Micro Nutrient Grade II @ 1% (T₅) with 55.93 tillers/m, and Two foliar sprays of 19:19:19 @ 1% (T₂) with 53.83 tillers/m. These treatments were statistically at par and significantly superior to the Absolute Control (T₁), suggesting that balanced nutrient formulations, particularly with high nitrogen and phosphorus content, strongly stimulate tiller formation during the early vegetative phase. Two foliar sprays of MPKV's Phule Liquid Micro Nutrient Grade II @ 0.5% (T₄) and two foliar sprays of Vermiwash @ 10% (T₇) also showed improved tillering, recording 53.27 and 50.60 tillers/m, respectively, and were comparable to the top-performing treatments. Rahman *et al.*, (2014) [11], Mudalagiriappa *et al.*, (2016) [7], Bulbule *et al.*, (2018) [3], Jadhav *et al.*, (2024) [5] also found the analogous research outcomes.

Table 1: Growth attributes of finger millet as influenced by different treatments

Tr. No.	Treatments details	Mean plant height (cm) at harvest	Mean dry matter accumulation plant ⁻¹ (g) at harvest	Mean No. of tillers per running meter
T ₁	Absolute Control	105.21	57.37	28.45
T ₂	Two foliar sprays of 19:19:19 @ 1%	121.40	70.61	53.83
T ₃	Two foliar sprays of 19:19:19 @ 2%	124.82	72.70	57.74
T ₄	Two foliar sprays of MPKV'S Phule Liquid Micro Grade II @ 0.5%	120.73	70.29	53.27
T ₅	Two foliar sprays of MPKV'S Phule Liquid Micro Grade II @ 1%	123.56	71.02	55.93
T ₆	Two foliar sprays of Vermiwash @ 5%	115.81	67.04	43.97
T ₇	Two foliar sprays of Vermiwash @ 10%	120.23	68.37	50.60
T ₈	Two foliar sprays of DAP @ 1%	111.58	64.13	38.76
T ₉	Two foliar sprays of DAP @ 2%	117.43	67.14	44.37
T ₁₀	Two foliar sprays of Cow urine @ 5%	107.01	59.87	30.60
T ₁₁	Two foliar sprays of Cow urine @ 10%	108.63	62.90	32.64
T ₁₂	Two foliar sprays of Urea @ 1%	109.37	63.82	35.53
T ₁₃	Two foliar sprays of Urea @ 2%	113.92	64.94	41.93
	S.Em±	1.17	4.46	2.44
	CD @ 5%	3.41	13.01	7.13
	General Mean	20.88	115.36	66.17

Mean Dry Matter Accumulation: The maximum dry matter accumulation (72.70 g) was recorded in T₃: Two foliar sprays of 19:19:19 @ 2%, followed closely by T₅: (71.02 g), T₂: (70.61 g) and T₄: (70.29 g). The superior performance of balanced nutrient formulations like 19:19:19 and Phule Liquid Micro Nutrient Grade II in both concentrations (T₃, T₅, T₂, and T₄) can be attributed to the availability of essential nutrients that support active photosynthesis and biomass synthesis. These treatments facilitated greater absorption and translocation of nutrients,

thereby enhancing vegetative growth and dry matter production. Organic treatments like Vermiwash and cow urine, while beneficial to some extent, did not match the efficiency of synthetic foliar fertilizers. The higher nutrient availability from this foliar application of nutrients could have enhanced the plant aperture and ability to produce more dry matter as previously equivalent consequences were recorded by Rahman *et al.*, (2014) ^[11], Bulbule *et al.*, (2018) ^[3], Reddy *et al.*, (2018) ^[12], Jadhav *et al.*, (2024) ^[5].

Table 2: Yield attributes of finger millet as influenced by different treatments

Tr. No.	Treatments details	No. of earhead plant ⁻¹	No. of fingers earhead ⁻¹	Weight of earhead plant ⁻¹ (g)	Weight of grain earhead ⁻¹ (g)
T ₁	Absolute Control	2.50	4.67	17.21	7.09
T ₂	Two foliar sprays of 19:19:19 @ 1%	3.79	6.77	22.44	10.22
T ₃	Two foliar sprays of 19:19:19 @ 2%	4.04	7.50	23.14	11.23
T ₄	Two foliar sprays of MPKV'S Phule Liquid Micro Grade II @ 0.5%	3.47	6.65	21.15	10.03
T ₅	Two foliar sprays of MPKV'S Phule Liquid Micro Grade II @ 1%	3.82	7.37	22.93	10.91
T ₆	Two foliar sprays of Vermiwash @ 5%	3.19	6.27	19.47	9.12
T ₇	Two foliar sprays of Vermiwash @ 10%	3.41	6.50	20.76	9.47
T ₈	Two foliar sprays of DAP @ 1%	2.98	5.45	18.92	8.64
T ₉	Two foliar sprays of DAP @ 2%	3.31	6.43	19.69	9.20
T ₁₀	Two foliar sprays of Cow urine @ 5%	2.66	4.87	18.19	7.58
T ₁₁	Two foliar sprays of Cow urine @ 10%	2.69	5.10	18.24	7.95
T ₁₂	Two foliar sprays of Urea @ 1%	2.95	5.77	18.57	8.02
T ₁₃	Two foliar sprays of Urea @ 2%	3.08	5.93	19.30	8.73
	S.Em±	1.17	0.25	0.25	1.29
	CD @ 5%	3.41	0.74	0.74	3.76
	General Mean	20.88	3.22	6.10	20

Mean number of Earheads Plant⁻¹: Two foliar sprays of 19:19:19 @ 2% (T₃) recorded the highest number of earheads plant⁻¹ (4.04), significantly outperforming other treatments. This was followed closely by Two foliar sprays of MPKV's Phule liquid micro grade II @ 1% (T₅) (3.82) and Two foliar sprays of 19:19:19 @ 1% (T₂) (3.79). The enhanced earhead formation under these treatments can be attributed to the balanced supply of essential nutrients, which promotes tiller initiation and development during critical growth stages. Rahman *et al.*, (2014) ^[11], Bulbule *et al.*, (2018) ^[3], Senthilkumar and Gokul (2020) ^[13], Jadhav *et al.*, (2024) ^[5] also reported the parallel investigation conclusions.

Mean Number of Fingers Earhead⁻¹: The highest number of fingers was observed in Two foliar sprays of 19:19:19 @ 2% (T₃) with 7.50 fingers earhead⁻¹, followed by MPKV's Phule liquid micro grade II @ 1% (T₅) with 7.37 fingers, and Two foliar sprays of 19:19:19 @ 1% (T₂) with 6.77 fingers. The improved finger formation can be linked to the enhanced nutrient availability during the key growth stages, promoting better earhead development and grain setting. Formerly alike significances were verified by Rahman *et al.*, (2014) ^[11], Bulbule *et al.*, (2018) ^[3], Reddy *et al.*, (2018) ^[12], Senthilkumar and Gokul (2020) ^[13], Jadhav *et al.*, (2024) ^[5].

Mean Weight of Earhead⁻¹: The weight of earhead plant⁻¹ is a key yield component reflecting grain filling and biomass accumulation. The highest earhead weight was recorded in two foliar sprays of 19:19:19 @ 2% (T₃) at 23.14 g, significantly higher than all other treatments. This was followed closely by MPKV's Phule liquid micro grade II @ 1% (T₅) (22.93 g) and Two foliar sprays of 19:19:19 @ 1% (T₂) (22.44 g). These treatments provided balanced nutrients that support effective photosynthesis and translocation of assimilates to the developing

earheads, thus enhancing weight. Comparable study discoveries were previously conveyed by Rahman *et al.*, (2014) ^[11], Bulbule *et al.*, (2018) ^[3], Reddy *et al.*, (2018) ^[12], Senthilkumar and Gokul (2020) ^[13], Jadhav *et al.*, (2024) ^[5].

Mean weight of Grain Earhead⁻¹: Grain weight per earhead is a direct measure of productive capacity. Two foliar sprays of 19:19:19 @ 2% (T₃) recorded the highest grain weight (11.23 g), followed by MPKV's Phule liquid micro grade II @ 1% (T₅) (10.91 g) and Two foliar sprays of 19:19:19 @ 1% (T₂) (10.22 g). The higher grain weight reflects improved nutrient availability during grain filling stages, ensuring proper development and size of grains. Rahman *et al.*, (2014) ^[11], Bulbule *et al.*, (2018) ^[3], Reddy *et al.*, (2018) ^[12], Senthilkumar and Gokul (2020) ^[13], Jadhav *et al.*, (2024) ^[5] correspondingly described the matching study inferences.

Conclusion

The present investigation clearly demonstrated that foliar nutrient applications, particularly two sprays of 19:19:19 @ 2% and MPKV's Phule Liquid Micro Grade II @ 1%, significantly enhanced the growth, yield attributes, and grain yield of finger millet under sub-montane conditions of Maharashtra. These treatments consistently outperformed the control and other organic sources such as vermiwash and cow urine by improving plant height, tillering, dry matter accumulation, earhead development, and grain weight. The results underline the importance of balanced foliar nutrition in improving nutrient uptake efficiency, supporting vigorous plant growth, and enhancing yield potential. Thus, the adoption of foliar application of balanced fertilizers, especially 19:19:19 @ 2% or Phule Liquid Micro Grade II @ 1%, can be recommended as an effective, economical, and sustainable practice for boosting finger millet productivity in rainfed and nutrient-deficient soils.

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