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Response of High Yielding Variety of Finger Millet to NPK Nutrition in North Central Laterites of Kerala, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Finger millet is one of the most healthy and nutritious crop grown all over India. A field experiment was conducted to standardize nutrient requirement of HYV of finger millet "Hima" at the Department of Agronomy, College of Agriculture, Vellanikkara, Kerala from October 2021 to February 2022. Randomized block design was followed with 8 treatments replicated thrice. The experiment comprised of eight treatments *ie*; T1 - Farm Yard Manure @ 5t ha^{-1} alone and six N: P_2O_5: K_2O fertiiser doses along with FYM @ 5t/ha T2- NPK 90: 45: 45 kg ha^{-1} T3- NPK 60: 30: 30 kg ha^{-1} T4- NPK 50: 25: 25 kg ha^{-1} T5- NPK 40: 20: 20 kg ha^{-1} T6- NPK 30: 15: 15 kg ha^{-1} T7- NPK 20: 10: 10

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kg ha^{-1} compared with an absolute control (without manures & fertilizers) (T8). Net plot size was 19.2m^2 [640 plants per plot]. Finger millet was transplanted at a spacing of 30cm x 10cm at 30 DAS. Application of Farm Yard Manure @ 5 t ha^{-1} along with different N: P_2O_5: K_2O levels resulted in higher plant height, leaf area index, dry matter production, grain yield and crude protein content in finger millet compared to absolute control. At all stages, the plants that received FYM @ 5 t ha^{-1} along with N: P_2O_5: K_2O levels of 90: 45: 45 kg ha^{-1}, 60: 30: 30 kg ha^{-1} and 50: 25: 25 kg ha^{-1} registered statistically comparable plant height and were superior compared to other levels of N P K. The plants which got the highest fertilizer dose (90:45:45 kg ha^{-1} N: P_2O_5: K_2O) had the highest LAI (2.91), dry matter production (3874kg/ha) and grain yield (1523 kg ha^{-1}) which was superior to all other N: P_2O_5: K_2O levels and absolute control. The highest B: C ratio (1.43), grain and straw yield in finger millet was recorded with application of Farm Yard Manure @ 5t ha^{-1} + 90:45:45 kg N: P_2O_5: K_2O ha^{-1} applied in two splits (at basal and 30 DAT) under north central laterites of Kerala.

Keywords: Nutrient management; eleusine; hima variety; ragi.

1. INTRODUCTION

Finger millet (*Eleusine coracana* L. Gaertn) commonly called as ragi, is an important millet crop grown in India. It is the third most important millet after sorghum and pearl millet with a cultivated area of 1.014 million hectares and production of 1.52 million tonnes, having a productivity of 1499 kg per hectare [1]. Finger millet is cultivated as a staple food crop all across the arid and semi-arid tropics of the world. As a part of improving the production and consumption of millets, Government of India declared the year 2018 as “National year of millets”. Also, to raise awareness and to direct policy attention to the nutritional and health benefits of millets and their suitability for cultivation under adverse and changing climatic conditions, United Nations declared 2023 as the ‘International Year of Millets (IYM 2023)’. Nutritionally, along with high carbohydrate content, finger millet is superior to wheat and rice, as a good source of cheap proteins, vitamins and minerals.

Finger millet can be recommended as a contingent crop due to its short duration and ability to withstand harsh weather condition. Being a C4 crop, it has higher water use efficiency and low input requirements. As this crop shows adapting ability to various ecological conditions, it can be integrated to different cropping systems. It is moderately tolerant to saline and acidic soils, but does not perform well under water logged conditions. Millets are one category of crops that are recommended to all Agro Ecological Units of Kerala [2].

Nutrient management is a pre requisite to enhance the crop productivity and several research studies have revealed that finger millet responds well to balanced nutrient application. Application of fertilizers along with farm yard manure (FYM) as an integrated approach enhanced the crop growth, development as well as increased the yield of finger millet [3]. The nutrient requirement of crops vary with several factors such as type of soil type, nutrient status, climatic conditions, soil moisture availability, varieties etc.

Though, studies on nutrient requirements of finger millet have been conducted at different parts of the country such studies have not been undertaken in Kerala. Currently several schemes on promotion of millet cultivation are being implemented in the state by the Department of Agriculture. Even though, many high yielding varieties with good production potential are available for cultivation, proper nutrient management is crucial in realizing higher yields. With this point of view, the present study was conducted with the objective of standardisation of nutrient requirement for high yielding variety of ragi “Hima” in North Central Laterites of Kerala.

2. MATERIALS AND METHODS

The trial was carried out in Agronomy Farm [which comes under Agro Ecological Unit 10: North Central Laterites] at Department of Agronomy, College of Agriculture, Vellanikkara located at 13°32'N latitude and 76°26'E longitude. Experiment was done during October 2021 to February 2022. The soil of the experimental site is sandy loam in texture, acidic in reaction with a pH of 5.78, low in organic carbon (0.4%), medium in available nitrogen (293 kg ha^{-1}) and potassium (258 kg ha^{-1}) and high in available phosphorus (103 kg ha^{-1}). The ragi variety ‘Hima’ (VR 936) used for this experiment was released in 2012 from ARS, Vizianagaram, Andhra Pradesh. It is a dull white/ cream seeded variety growing to a height of 100-115 cm with 115-120 days duration having an average grain yield of 2.8-3 t ha^{-1}.

The experiment was laid out in Randomized Block Design with 8 treatments and 3 replications. The experiment comprised of seven levels of fertiiser recommendations [1) Farm Yard Manure @ 5t ha^{-1} alone 2) Farm Yard Manure @ 5t ha^{-1} + NPK 90: 45: 45 kg ha^{-1} 3) Farm Yard Manure @ 5t ha^{-1} + NPK 60: 30: 30 kg ha^{-1} 4) Farm Yard Manure @ 5t ha^{-1} + NPK 50: 25: 25 kg ha^{-1} 5) Farm Yard Manure @ 5t ha^{-1} + NPK 40: 20: 20 kg ha^{-1} 6) Farm Yard Manure @ 5t ha^{-1} + NPK 30: 15: 15 kg ha^{-1} 7) Farm Yard Manure @ 5t ha^{-1} + NPK 20: 10: 10 kg ha^{-1}] compared with an absolute control (without manures & fertilisers).

Nursery beds were made and seeds of finger millet were broadcasted uniformly on the well-prepared fine seedbed at a seed rate of 5 kg ha^{-1}. Seed treatment with *Pseudomonas fluorescens* @ 10g kg^{-1} seed was done before sowing in nursery. The main field was ploughed thoroughly twice with disc plough, levelled and made into a fine tilth. Plots of 4.8 m x 4 m [19.2m^2] were made and separated by bunds. Transplanting was done at 30 DAS at a spacing of 30 cm x 10 cm with one seedling per hill. FYM @ 5 t ha^{-1} was incorporated in each plot except in absolute control. Fertilizers (Urea, Factamfos, Muriate of Potash) according to different treatments were applied as full P and K and half dose of recommended N as basal (except in treatments 1 & 8). Remaining N was applied at 30 DAT as urea. Protective irrigation was given for four days after transplanting for proper establishment of the seedlings in the main field. Later irrigation was given as and when necessary, depending on soil moisture status using sprinkler. Hand weeding was carried out at 30 DAT, before top dressing. The observations on growth parameters were recorded at 30 DAT, at flowering and at harvest stage. At harvest stage, the matured ear heads from each plot were harvested separately, and were sundried, threshed manually to collect seeds. Then the grains were winnowed, cleaned and sun dried to reduce moisture content to 12 per cent for safe storage. The straw from each plot was sundried and weighed separately for calculating straw yield and dry matter production at harvest. N content in grain was estimated by using KELPLUS digestion and distillation system [4] and the content obtained was multiplied with a factor of 6.25 to get crude protein content. Ca and Fe were estimated using Atomic Absorption Spectrophotometer (AAS). The data collected were subjected to analysis of variance using the statistical package "GRAPES" [5].

3. RESULTS AND DISCUSSION

3.1 Biometric Parameters

3.1.1 Plant height (cm)

Application of varying levels of NPK influenced the plant height at 30 days after transplanting (DAT), at flowering and at harvesting stage (Table 1). At 30 DAT, the plants that received FYM @ 5 t ha^{-1} along with different N: P_2O_5: K_2O levels of 90: 45: 45 kg ha^{-1}, 60: 30: 30 kg ha^{-1} and 50: 25: 25 kg ha^{-1} registered statistically comparable plant height and was found to be superior to absolute control. The plant height varied from 47.8 cm to 75.3 cm at 30 DAT. At flowering and harvesting stage also a similar trend was observed. At flowering, the plots treated with FYM @ 5 t ha^{-1} + fertilizer dose of 50:25:25 N: P_2O_5: K_2O kg ha^{-1} had taller plants (77.2 cm) and it was on par with plants applied with 90: 45: 45 N: P_2O_5: K_2O kg ha^{-1} (76.6 cm) and 60:30:30 N: P_2O_5: K_2O kg ha^{-1} (74.3 cm). The application of FYM @ 5 t ha^{-1} alone as well as absolute control resulted in lower plant height of 54.1 cm and 50.6 cm respectively and were comparable. At harvest, there was an increase of 146 per cent in plant height in higher fertilizer doses compared to that of absolute control. Similar to this a linear relationship between plant height and different levels of fertilizers in finger millet was reported [6]. This could be attributed to the increased availability of nutrients from soil which enabled higher uptake and better nutrient status inside the plant system and thereby higher crop growth parameters. In ragi, improved availability of primary nutrients resulted in higher root and shoot growth and optimal supply of these nutrients enhanced the photosynthetic area, which collectively contributed to higher vegetative development [7].

3.1.2 Leaf area index

The leaf area represents the photosynthetic surface available for food synthesis. Higher the leaf area higher will be the dry matter assimilation favourably influencing the growth parameters. This can further lead to a higher source to sink ratio also. There was a significant increase in LAI of the plants with an increase in

Table 1. Effect of treatments on plant height as influenced by NPK levels

Treatments	Plant height (cm)		
	30 DAT	**Flowering**	**Harvest**
FYM @ 5t ha^{-1} alone	51.61	54.17	56.10
FYM @ 5t ha^{-1} + NPK 90: 45: 45 kg ha^{-1}	75.33	76.63	77.90
FYM @ 5t ha^{-1} + NPK 60: 30: 30 kg ha^{-1}	72.35	74.37	76.96
FYM @ 5t ha^{-1} + NPK 50: 25: 25 kg ha^{-1}	72.44	77.23	79.06
FYM @ 5t ha^{-1} + NPK 40: 20: 20 kg ha^{-1}	64.55	66.33	68.53
FYM @ 5t ha^{-1} + NPK 30: 15: 15 kg ha^{-1}	64.21	67.30	69.40
FYM @ 5t ha^{-1} + PK 20: 10: 10 kg ha^{-1}	62.81	65.90	67.93
Absolute control (without manures & fertilisers)	47.81	50.60	52.36
SEm (±)	1.93	1.67	1.68
CD (0.05)	5.84	5.07	5.10

dosage of different N: P_2O_5: K_2O levels. The plants which got the highest fertilizer dose (90:45:45 kg ha^{-1} N: P_2O_5: K_2O) had the highest LAI (2.91), which was superior to all other N: P_2O_5: K_2O doses. The increase in LAI observed with higher levels of NPK application might be due to increased availability of nitrogen, which resulted in increased rate of leaf expansion, number of leaves coupled with better translocation and assimilation of nitrogen to the leaves [8] and [9] . Application of 60:30:30 kg NPK ha^{-1} was superior to 50:25:25 kg NPK ha^{-1} in terms of LAI. Nitrogen has significant role in cell division as well as cell elongation and is considered as one of the limiting factors for the growth and development of plant growth. N also plays an important role as an integral part of chlorophyll. Increase in the chlorophyll content enables the leaves to harvest higher amount of solar radiation which further contributes to growth and development of the crop. So, the early establishment of leaf area and the fast development of leaf and stem growth are greatly influenced by nitrogen [10]. Similarly, the use of inorganic phosphorus as fertilizer increased the P uptake which is essential for metabolic activities and the activation of several enzymes involved in the dark reaction during photosynthesis. Phosphorus is also an essential component of nucleic acids, amino acids, proteins and several co-enzymes. Being an integral component of ADP and ATP, it plays a significant role in providing energy. Similar to nitrogen, potassium nutrition is also crucial for the growth and development of cells. Potassium stimulates and controls ATPase enzyme in the cell membrane, which prompts hydrolase activation and cell wall weakening, resulting in increased cell growth [11]. In treatments that received 40:20:20 kg NPK ha^{-1}, 30:15:15 kg NPK ha^{-1} and 20:10:10 kg NPK ha^{-1}, there was no significant change in LAI and was statistically on par. Application of manure alone (T_1) as basal was found to be on par with absolute control with respect to LAI (2.12). There was an increase of 137% in LAI in the highest dose (90:45:45 kg NPK ha^{-1}) when compared to FYM alone.

3.1.3 Dry matter production (kg ha^{-1})

The dry matter production was recorded at 30 DAT, flowering and at harvest (Table 2). N: P_2O_5: K_2O application at different doses resulted in an increased dry matter production at different stages of plant growth. At 30 DAT, the application of 90: 45: 45 N: P_2O_5: K_2Okg ha^{-1} resulted in the highest dry matter production (840.71 kg ha^{-1}), which was significantly superior to other treatments. This was followed by the application of 60: 30: 30 N: P_2O_5: K_2O kg ha^{-1} (653 kg ha^{-1}). Application of 40:20:20 kg NPK ha^{-1} was statistically superior to 30:15:15 and 20:10:10 kg NPK ha^{-1}, whereas the lowest dry matter production was observed in absolute control (238 kg ha^{-1}).

Application of the highest dose of fertilizer (90:45:45 kg NPK ha^{-1}) along with FYM resulted in a statistically significant increase in dry matter accumulation (2813 kg ha^{-1}) than 60:30:30 N: P_2O_5: K_2O kg ha^{-1} (2187 kg ha^{-1}) at the flowering stage also The dry matter production observed in plants which got 50:25:25 N: P_2O_5: K_2O kg ha^{-1} and 40: 20: 20 N: P_2O_5: K_2O kg ha^{-1} was on par with each other followed by 30:15:15 and 20:10:10 kg ha^{-1}. Absolute control had the lowest dry matter production (803 kg ha^{-1}). At harvest, almost the same trend as that at flowering was observed with a dry matter production of 3874 kg ha^{-1} in 90:45:45 kg NPK ha^{-1} followed by 2973 kg ha^{-1} in 60:30:30 kg NPK ha^{-1}. The treatment which received 50:25:25 kg NPK ha^{-1}, 40:20:20

kg NPK ha^{-1} and 30:15:15 kg NPK ha^{-1} were statistically on par with respect to dry matter production with the lowest dry matter production in absolute control. Increased supply of primary nutrients might have increased the plant height, leaf growth, chlorophyll content and thereby photosynthetic efficiency which in turn enhanced the dry matter production in ragi.. This is in conformity with the findings of [12] and [13] where adequate supply of nutrients resulted in higher biomass production in ragi. The application of various doses of N: P_2O_5: K_2O fertilizers didn't significantly influence the flowering. Plants in almost all treatments attained 50% flowering in about 70-74 DAT.

3.2 Yield and Yield Attributes

3.2.1 Finger length (cm)

Finger length of ragi was not influenced by the application of different N:P_2O_5: K_2O levels and the average length of fingers was 5.7 cm.

3.2.2 Weight of grains per panicle (g)

Data on the weight of grains per panicle varied significantly between different fertilizer treatments. The N: P_2O_5: K_2O level of 90: 45: 45 kg ha^1 recorded the highest value for grain weight per panicle (6.15 g), which was statistically superior to others. All other doses of fertilizer except 20:10:10 kg NPK ha^{-1} were at par in weight of grains per panicle.

3.2.3 1000 grain weight (g)

1000 grain weight was not influenced by the application of different N: P_2O_5: K_2O levels. The average test weight was 2.75 g.

3.2.4 Grain yield (kg ha^{-1})

Grain yield varied significantly between different doses of fertilizers. The highest and statistically superior grain yield (1523 kg ha^{-1}) was recorded in 90: 45: 45 N: P_2O_5: K_2O kg ha^{-1} (Table 4). This was followed by grain yield by application of 60:30:30 N: P_2O_5: K_2O kg ha^{-1} (1154 kg ha^{-1}) and 50:25:25 N: P_2O_5: K_2O kg ha^{-1} (1079 kg ha^{-1}), both of which were comparable. This increase in yield indicates that higher nutrient use efficiency can be achieved with higher dose of NPK fertilizers. It can be attributed to increased uptake of nutrients and its adequate assimilation, which in turn led to vigorous plant growth and the synthesizing of carbohydrates and its transfer to the developing ear heads. Improved grain filling and thereby increased grain yield with nutrient management in ragi was also reported by [14]. Application of 90 kg N ha^{-1} and 40 kg P_2O_5 ha^{-1} produced highest grain and straw yield in finger millet [15]. Application of 40:20:20 kg N: P_2O_5: K_2O ha^{-1} and 30:15:15 kg N: P_2O_5: K_2O ha^{-1} were statistically on par with respect to grain yield and were statistically superior to FYM application alone, indicating higher nutrient requirement for high yielding variety of ragi.

3.2.5 Straw yield (kg ha^{-1})

Straw yield varied significantly with various N: P_2O_5: K_2O levels as in the case of grain yield (Table 4). Significantly superior straw yield (2568 kg ha^{-1}) was recorded in 90: 45: 45 N: P_2O_5: K_2O kg ha^{-1}. It was followed by 60:30:30 N: P_2O_5: K_2O kg ha^{-1} (2024 kg ha^{-1}) which was found to be on par with 40:20:20 kg N: P_2O_5: K_2O ha^{-1}. The lowest straw yield (770 kg ha^{-1}) was recorded in absolute control. Increase in grain and straw yield with increasing levels of nutrients has also been observed by [16,17] and [18] .

Table 2. Leaf area index and dry matter production of finger millet as influenced by NPK levels

Treatments	LAI	Dry matter production (kg ha^{-1})		
		30 DAT	Flowering	Harvest
FYM @ 5t ha^{-1} alone	2.12	287.69	967.40	1147.69
FYM @ 5t ha^{-1} + NPK 90: 45: 45 kg ha^{-1}	2.91	840.71	2813.54	3874.12
FYM @ 5t ha^{-1} + NPK 60: 30: 30 kg ha^{-1}	2.64	653.1	2186.99	2972.85
FYM @ 5t ha^{-1} + NPK 50: 25: 25 kg ha^{-1}	2.46	598.01	2006.63	2688.98
FYM @ 5t ha^{-1} + NPK 40: 20: 20 kg ha^{-1}	2.27	603.39	2021.30	2727.21
FYM @ 5t ha^{-1} + NPK 30: 15: 15 kg ha^{-1}	2.22	574.82	1925.92	2614.74
FYM @ 5t ha^{-1} + NPK 20: 10: 10 kg ha^{-1}	2.20	501.23	1680.25	2189.57
Absolute control (without manures & fertilisers)	2.13	238.40	802.87	888.80
SEm (±)	0.01	12.30	41.07	66.04
CD (0.05)	0.04	37.32	124.58	200.30

Table 3. Yield attributes of finger millet as influenced by NPK levels

Treatments	Finger length (cm)	Weight of grains per panicle (g)	1000 grain weight (g)
FYM @ 5t ha^{-1} alone	4.72	3.55	2.55
FYM @ 5t ha^{-1} + NPK 90: 45: 45 kg ha^{-1}	6.2	6.15	2.58
FYM @ 5t ha^{-1} + NPK 60: 30: 30 kg ha^{-1}	5.9	4.5	2.75
FYM @ 5t ha^{-1} + NPK 50: 25: 25 kg ha^{-1}	6.6	4.68	2.93
FYM @ 5t ha^{-1} + NPK 40: 20: 20 kg ha^{-1}	5.2	4.47	2.82
FYM @ 5t ha^{-1} + NPK 30: 15: 15 kg ha^{-1}	6.32	4.15	2.83
FYM @ 5t ha^{-1} + NPK 20: 10: 10 kg ha^{-1}	6.24	3.61	2.89
Absolute control (without manures & fertilisers)	4.72	2.68	2.75
SEm (±)	0.5	0.16	0.11
CD (0.05)	NS	0.48	NS

3.2.6 Harvest index

Application of 90: 45: 45 N: P_2O_5: K_2O kg ha^{-1}, 60: 30: 30 N: P_2O_5: K_2O kg ha^{-1} and 50: 25: 25 N: P_2O_5: K_2O kg ha^{-1} registered higher harvest index (0.37) than other treatments. However, significantly lowest harvest index (0.32) was recorded in absolute control.

3.3 Quality Parameters of Grain

3.3.1 Crude protein (%)

Crude protein content of ragi grain ranged from 8.47 to 10.55%. Crude protein content was higher in FYM @ 5t ha^{-1} + NPK 90: 45: 45 kg ha^{-1} (10.55 %) which was on par with NPK 60: 30: 30 kg ha^{-1} (9.58%), NPK 50: 25: 25 kg ha^{-1} (9.85%) and NPK 40: 20: 20 kg ha^{-1} (9.53%). The lowest protein in grains was recorded in absolute control (8.47%). [Table 5] There was an increase of 124 per cent in crude protein content in 90: 45: 45 N: P_2O_5: K_2O kg ha^{-1} compared to absolute control. It might be due to the increased supply of nitrogen nutrition, which in turn has an impact on endosperm enzymology and storage protein deposition. Protein synthesis is generated by biochemical modification of glutamate, glutamine, and an array of amino acids (of which nitrogen is the primary component), and so the availability of N within the plant and grain is positively and significantly associated with the crude protein. The present investigation agrees with the findings of [19] and [20] in finger millet.

3.3.2 Calcium content

The mean calcium content in finger millet grain was 426 mg 100 g^{-1}. Calcium content in finger millet was significantly influenced by different treatments. Application of FYM @ 5t ha^{-1} alone (T_1) recorded the highest calcium content (431.6 mg 100 g^{-1}). The lowest calcium content was observed in the application of 90: 45: 45 N: P_2O_5: K_2O kg ha^{-1} (T_2). [21] reported that increased uptake of K had negatively affected the calcium uptake. Similarly, cation like NH_4^+ also directly or indirectly depressed calcium ion uptake and

Table 4. Grain yield, straw yield and harvest index of finger millet as influenced by NPK levels

Treatments	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index
FYM @ 5t ha^{-1} alone	481.7	906.02	0.35
FYM @ 5t ha^{-1} + NPK 90: 45: 45 kg ha^{-1}	1523.3	2567.79	0.37
FYM @ 5t ha^{-1} + NPK 60: 30: 30 kg ha^{-1}	1154.1	2024.18	0.36
FYM @ 5t ha^{-1} + NPK 50: 25: 25 kg ha^{-1}	1078.7	1849.31	0.37
FYM @ 5t ha^{-1} + NPK 40: 20: 20 kg ha^{-1}	998.7	1926.54	0.34
FYM @ 5t ha^{-1} + NPK 30: 15: 15 kg ha^{-1}	995.3	1797.41	0.36
FYM @ 5t ha^{-1} + NPK 20: 10: 10 kg ha^{-1}	864.2	1566.94	0.35
Absolute control (without manures & fertilisers)	373.7	770.80	0.32
SEm (±)	21.30	39.50	0.002
CD (0.05)	64.60	119.82	0.007

Table 5. Crude protein, calcium and iron content in finger millet grain as influenced by NPK levels

Treatments	Crude protein (%)	Calcium content (mg 100 g^{-1})	Iron content (mg 100 g^{-1})
FYM @ 5t ha^{-1} alone	8.75	431.6	5.35
FYM @ 5t ha^{-1} + NPK 90: 45: 45 kg ha^{-1}	10.55	419.4	5.49
FYM @ 5t ha^{-1} + NPK 60: 30: 30 kg ha^{-1}	9.58	423.8	5.44
FYM @ 5t ha^{-1} + NPK 50: 25: 25 kg ha^{-1}	9.85	427.2	5.38
FYM @ 5t ha^{-1} + NPK 40: 20: 20 kg ha^{-1}	9.53	429.3	5.42
FYM @ 5t ha^{-1} + NPK 30: 15: 15 kg ha^{-1}	8.80	428.5	5.36
FYM @ 5t ha^{-1} + NPK 20: 10: 10 kg ha^{-1}	9.15	426.2	5.76
Absolute control (without manures & fertilisers)	8.47	429.5	5.31
SEm (±)	0.35	0.55	0.285
CD (0.05)	1.07	1.68	NS

distribution. This might be the reason for the reduced content of calcium in finger millet when higher dose of N: P_2O_5: K_2O was applied.

3.3.3 Iron content

The mean iron content in finger millet grain was 5.4 mg 100 g^{-1}. Different treatments didn't influence Fe content in grains.

4. CONCLUSION

The objective of the research programme was standardisation of nutrient requirement for high yielding variety of ragi "Hima" in North Central Laterites of Kerala and the results clearly indicate the necessity of nutrient management for realizing better productivity in high yielding varieties of ragi. The present study suggests that application of farm yard manure @ 5t ha^{-1} + NPK 90: 45: 45 kg ha^{-1} can be recommended for higher grain yield as well as straw yield in finger millet in North Central Laterites of Kerala.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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