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Bhimraj Sahu
M.Sc. Final Year, Dept. of Agronomy, BTC College of Agriculture and Research Station, Bilaspur, Chhattisgarh, India

TD Pandey
Professor, Dept. of Agronomy, BTC College of Agriculture and Research Station, Bilaspur, Chhattisgarh, India

Dinesh Pandey
Principal Scientist, Dept. of Agronomy, BTC College of Agriculture and Research Station, Bilaspur, Chhattisgarh, India

Yushma Sao
Scientist, Dept. of Soil Science & Agri. Chemistry, BTC College of Agriculture and Research Station, Bilaspur, Chhattisgarh, India

NK Chaure
Principal Scientist, Dept. of Agricultural Statistics, BTC College of Agriculture and Research Station, Bilaspur, Chhattisgarh, India

Puja Nayak
M.Sc. Final Year, Dept. of Agronomy, BTC College of Agriculture and Research Station, Bilaspur, Chhattisgarh, India

Ram Sahu
M.Sc. Final Year, Dept. of Agronomy, BTC College of Agriculture and Research Station, Bilaspur, Chhattisgarh, India

Aakanchha Baghel
M.Sc. Final Year, Dept. of Agronomy, BTC College of Agriculture and Research Station, Bilaspur, Chhattisgarh, India

Shikha Kumari
M.Sc. Final Year, Dept. of Agronomy, BTC College of Agriculture and Research Station, Bilaspur, Chhattisgarh, India

Corresponding Author:
Bhimraj Sahu
M.Sc. Final Year, Dept. of Agronomy, BTC College of Agriculture and Research Station, Bilaspur, Chhattisgarh, India

Effect of fertilizer levels and foliar application of NPK (19:19:19) on growth, yield and yield attributes of Kodo millet (*Paspalum scrobiculatum* L.)

Bhimraj Sahu, TD Pandey, Dinesh Pandey, Yushma Sao, NK Chaure, Puja Nayak, Ram Sahu, Aakanchha Baghel and Shikha Kumari

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Abstract
A field experiment entitled "Effect of fertilizer levels and foliar application of NPK (19:19:19) on growth, yield and yield attributes of Kodo millet (*Paspalum scrobiculatum* L.)" was conducted during the *kharif* season of 2025 at the Instructional Farm of BTC College of Agriculture and Research Station, Sarkanda, Bilaspur. The experiment was laid out in a Randomized Block Design (RBD) with three replications. The study comprised seven nutrient management treatments, *viz*., (T_1) Control, (T_2) 100 % RDF (60:40:30 kg ha^{-1} N, P, K), (T_3) 100 % RDF + N, P, K (19:19:19) Foliar Spray at 30 DAS, (T_4) 75% RDF + N, P, K (19:19:19) Foliar Spray at 30 DAS, (T_5) 75% RDF + N, P, K (19:19:19) Foliar Spray at 30 and 50 DAS, (T_6) 50% RDF + N, P, K (19:19:19) Foliar Spray at 30 DAS and (T_7) 50% RDF + N, P, K (19:19:19) Foliar Spray at 30 and 50 DAS. The study revealed that different nutrient management practices significantly affected the growth, yield attributes and yield of kodo millet. Among the treatments, T_3 – 100% RDF + NPK (19:19:19) foliar spray at 30 DAS consistently produced the highest plant height, dry matter production, number of tillers and effective tillers throughout the crop growth period. It was followed by T_2 – 100% RDF (60:40:30 kg ha^{-1} NPK) and T_5 – 75% RDF + NPK (19:19:19) foliar spray at 30 and 50 DAS, whereas the Control (T_1) recorded the lowest values for all growth parameters. Similarly, yield attributes and yield parameters, namely panicle length, panicle weight, test weight, grain yield and straw yield, were markedly influenced by nutrient management. The highest panicle length (10.79 cm), panicle weight (8.78 g), grain yield (2329.06 kg ha^{-1}) and straw yield (5418.00 kg ha^{-1}) were obtained under T_3 – 100% RDF + NPK (19:19:19) foliar spray at 30 DAS, while the Control (T_1) recorded the lowest grain yield (906.81 kg ha^{-1}) and straw yield (2309.74 kg ha^{-1}). The highest cost of cultivation (₹ 33,631.00 ha^{-1}), gross return (₹ 85,365.92 ha^{-1}), net return (₹ 51,734.92 ha^{-1}) and benefit: cost ratio (2.54) were recorded under treatment T_3 – 100% RDF + NPK (19:19:19) foliar spray at 30 DAS. However, the lowest gross return (₹ 33,636.40 ha^{-1}), net return (₹ 7,955.40 ha^{-1}) and B:C ratio (1.31) were recorded under T_1 – Control. Soil pH and organic carbon were not significantly affected by the treatments; however, T_3 recorded the lowest soil pH (6.80) and highest organic carbon content (0.55%), while T_1 – Control recorded the highest soil pH (7.30) and lowest organic carbon content (0.51%), indicating a slight improvement in soil fertility under integrated nutrient management.

Keywords: Kodo millet, panicle, organic carbon, tillers, fertility and soil

Introduction
Kodo millet (*Paspalum scrobiculatum* L.) is an important nutri-cereal predominantly grown in India, mainly under low-fertility soils for both food and fodder purposes. It is commonly known by various names such as ditch millet, rice grass, cowgrass, varagu and kodra. Owing to its high drought tolerance, kodo millet is well suited for cultivation in low rainfall and rainfed regions. Millets are increasingly recognized as alternative cereals due to their superior nutritional qualities and their ability to perform well under low input conditions (Kapil and Singh, 2023) [18]. In India, minor millets are cultivated over an area of about 4.58 lakh hectares, with a total production of 3.70 lakh tonnes and an average productivity of 809 kg ha^{-1}. The major small millet–growing states include Madhya Pradesh, Chhattisgarh, Uttarakhand, Karnataka, Maharashtra, and Tamil Nadu. Millet cultivation gradually declined following the Green Revolution due to relatively lower productivity and reduced preference among the farming community. Additionally, changing food consumption patterns, driven by

increased cultivation and availability of cereals and pulses, contributed to the decline in millet consumption. However, in recent years, consumer interest in millets has been increasing owing to the rising prevalence of diabetes worldwide. Regular consumption of kodo millet has been reported to help in preventing cardiovascular diseases and in reducing blood pressure and cholesterol levels (Singh *et al*., 2023) [18]. Kodo millet (*Paspalum scrobiculatum* L.) is an annual cereal crop primarily cultivated in India and Nepal and is also grown in countries such as the Philippines, Indonesia, Vietnam, Thailand and parts of West Africa, where it is believed to have originated. In India, the major kodo millet–growing states include Madhya Pradesh, Chhattisgarh, Maharashtra, Tamil Nadu and Karnataka (Anonymous, 2023) [1]. The crop is cultivated over an area of about 1.96 lakh hectares, with an annual production of 3.86 lakh tonnes and an average productivity of 429 kg ha^{-1} (Anonymous, 2025) [3]. Kodo millet is important small millet grown for grain, food and fodder, particularly in tribal-dominated regions.

Nutritionally, kodo millet contains approximately 9.8 g protein, 3.6 g fat, 3.3 g ash, 5.2 g crude fibre, 66.6 g carbohydrates and 353 kcal of energy per 100 g of grain (Anonymous, 2023) [1]. It is characterized by low fat content and high levels of fibre, carbohydrates and protein. Kodo millet is mainly cultivated as a sole crop and provides higher net returns compared to other minor millets due to its relatively higher productivity, favorable market price and additional fodder value. Moreover, the iron content of kodo millet ranges from 25.86 to 39.60 ppm, highlighting its nutritional significance (Sneha *et al*., 2025) [14]. Kodo millet is well suited for individuals with gluten intolerance, as it is naturally gluten free. Owing to its higher lecithin content, kodo millet is easily digestible and supports the proper functioning of the nervous system. Regular consumption of kodo millet is particularly beneficial for postmenopausal women suffering from cardiovascular disorders, including hypertension and elevated cholesterol levels. The crop is rich in antioxidants, which help protect against oxidative stress and assist in maintaining stable blood glucose levels in patients with type 2 diabetes. Kodo millet has also been reported to be helpful in managing conditions such as asthma, migraines, high blood pressure, heart ailments, atherosclerosis and diabetic heart disease. Consequently, research on millet-based products is gaining increasing importance to harness their health benefits, especially in view of the rising population in developing countries.

Fertilizers play a crucial role in enhancing crop yield and quality, particularly with the advent of high-yielding varieties that respond effectively to nutrient inputs. Most crops, including kodo millet, require substantial amounts of inorganic fertilizers for optimal growth. Crop productivity, such as in rice, largely depends on soil properties and the availability of essential nutrients, including nitrogen, phosphorus, potassium, sulphur and zinc. Among these, nitrogen is particularly critical for achieving higher yields in kodo millet. Nitrogen plays a vital role in the synthesis of chlorophyll, which is essential for photosynthesis, making it one of the most important nutrients for plant growth. It imparts a healthy green color to leaves and promotes vigorous vegetative development. In kodo millet, nitrogen is particularly critical during early vegetative growth and panicle initiation stages. Application of nitrogen during early vegetative stages enhances tillering and overall vegetative growth, contributing to higher yield, while nitrogen application at panicle initiation or early booting improves grain size and weight per panicle. Nitrogen is also a key component of various enzymes and proteins that regulate and catalyze plant metabolic processes. A balanced supply of nitrogen has been reported to positively influence growth and yield parameters in kodo millet, including panicle length, dry matter accumulation and number of panicles (Kashyap *et al*., 2025) [10]. Foliar application of nutrients is considered more efficient than soil application, as it requires smaller amounts of fertilizer to meet crop nutrient needs. With the rising cost of fertilizers, foliar feeding provides a cost-effective strategy to improve cereal crop yields. In recent years, Maharashtra has experienced dry spells of 15–35 days during the *kharif* season (Anonymous, 2023) [1], which have adversely affected crop growth and productivity. Foliar nutrition can enhance drought tolerance by minimizing water loss through evapotranspiration, thereby helping crops withstand the impact of such dry periods.

Materials and methods

A field experiment titled "Effect of fertilizer levels and foliar application of NPK (19:19:19) on growth, yield and yield attributes of Kodo millet (*Paspalum scrobiculatum* L.)" was carried out during the *kharif* season of 2025 at the Instructional Farm of Barrister Thakur Chhedilal College of Agriculture and Research Station, Sarkanda, Bilaspur. The experiment was conducted using Randomized Block Design (RBD) with three replications. A total of seven nutrient management treatments were included, *viz*., (T1) Control, (T2) 100 % RDF (60:40:30 kg ha^{-1} N, P, K), (T3) 100 % RDF + N, P, K (19:19:19) Foliar Spray at 30 DAS, (T4) 75% RDF + N, P, K (19:19:19) Foliar Spray at 30 DAS, (T5) 75% RDF + N, P, K (19:19:19) Foliar Spray at 30 and 50 DAS, (T6) 50% RDF + N, P, K (19:19:19) Foliar Spray at 30 DAS and (T7) 50% RDF + N, P, K (19:19:19) Foliar Spray at 30 and 50 DAS. Observations on plant population, plant height, number of tillers & effective tillers, dry matter accumulation and panicle weight, panicle length test weight, grain yield, straw yield and harvest index of kodo millet crop were recorded at harvest and statistically analyzed. Economics of kodo millet as a net return, gross return and benefit cost ratio were also worked out.

Results and discussions

Growth Parameters

1. Growth parameters of kodo millet recorded at 30 DAS, 60 DAS and at harvest showed significant variation among the treatments. Results revealed that under (T_3) 100% RDF + N, P, K (19:19:19) foliar spray at 30 DAS, the highest plant height of 23.37 cm, 79.31 cm and 113.49 cm at 30 DAS, 60 DAS and harvest, respectively, and the highest dry matter production of 1.96, 11.76 and 18.72 g m^{-2} at corresponding stages were recorded. This treatment was statistically at par with (T_2) 100% RDF (60:40:30 kg ha^{-1} NPK), which recorded plant height of 23.13, 77.02 and 110.06 cm and dry matter production of 1.87, 11.26 and 17.42 g m^{-2}, and (T_5) 75% RDF + N, P, K (19:19:19) foliar spray at 30 and 50 DAS, which recorded plant height of 20.75, 74.49 and 107.69 cm and dry matter production of 1.83, 10.78 and 16.99 g m^{-2}. The lowest plant height (15.64, 51.30 and 71.04 cm) and dry matter production

(1.13, 6.78 and 10.85 g m^{-2}) were recorded under (T_1) Control.

2. The number of tillers and effective tillers were significantly influenced by nutrient management practices. The maximum number of tillers under (T_3) 100% RDF + N, P, K (19:19:19) foliar spray at 30 DAS was 55.97 and 128.73 m^{-2} at 30 DAS and 60 DAS, respectively, along with the highest number of effective tillers (125.65 m^{-2}). This was followed by (T_2) 100% RDF (55.11 and 124.93 m^{-2}; effective tillers 122.09 m^{-2}) and (T_5) 75% RDF + N, P, K (19:19:19) foliar spray at 30 and 50 DAS (50.64 and 120.41 m^{-2}; effective tillers 118.23 m^{-2}). The lowest number of tillers (39.04 and 78.17 m^{-2}) and effective tillers (74.21 m^{-2}) were recorded under (T_1) Control.
3. The crop growth rate (CGR) and relative growth rate (RGR) of kodo millet were calculated for intervals 0–30, 30–60 DAS and 60 DAS to harvest. The highest CGR under (T_3) 100% RDF + N, P, K (19:19:19) foliar spray at 30 DAS was 0.065, 0.327 and 0.235 g day^{-1} $plant^{-1}$, while the highest RGR under the same treatment was 0.0097, 0.0263 and 0.0072 g g^{-1} $plant^{-1}$ at respective intervals. This was followed by (T_2) 100% RDF (60:40:30 kg ha^{-1} NPK) and (T_5) 75% RDF + N, P, K (19:19:19) foliar spray at 30 and 50 DAS treatments. The lowest CGR (0.038, 0.188 and 0.136 g day^{-1} $plant^{-1}$) and lowest RGR (0.0018, 0.0254 and 0.0063 g g^{-1} $plant^{-1}$) were consistently recorded under (T_1) Control.
4. Yield attributes of kodo millet *viz*., panicle length, panicle weight and test weight, were influenced by different fertilizer levels and foliar application of NPK (19:19:19). The maximum panicle length (10.79 cm) and panicle weight (8.78 g) were recorded under (T_3) 100% RDF + N, P, K (19:19:19) foliar spray at 30 DAS, which were statistically at par with (T_2) 100% RDF (10.39 cm and 8.14 g) and (T_5) 75% RDF + N, P, K (19:19:19) foliar spray at 30 and 50 DAS (10.26 cm and 7.96 g). The test weight was not significantly influenced by the treatments; however, the highest numerical value (4.94 g) was recorded under T_3, while the lowest (4.42 g) was recorded under T_1 Control.
5. Grain yield and straw yield differed significantly among the treatments. The highest grain yield (2329.06 kg ha^{-1}) and straw yield (5418.00 kg ha^{-1}) were recorded under (T_3) 100% RDF + N, P, K (19:19:19) foliar spray at 30 DAS, which was statistically at par with (T_2) 100% RDF (2112.42 kg ha^{-1} grain and 5180.71 kg ha^{-1} straw) and (T_5) 75% RDF + N, P, K (19:19:19) foliar spray at 30 and 50 DAS (2096.12 kg ha^{-1} grain and 4999.11 kg ha^{-1} straw). The lowest grain yield (906.81 kg ha^{-1}) and straw yield (2309.74 kg ha^{-1}) were recorded under (T_1) Control. Harvest index did not differ significantly among the treatments, although the highest numerical value (29.69%) was recorded under T_3.
6. There was no significant variation in soil pH and organic carbon after harvest of kodo millet due to different fertilizer levels and foliar application of NPK (19:19:19). The lowest soil pH (6.80) was recorded under (T_3) 100% RDF + N, P, K (19:19:19) foliar spray at 30 DAS, followed by (T_2) 100% RDF (60:40:30 kg ha^{-1} N, P, K) and (T_5) 75% RDF + N, P, K (19:19:19) foliar spray at 30 and 50 DAS (6.90), while (T_4) 75% RDF + N, P, K (19:19:19) foliar spray at 30 DAS and (T_7) 50% RDF + N, P, K (19:19:19) foliar spray at 30 and 50 DAS recorded a pH of 7.00. The highest soil pH (7.30) was recorded under (T_1) Control, followed by (T_6) 50% RDF + N, P, K (19:19:19) foliar spray at 30 DAS (7.10). The highest organic carbon content (0.55%) was recorded under (T_3) 100% RDF + N, P, K (19:19:19) foliar spray at 30 DAS, followed by (T_2) 100% RDF (60:40:30 kg ha^{-1} N, P, K) and (T_5) 75% RDF + N, P, K (19:19:19) foliar spray at 30 and 50 DAS (0.54%), while (T_4) 75% RDF + N, P, K (19:19:19) foliar spray at 30 DAS and (T_7) 50% RDF + N, P, K (19:19:19) foliar spray at 30 and 50 DAS recorded 0.53%, followed by (T_6) 50% RDF + N, P, K (19:19:19) foliar spray at 30 DAS (0.52%), whereas the minimum organic carbon content (0.51%) was recorded under (T_1) Control.
7. Economic analysis revealed that the highest cost of cultivation (₹ 33,631.00 ha^{-1}) was incurred under (T_3) 100% RDF + N, P, K (19:19:19) foliar spray at 30 DAS, followed by T_5 (₹ 32,821.00 ha^{-1}) and T_2 (₹ 32,689.00 ha^{-1}). The same treatment also recorded the highest gross return (₹ 85,365.92 ha^{-1}), net return (₹ 51,734.92 ha^{-1}) and benefit ratio (2.54), followed by T_2 with gross return of ₹ 77,959.84 ha^{-1}, net return of ₹ 45,270.84 ha^{-1} and B ratio of 2.38, and T_5 with gross return of ₹ 77,070.00 ha^{-1}, net return of ₹ 44,249.00 ha^{-1} and B ratio of 2.35. The minimum gross return (₹ 33,636.40 ha^{-1}), net return (₹ 7,955.40 ha^{-1}) and benefit ratio (1.31) were obtained under (T_1) Control.

Table 1: Effect of fertilizer levels and foliar application of NPK (19:19:19) on plant height of Kodo millet

Treatment details	Plant height (cm)		
	30 DAS	60 DAS	At harvest
T_1 - Control	15.64	51.3	71.0362
T_2 - 100 % RDF (60:40:30 kg ha^{-1} N, P, K)	23.13	77.02	110.059
T_3 - 100 % RDF + N, P, K (19:19:19) Foliar Spray at 30 DAS	23.37	79.31	113.49
T_4 - 75% RDF + N, P, K (19:19:19) Foliar Spray at 30 DAS	20.30	68.60	95.5308
T_5 - 75% RDF + N, P, K (19:19:19) Foliar Spray at 30 and 50 DAS	20.75	74.49	107.689
T_6 - 50% RDF + N, P, K (19:19:19) Foliar Spray at 30 DAS	18.41	58.19	82.1299
T_7 - 50% RDF + N, P, K (19:19:19) Foliar Spray at 30 and 50 DAS	18.84	63.90	93.4206
SEm (±)	0.77	1.84	3.55
CD (5%)	2.36	5.61	10.94

Table 2: Effect of fertilizer levels and foliar application of NPK (19:19:19) on number of tillers of Kodo millet

Treatment details	Number of tillers (m^{-2})		Number of effective tillers (m^{-2})
	30 DAS	60 DAS	
T_1 - Control	39.04	78.17	74.21
T_2 - 100 % RDF (60:40:30 kg ha^{-1} N, P, K)	55.11	124.93	122.09
T_3 - 100 % RDF + N, P, K (19:19:19) Foliar Spray at 30 DAS	55.97	128.73	125.65
T_4 - 75% RDF + N, P, K (19:19:19) Foliar Spray at 30 DAS	50.21	111.18	108.84
T_5 - 75% RDF + N, P, K (19:19:19) Foliar Spray at 30 and 50 DAS	50.64	120.41	118.23
T_6 - 50% RDF + N, P, K (19:19:19) Foliar Spray at 30 DAS	45.29	97.15	94.84
T_7 - 50% RDF + N, P, K (19:19:19) Foliar Spray at 30 and 50 DAS	45.92	106.87	105.87
SEm (±)	1.26	2.81	2.57
CD (5%)	3.94	8.66	7.95

Table 3: Effect of fertilizer levels and foliar application of NPK (19:19:19) on dry matter production of Kodo millet

Treatment details	Dry matter production (g m^{-2})		
	30 DAS	60 DAS	At harvest
T_1 - Control	1.13	6.78	10.85
T_2 - 100 % RDF (60:40:30 kg ha^{-1} N, P, K)	1.87	11.26	17.42
T_3 - 100 % RDF + N, P, K (19:19:19) Foliar Spray at 30 DAS	1.96	11.76	18.72
T_4 - 75% RDF + N, P, K (19:19:19) Foliar Spray at 30 DAS	1.75	9.18	14.69
T_5 - 75% RDF + N, P, K (19:19:19) Foliar Spray at 30 and 50 DAS	1.83	10.78	16.99
T_6 - 50% RDF + N, P, K (19:19:19) Foliar Spray at 30 DAS	1.42	7.52	12.03
T_7 - 50% RDF + N, P, K (19:19:19) Foliar Spray at 30 and 50 DAS	1.47	8.82	14.11
SEm (±)	0.05	0.39	0.62
CD (5%)	0.15	1.19	1.92

Table 4: Effect of fertilizer levels and foliar application of NPK (19:19:19) on panicle length, panicle weight and test weight of Kodo millet

Treatment details	Panicle length (cm)	Panicle weight (g)	Test weight (g)
T_1 - Control	6.30	4.78	4.42
T_2 - 100 % RDF (60:40:30 kg ha^{-1} N, P, K)	10.39	8.14	4.85
T_3 - 100 % RDF + N, P, K (19:19:19) Foliar Spray at 30 DAS	10.79	8.78	4.94
T_4 - 75% RDF + N, P, K (19:19:19) Foliar Spray at 30 DAS	9.392	6.85	4.68
T_5 - 75% RDF + N, P, K (19:19:19) Foliar Spray at 30 and 50 DAS	10.26	7.96	4.80
T_6 - 50% RDF + N, P, K (19:19:19) Foliar Spray at 30 DAS	8.11	5.70	4.53
T_7 - 50% RDF + N, P, K (19:19:19) Foliar Spray at 30 and 50 DAS	8.80	6.63	4.61
SEm (±)	0.21	0.29	0.27
CD (5%)	0.65	0.90	NS

Table 5: Effect of fertilizer levels and foliar application of NPK (19:19:19) on grain yield, straw yield and harvest index of Kodo millet

Treatment details	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index (%)
T_1 - Control	906.81	2309.74	28.16
T_2 - 100 % RDF (60:40:30 kg ha^{-1} N, P, K)	2112.42	5180.71	29.24
T_3 - 100 % RDF + N, P, K (19:19:19) Foliar Spray at 30 DAS	2329.06	5418.00	29.69
T_4 - 75% RDF + N, P, K (19:19:19) Foliar Spray at 30 DAS	1812.30	4342.03	28.98
T_5 - 75% RDF + N, P, K (19:19:19) Foliar Spray at 30 and 50 DAS	2096.12	4999.11	29.19
T_6 - 50% RDF + N, P, K (19:19:19) Foliar Spray at 30 DAS	1511.21	3655.08	28.87
T_7 - 50% RDF + N, P, K (19:19:19) Foliar Spray at 30 and 50 DAS	1768.88	4280.61	28.94
SEm (±)	83.23	150.62	-
CD (5%)	256.46	464.11	-

Table 6: Effect of fertilizer levels and foliar application of NPK (19:19:19) on available NPK in soil

Treatment details	Available nutrient (kg ha^{-1})		
	N	P_2O_5	K_2O
T_1 - Control	144.36	8.45	184.16
T_2 - 100 % RDF (60:40:30 kg ha^{-1} N, P, K)	196.27	12.24	264.64
T_3 - 100 % RDF + N, P, K (19:19:19) Foliar Spray at 30 DAS	205.84	12.76	275.83
T_4 - 75% RDF + N, P, K (19:19:19) Foliar Spray at 30 DAS	173.92	10.78	233.05
T_5 - 75% RDF + N, P, K (19:19:19) Foliar Spray at 30 and 50 DAS	188.06	11.66	252.00
T_6 - 50% RDF + N, P, K (19:19:19) Foliar Spray at 30 DAS	165.28	10.25	221.48
T_7 - 50% RDF + N, P, K (19:19:19) Foliar Spray at 30 and 50 DAS	169.45	10.51	227.06
SEm (±)	3.60	0.26	5.20
CD (5%)	11.08	0.79	16.02

Table 7: Effect of fertilizer levels and foliar application of NPK (19:19:19) on organic carbon and pH in soil

Treatment details	Organic carbon	pH
T_1 - Control	0.51	7.30
T_2 - 100 % RDF (60:40:30 kg ha^{-1} N, P, K)	0.54	6.90
T_3 - 100 % RDF + N, P, K (19:19:19) Foliar Spray at 30 DAS	0.55	6.80
T_4 - 75% RDF + N, P, K (19:19:19) Foliar Spray at 30 DAS	0.53	7.00
T_5 - 75% RDF + N, P, K (19:19:19) Foliar Spray at 30 and 50 DAS	0.54	6.90
T_6 - 50% RDF + N, P, K (19:19:19) Foliar Spray at 30 DAS	0.52	7.10
T_7 - 50% RDF + N, P, K (19:19:19) Foliar Spray at 30 and 50 DAS	0.53	7.00
SEm (±)	0.02	0.26
CD (5%)	NS	NS

Table 8: Effect of fertilizer levels and foliar application of NPK (19:19:19) on economics of Kodo millet cultivation

Treatment details	Cost of cultivation (₹ ha^{-1})	Gross return (₹ ha^{-1})	Net return (₹ ha^{-1})	B:C ratio
T_1 - Control	25681.00	33636.40	7955.40	1.31
T_2 - 100 % RDF (60:40:30 kg ha^{-1} N, P, K)	32689.00	77959.84	45270.84	2.38
T_3 - 100 % RDF + N, P, K (19:19:19) Foliar Spray at 30 DAS	33631.00	85365.92	51734.92	2.54
T_4 - 75% RDF + N, P, K (19:19:19) Foliar Spray at 30 DAS	31879.00	66683.20	34804.20	2.09
T_5 - 75% RDF + N, P, K (19:19:19) Foliar Spray at 30 and 50 DAS	32821.00	77070.00	44249.00	2.35
T_6 - 50% RDF + N, P, K (19:19:19) Foliar Spray at 30 DAS	30127.00	55662.16	25535.16	1.85
T_7 - 50% RDF + N, P, K (19:19:19) Foliar Spray at 30 and 50 DAS	31069.00	65164.36	34095.36	2.10

Conclusion

The results showed that growth parameters, *viz*., plant height, dry matter production, number of tillers and effective tillers were significantly influenced by nutrient management practices. The highest plant height, dry matter production, number of tillers and effective tillers at respective stages were found to be higher under treatment T_3 – 100% RDF + NPK (19:19:19) foliar spray at 30 DAS, followed by T_2 – 100% RDF (60:40:30 kg ha^{-1} NPK) and T_5 – 75% RDF + NPK (19:19:19) foliar spray at 30 and 50 DAS, whereas the lowest values were recorded under T_1 – Control. The yield attributes and yield parameters, *viz*., panicle length, panicle weight, test weight, grain yield and straw yield were significantly influenced by different nutrient management. The maximum panicle length (10.79 cm) and panicle weight (8.78 g) along with highest grain yield (2329.06 kg ha^{-1}) and straw yield (5418.00 kg ha^{-1}) were recorded under treatment T_3 – 100% RDF + NPK (19:19:19) foliar spray at 30 DAS, while the lowest grain yield (906.81 kg ha^{-1}) was recorded under T_1 – Control. The highest cost of cultivation (₹ 33,631.00 ha^{-1}), gross return (₹ 85,365.92 ha^{-1}), net return (₹ 51,734.92 ha^{-1}) and benefit: cost ratio (2.54) were recorded under treatment T_3 – 100% RDF + NPK (19:19:19) foliar spray at 30 DAS. However, the lowest gross return (₹ 33,636.40 ha^{-1}), net return (₹ 7,955.40 ha^{-1}) and benefit ratio (1.31) were recorded under T_1 – Control. The soil properties, *viz*., soil pH and organic carbon content after harvest did not vary significantly among treatments; however, slight improvement in soil fertility status was observed under integrated nutrient management practices.

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