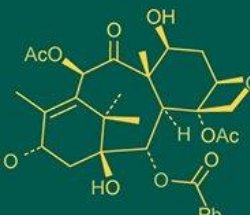
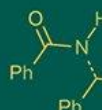


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Influence of Nutrient Levels on Growth and Yield Performance of Foxtail Millet (*Setaria italica* L.) Varieties

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Abstract

A field experiment was conducted during *rabi* 2025-26 at Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra, to evaluate the influence of nutrient levels on growth and yield performance of foxtail millet (*Setaria Italica* L.) varieties. The experiment was laid out in a Factorial Randomized Block Design with four nutrient levels and three varieties, replicated three times. Nutrient treatments comprised N₀: absolute control, N₁: 100% RDF (40:20:20 N:P₂O₅:K₂O kg ha⁻¹), N₂: 125% RDF (50:25:25 N:P₂O₅:K₂O kg ha⁻¹) and N₃: 150% RDF (60:30:30 N:P₂O₅:K₂O kg ha⁻¹). The varieties were V₁: PDKV Yashashree, V₂: KOPFX-2107 and V₃: DHFT 109-3. Nutrient application significantly improved growth and yield attributes. N₃ recorded the highest plant height, leaf area, dry matter accumulation, grain yield and straw yield, while N₂ was generally comparable for several parameters. Among varieties, KOPFX-2107 recorded superior vegetative growth and the highest straw yield, whereas PDKV Yashashree recorded the highest grain yield and harvest index. The interaction between nutrient levels and varieties was non-significant for growth parameters but significant for grain and straw yield. Overall, 150% RDF in combination with PDKV Yashashree showed the most promising performance for grain production under irrigated *rabi* conditions.

Keywords: Foxtail millet, nutrient levels, varieties, RDF, grain yield, straw yield, irrigated *rabi*

1. Introduction

Foxtail millet (*Setaria italica* L.) is an important small millet valued for its short duration, adaptability, nutritional quality and resilience to moisture stress. Its suitability for diverse agro-climatic conditions and relatively low water requirement make it a promising crop for cereal diversification and climate-resilient agriculture (Xing *et al.*, 2023) [13].

Despite its adaptability, productivity of foxtail millet is influenced considerably by nutrient availability. Balanced application of nitrogen, phosphorus and potassium promotes vegetative growth, leaf development, tillering, biomass accumulation and reproductive development. Nitrogen is particularly important for canopy development and biomass production, whereas phosphorus and potassium contribute to root development, energy metabolism, water regulation and assimilate translocation (Li *et al.*, 2022) [4].

Varietal selection is equally important because foxtail millet varieties differ in plant architecture, biomass production, yield potential and nutrient-use efficiency (Ramyasri *et al.*, 2018) [7]. Information regarding the response of recently developed varieties to enhanced nutrient levels under irrigated *rabi* conditions is comparatively limited. Therefore, the present investigation was undertaken to evaluate the response of foxtail millet varieties to different nutrient levels with respect to growth, yield, nutrient uptake, quality, nutrient-use efficiency and economic returns.

2. Material and Methods

The field experiment was conducted during *rabi* 2025-26 at the AICRP on Weed Management Field, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra. The experiment was laid out in Factorial Randomized Block Design with three replications comprising four nutrient levels and three foxtail millet varieties.

The nutrient treatments were N₀: absolute control, N₁: 100% RDF (40:20:20 N:P₂O₅:K₂O kg ha⁻¹), N₂: 125% RDF (50:25:25 N:P₂O₅:K₂O kg ha⁻¹) and N₃: 150% RDF (60:30:30 N:P₂O₅:K₂O kg ha⁻¹). The varieties evaluated were V₁: PDKV Yashashree, V₂: KOPFX-2107 and V₃: DHFT 109-3. The crop was sown on 2 December 2025 at a spacing of 30 × 10 cm with a seed rate of 10 kg ha⁻¹ and maintained under irrigated conditions. The experimental soil was clayey, slightly alkaline, medium in organic carbon, low in available nitrogen, medium in available phosphorus and high in available potassium.

Observations on plant height, number of tillers, leaf area, dry matter accumulation, yield attributes, grain yield, straw yield and harvest index were recorded at appropriate growth stages. Nutrient uptake, post-harvest soil fertility, quality parameters, nutrient-use efficiency and economics were also determined using standard procedures. The experimental data were subjected to analysis of variance, and treatment means were compared using the critical difference at the 5% level of significance.

3. Results and Discussion

3.1 Growth attributes

3.1.1 Plant height (cm)

Plant height increased progressively with increasing nutrient levels. N₃ recorded the maximum plant height at 30, 60, 90 DAS and harvest (30.62, 111.56, 150.14 and 154.51 cm, respectively), and was generally at par with N₂. The minimum plant height was recorded under N₀. The improved growth under higher nutrient availability may be attributed mainly to enhanced nitrogen supply, which promotes cell division, cell expansion and vegetative development. These results are consistent with those reported by Ramyasri *et al.* (2019) [6] and Jyothiet *al.* (2016) [3] in foxtail millet.

Among varieties, V₂ (KOPFX-2107) recorded the highest plant height at all growth stages, followed by V₃ and V₁, indicating genetic differences in vegetative growth potential. These results align with the studies conducted by Ramyasri *et al.* (2017) and Jyothi *et al.* (2016) [3] in foxtail millet. The interaction between nutrient levels and varieties was non-significant.

Table 1: Plant height (cm) of foxtail millet at various growth stages as influenced by nutrient levels and varieties

Treatments	Plant height (cm)			
	30DAS	60DAS	90DAS	At harvest
Factor A: Nutrient levels				
N ₀ : Absolute control	26.58	87.34	124.73	125.08
N ₁ : 100% RDF	27.04	105.04	146.47	150.87
N ₂ : 125% RDF	30.40	110.84	150.00	153.89
N ₃ : 150% RDF	30.62	111.56	150.14	154.51
SE (m)±	0.93	1.52	1.11	1.13
CD at 5%	2.73	4.45	3.25	3.33
Factor B: Varieties				
V ₁ : PDKV Yashashree	27.58	101.78	140.37	144.55
V ₂ : KOPFX- 2107	30.40	106.68	144.78	148.14
V ₃ : DHFT 109-3	28.00	102.63	143.37	145.57
SE (m)±	0.81	1.31	0.96	0.98
CD at 5%	2.36	3.85	2.82	2.88
Int. A X B				
SE (m)±	1.61	2.63	1.92	1.97
CD at 5%	NS	NS	NS	NS
GM	28.66	103.70	142.84	146.09

3.1.2 Number of tillers (m⁻²)

The number of tillers increased significantly with increasing nutrient levels, with N₃ (150% RDF) recording the highest tiller production. This may be attributed to improved nutrient availability, particularly nitrogen, which favoured tiller initiation and vegetative growth. These findings are in agreement with Raviraja *et al.* (2020) in foxtail millet and Divyashree *et al.* (2018) in little millet.

Among varieties, KOPFX-2107 (V₂) recorded the highest number of tillers, indicating its superior genetic potential for tillering. Varietal differences were significant during the earlier growth stages but became non-significant at harvest. Similar varietal differences in tillering have been reported by Ravindranadh *et al.* (2019) in foxtail millet. The nutrient level × variety interaction was non-significant, indicating a similar response of varieties to increasing nutrient levels.

Table 2: Total number of tillers (m⁻²) of foxtail millet at various growth stages as influenced by nutrient levels and varieties

Treatments	Total number of tillers (m ⁻²)			
	30DAS	60DAS	90DAS	At harvest
Factor A: Nutrient levels				
N ₀ : Absolute control	39.56	57.00	63.78	66.67
N ₁ : 100% RDF	51.78	72.22	84.44	85.78
N ₂ : 125% RDF	53.56	76.00	87.78	91.50
N ₃ : 150% RDF	55.56	78.33	91.11	94.89
SE (m)±	0.83	1.06	1.49	1.17
CD at 5%	2.42	3.09	4.38	3.44
Factor B: Varieties				
V ₁ : PDKV Yashashree	52.92	73.42	83.75	86.29
V ₂ : KOPFX- 2107	49.92	71.08	82.50	84.79
V ₃ : DHFT 109-3	47.50	68.17	79.08	83.04
SE (m)±	0.72	0.91	1.29	1.02

CD at 5%	2.10	2.68	3.80	NS
Int. A X B				
SE (m)±	1.43	1.83	2.59	2.03
CD at 5%	NS	NS	NS	NS
GM	50.11	70.89	81.78	84.71

3.1.3 Leaf area (cm² plant⁻¹)

N₃ recorded the highest leaf area at 30, 60, 90 DAS and harvest (22.15, 256.65, 731.78 and 158.22 cm² plant⁻¹, respectively), and was at par with N₂ (20.04, 246.63, 697.26 and 153.48 cm² plant⁻¹). The increase in leaf area with nutrient application may be associated with enhanced nutrient availability, particularly nitrogen, which promotes leaf expansion and canopy development. The decline in leaf area at harvest was associated with progressive leaf

senescence. These results align with previous foxtail millet studies Ravindranadh *et al.*, (2019) [8].

Among varieties, V₂ recorded the highest leaf area at all stages and was generally comparable with V₃, while V₁ recorded lower values. Similar varietal differences in leaf area were reported by Ravindranadh *et al.* (2019). The interaction between nutrient levels and varieties was non-significant.

Table 3: Leaf area (cm² plant⁻¹) of foxtail millet at various growth stages as influenced by nutrient levels and varieties

Treatments	Leaf area (cm ² plant ⁻¹)			
	30DAS	60DAS	90DAS	At harvest
Factor A: Nutrient levels				
N ₀ : Absolute control	12.51	187.07	408.88	110.03
N ₁ : 100% RDF	18.63	232.84	618.14	127.72
N ₂ : 125% RDF	20.04	246.63	697.26	153.48
N ₃ : 150% RDF	22.15	256.65	731.78	158.22
SE (m)±	0.79	4.26	13.61	3.04
CD at 5%	2.31	12.48	39.92	8.91
Factor B: Varieties				
V ₁ : PDKV Yashashree	16.72	222.85	550.85	128.66
V ₂ : KOPFX- 2107	19.58	236.83	657.93	144.91
V ₃ : DHFT 109-3	18.70	232.71	633.26	138.51
SE (m)±	0.68	3.69	11.79	2.63
CD at 5%	2.00	10.81	34.58	7.72
Int. A X B				
SE (m)±	1.37	7.37	23.58	5.26
CD at 5%	NS	NS	NS	NS
GM	18.33	230.80	614.01	137.36

3.1.4 Dry matter accumulation (g plant⁻¹)

N₃ recorded the highest dry matter accumulation at 30, 60, 90 DAS and harvest (0.28, 9.72, 23.01 and 34.99 g plant⁻¹, respectively), and was generally at par with N₂. The lowest accumulation was recorded under N₀. Enhanced nutrient availability likely increased leaf area, photosynthetic activity and biomass production. Sathisha *et al.*, (2020) [10] also reported higher dry matter accumulation in foxtail millet under improved nutrient management.

Among varieties, V₂ recorded the highest dry matter accumulation, generally comparable with V₃. At harvest, V₂ and V₃ were superior to V₁. Similar varietal differences in dry matter accumulation at different growth stages were reported in foxtail millet by Sathisha *et al.* (2020) and Venkatesh Babu *et al.* (2025). The interaction between nutrient levels and varieties was non-significant at all growth stages.

Table 4: Dry matter accumulation (g plant⁻¹) of foxtail millet at various growth stages as influenced by nutrient levels and varieties

Treatments	Dry matter accumulation (g plant ⁻¹)			
	30 DAS	60 DAS	90 DAS	At harvest
Factor A: Nutrient levels				
N ₀ : Absolute control	0.15	4.46	10.06	10.50
N ₁ : 100% RDF	0.23	7.36	16.53	23.33
N ₂ : 125% RDF	0.26	9.51	22.83	32.57
N ₃ : 150% RDF	0.28	9.72	23.01	34.99
SE (m)±	0.01	0.11	0.34	0.94
CD at 5%	0.03	0.33	0.99	2.75
Factor B: Varieties				
V ₁ : PDKV Yashashree	0.21	7.49	17.32	22.92
V ₂ : KOPFX- 2107	0.25	8.05	18.78	26.72
V ₃ : DHFT 109-3	0.23	7.74	18.22	26.41
SE (m)±	0.01	0.10	0.29	0.81
CD at 5%	0.02	0.29	0.86	2.38
Int. A X B				
SE (m)±	0.02	0.20	0.59	1.62
CD at 5%	NS	NS	NS	NS
GM	0.23	7.76	18.11	25.35

3.2 Yield (kg ha⁻¹)

3.2.1 Grain yield (kg ha⁻¹)

Grain yield increased significantly with increasing nutrient levels. N₃ (150% RDF) recorded the highest grain yield (1777 kg ha⁻¹), which was at par with N₂ (125% RDF; 1717 kg ha⁻¹), while N₁ (1492 kg ha⁻¹) and N₀ (1004 kg ha⁻¹) recorded lower yields. The increase in grain yield may be attributed to improved vegetative growth, greater dry matter production and enhanced translocation of assimilates towards grain formation. Similar improvement in grain yield with increased fertilizer application was reported by Jhansi *et al.* (2025) [2]. Similar improvement in foxtail millet growth and yield with increasing fertilizer levels was reported by Jhansi *et al.* (2025) [2], who recorded the highest grain yield with 125% RDF.

Among varieties, PDKV Yashashree (V₁) recorded the highest grain yield (1555.96 kg ha⁻¹), followed by KOPFX-2107 (1507.83 kg ha⁻¹) and DHFT 109-3 (1428.77 kg ha⁻¹). The superior grain yield of V₁ may be attributed to its better yield potential and assimilate partitioning towards grains. These results are comparable to Navya Jyothi *et al.* (2016) [3] and Radha Kumari and Sahadeva Reddy (2023) who observed numerical varietal differences in grain yield. The nutrient level × variety interaction was significant, with the highest grain yield recorded in N₃V₁. These results align with previous studies by Jyothi *et al.* (2016) [3].

3.2.2 Straw yield (kg ha⁻¹)

Straw yield increased significantly with increasing nutrient levels. N₃ recorded the highest straw yield (3192 kg ha⁻¹), which was at par with N₂ (3169 kg ha⁻¹), while N₀ recorded the lowest yield (2085 kg ha⁻¹). Higher nutrient availability enhanced vegetative growth and dry matter accumulation, resulting in greater straw production. Jhansi *et al.* (2025) [2] similarly reported a marked increase in straw yield of foxtail millet with higher fertilizer levels.

Among varieties, KOPFX-2107 (V₂) recorded the highest straw yield (2996.02 kg ha⁻¹), followed by DHFT 109-3 (2842.68 kg ha⁻¹) and PDKV Yashashree (2751.46 kg ha⁻¹). The higher straw yield of V₂ may be associated with its superior vegetative growth and greater biomass production. These findings concur with Vaghdevi *et al.*, (2020) [11], who reported varietal variation in straw yield. This highlights the role of genotypes in biomass production. The nutrient level × variety interaction was significant, with N₃V₂ recording the highest straw yield. Relevant study of foxtail millet recorded by Ravindranadh *et al.* (2019) along with supporting studies.

3.2.3 Harvest index (%)

Harvest index increased with increasing nutrient levels, with N₃ (35.77%) recording the highest value, followed by N₂ (35.16%), N₁ (33.13%) and N₀ (32.48%). The higher harvest index under increased nutrient supply indicates improved partitioning of accumulated dry matter towards grain production. These findings align with Raviraja *et al.* (2020), who found harvest index varied under different nutrient managements compared to the control.

Among varieties, PDKV Yashashree (V₁) recorded the highest harvest index (35.80%), followed by KOPFX-2107 (33.35%) and DHFT 109-3 (33.25%), indicating better assimilate partitioning towards grain formation in V₁. Vaghdevi *et al.* (2020) observed significant varietal

variation in harvest index. The nutrient level × variety interaction was non-significant for harvest index.

Table 5: Grain yield (kg ha⁻¹), straw yield (kg ha⁻¹) and harvest index (%) of foxtail millet as influenced by nutrient levels and varieties

Treatments	Grain yield (kg ha ⁻¹)	Straw yield (kg ha ⁻¹)	Harvest index (%)
Factor A: Nutrient levels			
N ₀ : Absolute control	1004	2085	32.48
N ₁ : 100% RDF	1492	3008	33.13
N₂: 125% RDF	1717	3169	35.16
N₃: 150% RDF	1777	3192	35.77
SE (m)±	31.83	53.71	-
CD at 5%	93.36	157.52	-
Factor B: Varieties			
V ₁ : PDKV Yashashree	1555.96	2751.46	35.80
V ₂ : KOPFX- 2107	1507.83	2996.02	33.35
V ₃ : DHFT 109-3	1428.77	2842.68	33.25
SE (m)±	27.57	46.51	-
CD at 5%	80.85	136.42	-
Int. A X B			
SE (m)±	55.14	93.02	-
CD at 5%	161.71	272.83	-
GM	1497.52	2863.39	-

4. Conclusion

Nutrient levels significantly improved the growth and productivity of foxtail millet under irrigated *rabi* conditions. Among nutrient levels, 150% RDF recorded the highest grain yield, straw yield and harvest index and was comparable with 125% RDF for several yield parameters. PDKV Yashashree recorded the highest grain yield and harvest index, whereas KOPFX-2107 produced the highest straw yield. The N₃V₁ combination recorded the highest grain yield, while N₃V₂ produced the highest straw yield. Overall, 150% RDF with PDKV Yashashree was the most promising treatment for grain production under the conditions of the study.

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