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STUDIES ON EFFECT OF NUTRIENT MANAGEMENT ON FLOWERING YIELD AND ROOT PARAMETERS OF CROSSANDRA UNDER CHHATTISGARH PLAIN

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ABSTRACT

The present study, entitled “Studies on Effect of Nutrient Management on Flowering Yield and Root Parameters of Crossandra under Chhattisgarh Plain” was carried out at Horticultural Research cum Instructional Farm, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G) during 2025 - 2026 Rabi season. The experiment was arranged in a Randomized Block Design (RBD) with seven treatments, each replicated three times. The treatments consisted of T_1 as the control with 100 % RDF (75:50:125 kg ha⁻¹ N:P:K), T_2 with 90 % N, 100 % P and 100 % K (67.5:50:125 kg ha⁻¹), T_3 with 110 % N, 100 % P, and 100 % K (82.5:50:125 kg ha⁻¹), T_4 with 100 % N, 90 % P, and 100 % K (75:45:125 kg ha⁻¹), T_5 with 100 % N, 110 % P and 100 % K (75:55:125 kg ha⁻¹), T_6 with 100 % N, 100 % P and 90 % K (75:50:112.5 kg ha⁻¹) and T_7 with 100 % N, 100 % P, and 110 % K (75:50:137.5 kg ha⁻¹). Observations were recorded on the flowering yield and root performance of crossandra. Among all those treatments, T_1 as control (100% RDF) consistently recorded maximum number of flowers plant⁻¹ (683.60), number of spikes plant⁻¹ (11.18), yield plot⁻¹ (3.08 kg) and yield (102.09 q ha⁻¹), root number (17.54) and fresh weight of roots (14.14 g), while T_4 showed maximum root length (11.33 cm). In contrast, T_7 (100% N:100% P:110% K) consistently restricted flowering quality and yield. Soil fertility parameters of soil pH (7.2–7.5), EC (0.22–0.31 dS m⁻¹), organic carbon (0.48–0.61 %). The highest nitrogen was in T_3 (262.90 kg ha⁻¹) and the lowest was in T_2 (246.09 kg ha⁻¹). The highest phosphorus was in T_5 (21.50 kg ha⁻¹), while the lowest was in T_4 (15.22 kg ha⁻¹) and The highest potassium was in T_7 (361.00 kg ha⁻¹), while the lowest was in T_5 (347.53).

Key word: Crossandra, nutrient management, flowering yield, root parameters and soil fertility.

Introduction

Crossandra (*Crossandra infundibuliformis* L.Nees) commonly known as “Firecracker Flower” which is a significant ornamental perennial belonging to the family Acanthaceae. Among 20-25 species, only a few are cultivated commercially with *Crossandra undulaefolia* Salisb (syn: *C.infundibuliformis*) being the primary species for commercial flower production. It is an erect, herbaceous perennial with glossy, dark green, lanceolate leaves (10-20 cm in length) and tubular flowers arranged in terminal spikes displaying orange, salmon-orange, yellow, and red shades. The fibrous shallow root system (30 cm depth) makes it sensitive to soil moisture fluctuations. Crossandra is a tropical plant and cannot

tolerate low temperature or frost. It grows well in places where the temperature is around 30°C and requires well drained soil rich in organic matter. Alkaline or saline soils are unsuitable, as plants develop chlorosis. NPK fertilisers play a vital role in crossandra cultivation on the chhattisgarh plains by addressing soil nutrient deficiencies and boosting plant performance. Nitrogen promotes lush vegetative growth and leaf development, phosphorus enhances root establishment and flower initiation, while potassium strengthens stems, improves spike quality, and increases disease resistance. Balanced application leads to higher flower yields and better market value for this commercial crop. Nitrogen drives rapid plant height increase and larger leaf area, essential for photosynthesis

in the region’s hot, humid climate. Phosphorus supports strong root systems, aiding nutrient and water uptake from the often shallow, loamy clay soils. Potassium improves overall vigor, reduces lodging, and enhances tolerance to monsoon stresses.

Methods and Materials

The experiment was carried out at Horticultural Research cum Instructional Farm, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G) during *Rabi* season 2025-2026. The experiment was laid out in randomized block design with 3 replications and 7 treatments viz., T₁ as the control with 100 % RDF (75:50:125 kg ha⁻¹ N:P:K), T₂ with 90 % N, 100 % P, and 100 % K (67.5:50:125 kg ha⁻¹), T₃ with 110 % N, 100 % P and 100 % K (82.5:50:125 kg ha⁻¹), T₄ with 100 % N, 90 % P, and 100 % K (75:45:125 kg ha⁻¹), T₅ with 100 % N, 110 % P and 100 % K (75:55:125 kg ha⁻¹), T₆ with 100 % N, 100 % P and 90 % K (75:50:112.5 kg ha⁻¹) and T₇ with 100 % N, 100 % P and 110 % K (75:50:137.5 kg

ha⁻¹) were treated. Observations were recorded on flowering parameters (days to spike initiation, days to 50% flowering, spike length (cm), duration of flowering), yield parameters (number of flowers plant⁻¹, number of spikes plant⁻¹, yield plot⁻¹ (kg) and yield (q ha⁻¹), root parameters (root length, number of roots, fresh weight of roots), and soil analysis parameters (pH, organic carbon, electrical conductivity, and available N, P, and K after harvest) were estimated using standard procedure.

Results and Discussion

Flowering parameters

The data on flowering parameters as influenced by nutrient management are presented in Table 1. Spike initiation was earliest in T₁ (100 % RDF) at 59.00 days, followed by T₃ (61.40 days), which were statistically at par, while the latest initiation occurred in T₇ (66.33 days). This could be attributed to an spike emergence was earliest with 0 kg potassium compared to 60, 120 and 180 kg potassium per ha. This confirms the fact that higher amount of nitrogen and potassium delays flowering. Similar findings were reported by Pandet *et al.*, (2018)., Kumar *et al.*, (2023) and Shankar *et al.*, (2010) in gladiolus. A balanced supply of nitrogen promotes the translocation of phyto hormones, which might have induces early flower bud initiation as reported by Barenya *et al.*, (2023) in gladiolus. Days to 50 % flowering showed non-significant differences, though T₁ recorded the minimum (66.41 days), followed by T₃ (72.47 days), while T₇ exhibited the maximum (83.61 days). The earliest first flower bud appearance and duration of flowering in treatment T₁ as control (100 % RDF) might be due to the presence of a lower nitrogen supply, resulting in early stress conditions in plants, thus inducing early flowering. In contrast, delayed flowering might be due to the presence of a higher amount of nitrogen, which in turn may have prolonged the vegetative phase of the plant. The results are similar to the findings of Mitra *et al.*, (2010), Praneetha *et al.*, (2002) and Kumar *et al.*, 2023 in marigold and Pandey *et al.*, (2018) in gladiolus. The

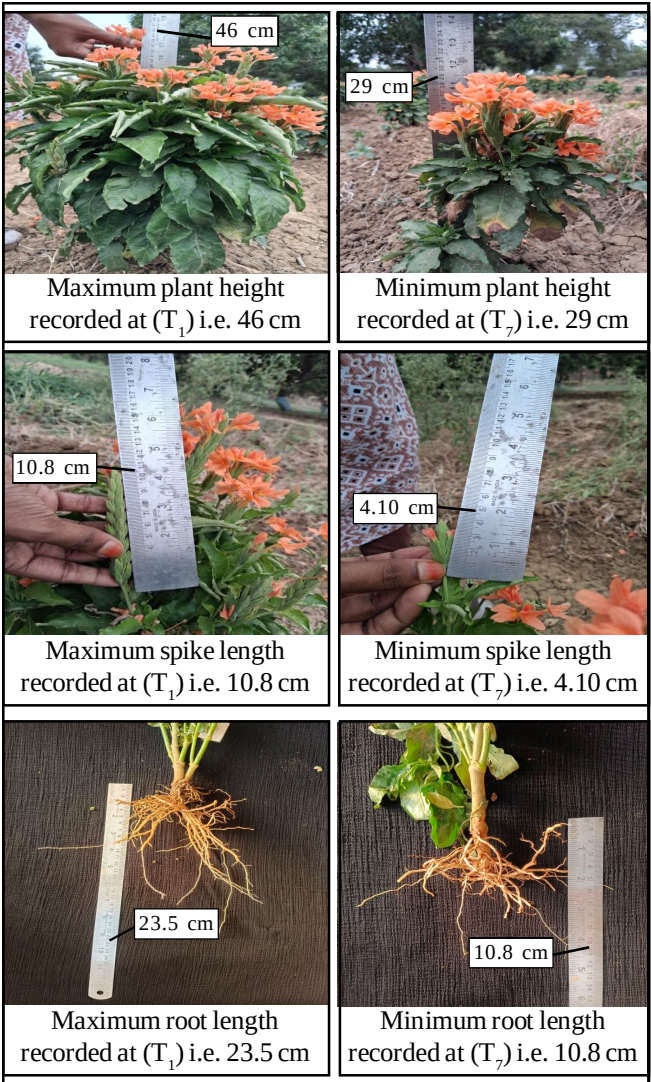


Plate 1: Comparison between treatments.

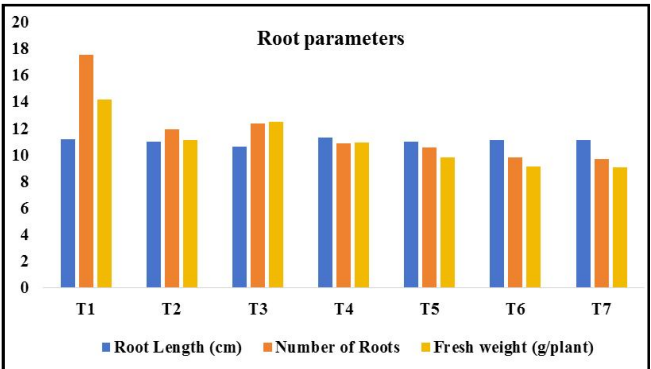


Fig. 1: Effect of nutrient management on root parameters.

Table 1: Effect of Nutrient Management on Flowering, Yield and Root Parameters.

Notation	Treatment	DSI	DTF	SL	DF	NFP	NSP	YP	Y	RL	NR	FWR
T ₁	Control-100 % RDF (75:50:125) kg ha ⁻¹	59.00 ^a	66.41 ^a	7.75 ^a	77.13	683.60 ^a	11.18 ^a	3.08 ^a	102.09 ^a	11.20 ^a	17.54	14.14 ^a
T ₂	90 % N:100 % P:100 % K (67.5:50:125) kg ha ⁻¹	62.00 ^a	76.2 ^{ab}	6.65 ^{bc}	75.80	666.37 ^{ab}	8.33 ^b	2.65 ^a	92.13 ^{ab}	11.00 ^a	11.91	11.13 ^{bc}
T ₃	110 % N:100 % P:100 % K (82.5:50:125) kg ha ⁻¹	61.4 ^a	72.47 ^{bc}	6.57 ^{bc}	76.47	679.80 ^a	8.94 ^b	2.68 ^a	92.91 ^{ab}	10.60 ^a	12.39	12.49 ^{ab}
T ₄	100 % N:90 % P:100 % K (75:45:125) kg ha ⁻¹	65.00 ^a	75.70 ^{ab}	6.28 ^{bc}	75.93	656.7 ^{ab}	8.13 ^b	2.50 ^a	86.76 ^{ab}	11.33 ^a	10.89	10.94 ^{bc}
T ₅	100 % N:110 % P:100 % K (75:55:125) kg ha ⁻¹	62.53 ^a	78.40 ^{ab}	6.06 ^{bc}	76.33	648.33 ^b	8.07 ^b	2.36 ^a	82.02 ^{bc}	11.00 ^a	10.58	9.80 ^c
T ₆	100 % N:100 % P:90 % K (75:55:112.5) kg ha ⁻¹	63.33 ^a	80.00 ^{ab}	6.71 ^b	75.40	641.80 ^b	8.00 ^b	2.22 ^a	76.99 ^{bc}	11.13 ^a	9.84	9.12 ^c
T ₇	100 % N:100 % P:110 % K (75:50:137.5) kg ha ⁻¹	66.33 ^a	83.61 ^a	5.67 ^c	75.07	607.07 ^c	7.17 ^b	2.01 ^a	69.91 ^c	11.13 ^a	9.72	9.06 ^c
CD at 5 %		8.97	7.96	0.89	NS	26.16	1.72	0.34	14.49	2.38	NS	2.07
CV %		8.38	6.13	8.03	1.14	2.34	11.79	7.92	9.86	12.08	12.52	10.67
SE (m) ±		3.04	2.69	0.30	0.50	8.85	0.58	0.11	4.90	0.77	0.85	0.67
DSI: Days to spike initiation; DTF: Days to 50 % Flowering; SL: Spike Length (cm); DF: Duration of Flowering (days); NFP: Number of flowers plant ⁻¹ ; NSP: Number of spikes plant ⁻¹ ; YP: Yield plot ⁻¹ (Kg); Y: Yield (q ha ⁻¹); RL: Root Length (cm); NR: Number of Roots; FWR: Fresh weight of roots (g)												

longest spikes length was recorded in T₁ (7.75 cm), followed by T₂ (6.65 cm), while T₇ recorded the shortest (5.67 cm). This is likely due to the nitrogen, phosphorus and potassium have significant effects on spike production and floret quality Singh *et al.*, (2019) in gladiolus. The highest duration of flowering in T₁ (77.13 days), followed by T₃ (76.47 days), while T₇ had the lowest (75.05 days). The more number of flowering branches might have increased the number of flowers ultimately leading to increased flower yield. Better assimilation of photosynthates resulted in more food reserve, thus, more flowering duration and shelf-life. These results were in agreement with the findings of Mohnty *et al.*, (2002) in aster and Kirar *et al.*, (2010) in gladiolus.

Yield parameters

The data on yield parameters as influenced by nutrient management are presented in Table 1. The data on yield parameters of crossandra under different nutrient

management practices showed significant treatment effects. The number of flowers plant⁻¹ was highest in T₁ (100 % RDF) with 683.60 flowers, while T₇ recorded the minimum (607.07). The production of an increased number of flowers plant⁻¹ and flower yield acre⁻¹ might be due to the indirect effect of a greater number of branches as estimated and developed by the influence of inorganic fertilisers. This was in conformity to the findings of Chandrikapure *et al.*, (2003) in marigold, Singh *et al.* (2000) and Gynandev *et al.*, (2006) in china aster and Acharya *et al.*, (2004) in marigold. Similarly, the number of spikes plant⁻¹ was maximum in T₁ (11.18), while T₇ produced the least (7.17). The number of spikes per plant under higher RDF levels indicate better floral development and improved assimilate partitioning towards reproductive structures, which enhances ornamental quality and market value. The present experimental results are in line with the findings reported by Aswath *et al.*, (2007) in crossandra and Singh *et al.*, (2008) in chrysanthemum.

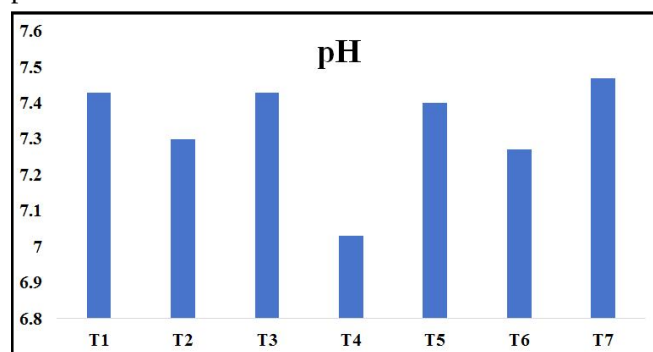
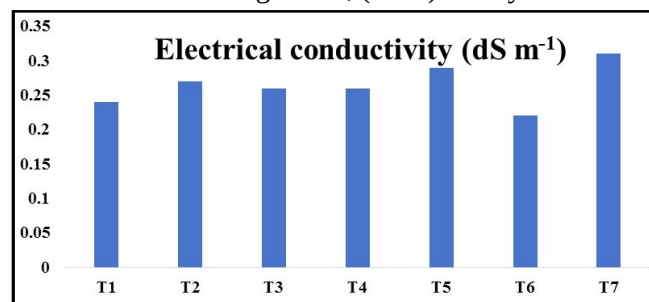
**Fig. 2:** Effect of nutrient management on pH.**Fig. 3:** Effect of nutrient management on electrical conductivity (dS m⁻¹).

Table 2 : Effect of Nutrient Management on Soil Analysis.

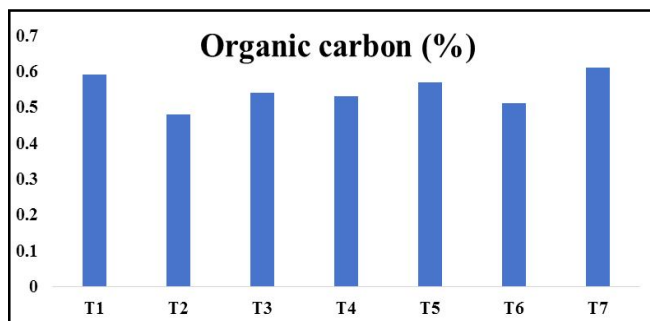
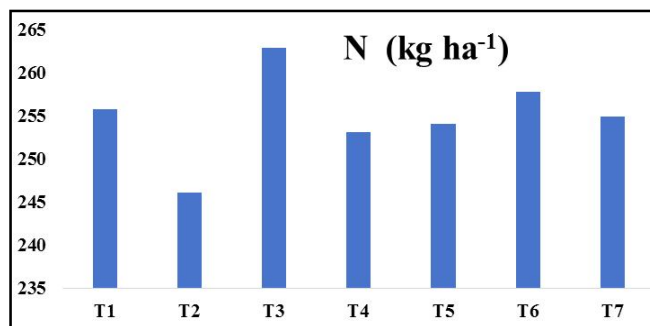
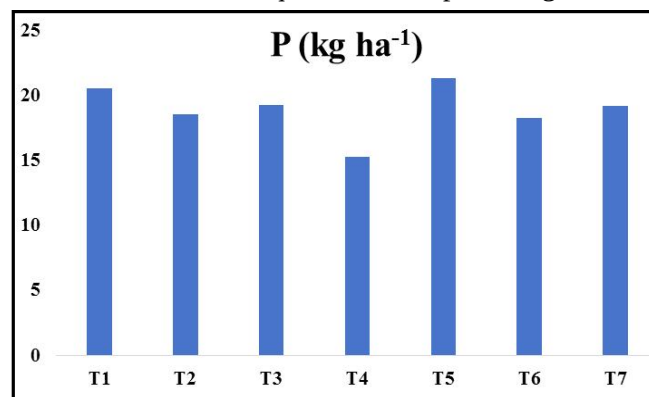
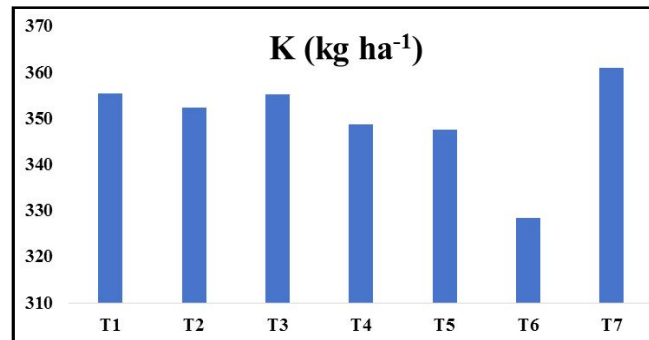
Notation	Treatment	pH	Organic carbon (%)	EC (dS m ⁻¹)	N (kg ha ⁻¹)	P (kg ha ⁻¹)	K (kg ha ⁻¹)
T ₁	Control-100 % RDF (75:50:125) kg ha ⁻¹	7.43	0.59	0.24	255.77	20.5 ^{ab}	355.34 ^a
T ₂	90 % N:100 % P:100 % K (67.5:50:125) kg ha ⁻¹	7.30	0.48	0.27	246.09	18.53 ^{ab}	352.41 ^a
T ₃	110 % N:100 % P:100 % K (82.5:50:125) kg ha ⁻¹	7.43	0.54	0.26	262.90	19.21 ^{ab}	355.24 ^a
T ₄	100 % N:90 % P:100 % K (75:45:125) kg ha ⁻¹	7.23	0.53	0.26	253.17	17.22 ^b	348.68 ^a
T ₅	100 % N:110 % P:100 % K (75:55:125) kg ha ⁻¹	7.40	0.57	0.29	254.06	21.3 ^a	347.53 ^a
T ₆	100 % N:100 % P:90 % K (75:55:112.5) kg ha ⁻¹	7.27	0.51	0.22	257.81	18.27 ^{ab}	328.31 ^a
T ₇	100 % N:100 % P:110 % K (75:50:137.5) kg ha ⁻¹	7.47	0.61	0.31	254.91	19.15 ^{ab}	361.00 ^a
CD at 5 %		NS	NS	NS	NS	3.52	31.13
CV %		5.03	7.35	7.92	5.46	10.76	5.21
SE (m) ±		0.21	0.02	0.01	8.03	1.19	10.53

Yield plot⁻¹ also varied significantly, with T₁ producing the highest (3.08 kg), while T₇ recorded the lowest (2.01 kg). Yield with T₁ recording maximum yield (102.09 q ha⁻¹), while T₇ remained lowest (69.91 q ha⁻¹). The favourable growing environment and climatic factors will contribute for expression of maximum yield potential in the flowers. Similar findings were reported in Aruna *et al.*, (2007) in crossandra, Praneetha *et al.*, (2002) in china aster and Talia *et al.*, (2003) in gladiolus.

Root parameters

The data on root parameters as influenced by nutrient management are presented in Table 1 and. Maximum root length was in T₄ (11.33 cm), followed closely by T₁ (11.20 cm), while T₃ recorded the minimum (10.60 cm). Nitrogen is crucial for root growth and elongation and its deficiency influences the assimilation of other nutrients, as reported by Alam *et al.*, (2003) in rice. These findings

are also in lines with Dotaniya *et al.*, (2013) in rice. They reported that suitable dose of nitrogen results in premier root length. The number of roots was highest in T₁ (17.54), followed by T₃ (12.39), while T₇ had the least (9.72). The maximum fresh weight of roots T₁ (14.14 g), followed by T₃ (12.49 g), while T₇ remained lowest (9.06 g). Higher RDF levels consistently enhanced biomass accumulation, as nutrient sufficiency promoted vigorous vegetative growth, stronger root systems, and prolonged flowering, all of which contributed to greater plant fresh weight. The reason for better growth may be due to stimulation of the root system with consequent help in greater translocation of nutrients due to the favourable and additive effect of nitrogen and micronutrients on balanced nutritional requirements for plant height. These

**Fig. 4:** Effect of nutrient management on organic carbon (%).**Fig. 5:** Effect of nutrient management on nitrogen (kg ha⁻¹).**Fig. 6:** Effect of nutrient management on phosphorus (kg ha⁻¹).**Fig. 7:** Effect of nutrient management on potassium (kg ha⁻¹).

findings were reported by Vishnu *et al.*, (2015) in gladiolus and Aruna *et al.*, (2007) in crossandra.

Soil analysis

The data on soil analysis as influenced by nutrient management are presented in Table 2. Soil pH values ranged between 7.2–7.5, with the highest in T_7 (7.47) and the lowest in T_6 (7.28). Differences were non-significant, indicating nutrient management did not alter soil reaction. Organic carbon content ranged between 0.48–0.61 %. The highest was in T_7 (0.61 %), followed by T_1 (0.59 %) and T_5 (0.57 %), while the lowest was in T_2 (0.48 %). Electrical conductivity (EC) values ranged between 0.22–0.31 dS m^{-1} . The highest was in T_7 (0.31 dS m^{-1}), followed by T_5 (0.29 dS m^{-1}) and T_2 (0.27 dS m^{-1}), while the lowest was in T_6 (0.22 dS m^{-1}). The highest nitrogen was in T_3 (262.90 kg ha^{-1}), followed by T_6 (257.81 kg ha^{-1}) and T_1 (255.77 kg ha^{-1}), which were statistically at par. The lowest was in T_2 (246.09 kg ha^{-1}). Post-2000 studies have consistently shown that nitrogen fertilisation increases soil available N, though excessive application can lead to leaching losses and reduced efficiency. Similar findings were reported in Gowtham *et al.*, (2004) in maize and Pramila *et al.*, (2022) in rice. The highest phosphorus was in T_5 (21.50 kg ha^{-1}), followed by T_1 (20.50 kg ha^{-1}) and T_6 (18.27 kg ha^{-1}), while the lowest was in T_4 (15.22 kg ha^{-1}). Reviews emphasise that sustainable phosphorus management is essential to maintain soil fertility while minimising environmental risks by Chandrikapure *et al.*, (2003) in maize and wheat. Highest potassium was in T_7 (361.00 kg ha^{-1}), followed by T_1 (355.34 kg ha^{-1}) and T_3 (355.24 kg ha^{-1}), while the lowest was in T_6 and T_5 (347.53 kg ha^{-1}). Likewise, in wheat, Meena *et al.*, (2026) demonstrated that higher potassium application maintained soil fertility and supported better nutrient mobilisation.

Conclusion

Overall, the study demonstrated that nutrient management in crossandra significantly influenced, flowering, yield, root development and soil fertility. The control treatment T_1 (100% RDF) consistently produced superior performance with maximum early spike initiation, longer spikes, extended flowering duration, highest flower count (683.60), spikes per plant (11.18), yield $plot^{-1}$ (3.08 kg), yield (102.09 q ha^{-1}), root number (17.54) and fresh root weight (14.14 g) and T_4 showed maximum root length (11.33 cm). In contrast, T_7 (100% N : 100% P : 110% K) consistently restricted flowering quality and yield. Soil fertility parameters remained within moderate ranges of pH (7.2–7.5), organic carbon (0.48–0.61 %) and EC (0.22–0.31 dS m^{-1}) with higher residual potassium in T_7

(361.00 kg ha^{-1}) and lower nitrogen in T_2 (246.09 kg ha^{-1}). In summary, balanced fertilisation under T_1 ensured optimum crop performance and maintained soil fertility, while nutrient imbalance, particularly excess potassium in T_7 , adversely affected growth, yield and nutrient dynamics.

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