



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
NAAS Rating (2026): 5.20
www.agronomyjournals.com
2026; 9(9): 793-797
Received: 14-07-2026
Accepted: 18-08-2026

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Effect of major nutrients on growth and yield of cashew (*Anacardium occidentale* L.) at Maidan parts of Karnataka

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DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i9k.6606>

Abstract

The research on effect of major nutrients on growth and yield of Cashew was conducted at Horticulture Research and Extension Centre, Hogalagere, Kolar district, Karnataka state, India during the period of 2021-22, 2022-23 and 2023-24 i.e. three years as part of AICRP on Cashew scheme. There were six treatments imposed in the experiment, among the treatments, treatment-5 (T₅) i.e., cashew trees imposed with 100% RDF (500:250:250 g)+10 kg FYM along with foliar spray of major nutrients (3% Urea+0.5% MAP+1% K₂SO₄), secondary and micronutrients (0.5% ZnSO₄+0.1% solubor as boron+0.5% MgSO₄) was found significantly superior over remaining treatments in terms of growth parameters (pooled mean of three years) like plant height (4.40 m), stem girth (80.00 cm) and mean canopy spread (7.65 m). T₅ also recorded significantly higher in yield parameters such as mean flowering duration (104.75 days), mean nut weight (7.32 g), nut yield per plant (9.15 kg), Yield per hectare (14.27 q) and Cumulative nut yield for nine years of harvests (75.73 kg) and followed by T₄. However the lowest observation values were found in control (T₆). When look at the overall performance, T₅ was found to be best treatment.

Keywords: Cashew, nutrient management, foliar application

1. Introduction

The cashew (*Anacardium occidentale* L.) was introduced to other parts of the world from Brazil including India during the 16th century mainly for afforestation and soil conservation purpose being a hardy crop. However, cashew has earned a commendable position in the global market as a major foreign exchange earner from its initial beginning as a wasteland crop to control soil erosion and reclamation of degraded land (Babli. *et al*, 2019) [2]. Cashew belongs to the family *Anacardiaceae* including 60 genera and 400 species of trees and shrubs. The area under Indian cashew cultivation is about 9.82 lakh ha and Indian cashew nut production has shown steady growth to the extent of 4.4% over the five decades (Anonymous, 2014) [1]. This can be attributed to several factors such as release of varieties with good agronomical traits. Indian cashew occupies a commendable position in the global market with 20% and 16% share in terms of the area and raw nut production.

In Karnataka the raw cashew nut production was 81.929 MT with an area of 1.39 lakh ha with productivity of 739 kg ha⁻¹. Cashew being a regular bearer which puts forth flowering and sets fruits on the current season flush, the plant requires adequate nutrients for production of new flowers, fruit set and production of quality nuts. Nutrients have beneficial effect on flower initiation, fruit set and development, nut yield, quality kernel and shell (Yamakanamardi *et al.*, 2020) [35]. According to research conducted in various fruit crops, foliar application of nutrition appears to have a beneficial impact on yield and quality (Gawankar *et al.*, 2010; Jat and Kacha, 2014; Gajbhiye *et al.*, 2015; Yamakanamardi *et al.*, 2020) [8, 11, 12, 35]. Basal application of fertilizers during monsoon is not completely utilized by the crop and lost via leaching, fixation and other processes, leaving the crop vulnerable to nutrient deficiency. As a result, supplementary foliar spray is one of the means to enhance the crop performance through fertilizer or nutrient use

efficiency. In pulses and oilseeds, nutrients applied by foliage play a crucial role in increasing plant growth and yield (Chandrasekhar and Bangarusamy, 2003) [4]. Supplemental foliar nutrients are more efficient than soil application because nutrients are more effectively adsorbed by leaves through phloem tissues (Manonmani and Srimathi, 2009) [15]. Nutrients applied through foliages are targeted directly towards the synthesis of photoassimilates, accelerating its supply without waste, which eventually increases the fertilizer use efficiency.

Cashew tree responds well to nutrient application, though the results vary greatly depending on tree age, genotype, cultivation, soil and environmental conditions, as well as several other factors (Vanlauwe *et al.*, 2002) [34]. Young cashew plants react well to nitrogen and phosphate application, but during bearing stage, potash in conjunction with nitrogen is most essential. Nitrogen, phosphorus and potassium are the essential nutrients for plant growth and development. Nitrogen is present in amino acids, proteins, nucleic acids, porphyrins, purines and pyrimidine nucleotides, flavin nucleotides, enzymes, co-enzymes and alkaloids. Energy transmission, photosynthetic operation, sugar and starch conversion, nutrient transport within the plant, and the transfer of hereditary traits from one generation to another are all dependent on phosphorus. Potassium is necessary for transporting water and nutrients in the plant's xylem. It encourages root growth and improves drought resistance as well as activates and synthesizes the protein-forming nitrate reductase enzyme (Rattan and Goswami, 2009) [27]. Since urea penetrates the cuticle 10 to 20 times better than inorganic ions, it is considered the best source of nitrogen to apply as a foliar spray (Khan *et al.*, 2009; Ding *et al.*, 2020) [7, 13].

Fertilizer NPK 19-19-19 is a 100% water soluble fertilizer that contains nitrogen in three forms: NO⁻-N (45.0%), NH⁻-N (4.5%), 3 4 and NH⁻-N (10.5%), as well as water soluble phosphorus and 2 potassium, each of which contains 19% and has a low salt index. It improves pest and disease tolerance by keeping plants healthy, resulting in lesser need of agrochemicals and more uniform flowering with little droppings, leading to higher crop yield (Yawalkar *et al.*, 1996) [36]. Fertilizer NPK 13-0-45 contains nitrate and potash which helps in assimilation, translocation and formation of sugars which attributes to yield and quality fruits. Similarly, fertilizer 12:32:16 contains all three major nutrients essential for luxury growth of plants. Among the many constraints to cashew yield, nutrition plays an important role in increasing cashew nut production. Cashew tree extracts a substantial portion of nutrients from the soil each year. Fruit set response is attributed to plant hormone activity in a more ambiguous way to nutrition (Mengel *et al.*, 2001) [18]. The cashew yield recorded in India and Karnataka is very low due to imbalanced application of fertilizers and manures (Maruthi prasad *et al.*, 2015) [17]. 500:250:250 NPK g tree⁻¹ of cashew recommended in Karnataka state (Saroj, 2015) [30].

Application of micronutrients has ability to increase nut yield in cashew (Rajamanickam *et al.*, 2020) [24]. Planting density as well as levels of fertilizer have significant influence on growth and yield in cashew (Tripathy *et al.*, 2015) [32]. Integrated nutrient of both inorganic and organic nutrients increases nut yield in cashew (Patil *et al.*, 2020) [22]. Thus, the objectives of the experiment were to study the influence of combined effect of RDF with manure and foliar spray of major, secondary and micronutrients on vegetative, reproductive and quality traits of cashew in maidan parts of Karnataka, India. While cashew is also being cultivated in fairly traditional regions of maidan parts of Karnataka, no attempt has been made to investigate the impact of foliar nutrient application on its growth and yield characteristics. As cashew is

more responsive crop to foliar nutrient application, the present research investigates the effect

2. Material and Methods

The experiment was conducted on 8 year old trees of Chintamani-1 variety of cashew plantation at All India Co-ordinated Research Project (AICRP) on Cashew, Horticulture Research and Extension Centre, Hogalagere, Kolar district, Karnataka state, India which was located at longitude-78.2741 and latitude-13.32507 during the period of 2021-22, 2022-23 and 2023-24 (three years) by adopting Randomized block design with six treatment, four replications, number of plants per replication were six under the spacing of crop 8m × 8m and the method of irrigation was by drip irrigation, especially after the trees were reached fifty percent flowering, each row of trees were installed by drip lateral and in each tree was ensure drip emitter of 8 litres per hour and there was no irrigations were supplemented during rainy season.

The details of the treatments were T: 100% RDF dose of NPK fertilizers (RDF) 500: 250: 250g NPK /tree /year, T₂:100% RDF+10 kg FYM plant⁻¹ year⁻¹, T₃:100% RD F+10 kg FYM + Foliar spray of major nutrients (3% Urea+0.5% MAP+1% K₂SO₄), T₄: 100% RDF+10kg FYM/plant/year + foliar spray of secondary nutrients (0.5% ZnSO₄+0.1% solubar as boron source+0.5% MgSO₄, T₅: 100% RDF+10 kg FYM/plant /year + Foliar spray of major nutrients (3% urea + 0.5% H₃PO₄+1% K₂SO₄)+foliar spray of secondary & micronutrients(0.5% ZnSO₄+0.1% solubor as Boron source+0.5% MgSO₄) and T₆: Control (without any application of fertilizer and manures). The foliar spray of nutrients were taken at three different stages flushing, flowering and nut development stages by using tractor mounted power sprayer covering the entire canopy.

Uniform 10 years old trees of cashew cv. Chintamani-1 planted at the spacing of 8m × 8 m (156 plants ha⁻¹) were used for the current experimentation. The fertilizers application (RDF: 500:250:250 NPK per plant⁻¹ year⁻¹) by excavating round trenches of 30 cm× 20 cm size under the tree and 1 m away from trunk was uniformly followed simultaneously including plant protection schedule. The growth and yield attributing parameters data's were recorded, in different stages of the crop season, then determined and analyzed statistically by suitable the procedure (Panse and Sukhatme, 1995) [21].

3. Results and Discussion

The nutrient management in cashew is very important task, which should be fulfilled by major, secondary and micro nutrients, method of application as well as stages of application, in this direction the above research was conducted on cashew crop, while experimentation different combinations of treatments were formulated which contains soil application of recommended dose of fertilizers (RDF) and also foliar spray of major nutrients, secondary and micro nutrients at different stages of crop like flushing, flowering as well as nut development stages. Among the treatments (Table 1), the plants were fed with 100% RDF (500:250:250 g NPK/plant)+10 kg FYM along with foliar spray of major nutrients (3% Urea+0.5% MAP+1% K₂SO₄) and secondary, micronutrients (0.5% ZnSO₄+0.1% solubor as boron source+0.5% MgSO₄) (T₅) was found to be performed significantly (Table 1) in terms of growth attributing parameters like plant height (pooled mean of three years) (4.40 m), stem girth (80.00 cm), canopy spread east west direction (7.73 m) as well as north-south direction (7.57 m) and mean canopy spread (7.65 m), whereas remaining growth parameters were numerically higher values in T₅ compare to other imposed treatments. The least

values growth attributing parameters were recorded in control treatment (T_6) as compare to other treatments i.e. trees were did not applied any nutrients neither through soil nor through foliar spray.

The yield attributing parameters (Table 2) were significantly recorded in T_5 : 100% RDF (500:250:250 g NPK/plant)+10 kg FYM along with foliar spray of major nutrients (3% Urea+0.5% MAP+1% K_2SO_4) and secondary, micronutrients (0.5% $ZnSO_4$ +0.1% solubor as boron source+0.5% $MgSO_4$) such a, flowering duration (104.75 days), nut weight (7.32g), shelling (30.85%), nut yield plant⁻¹ (9.15 kg), nut yield per hectare (14.27 q) and Cumulative nut yield per plant (75.79 kg for 9 seasons harvests) and lowest values were found in both growth and yield attributing parameters were in control treatment (T_6). T_5 was on par with T_4 : 100% RDF+10kg FYM/plant/year + foliar spray of secondary nutrients (0.5% $ZnSO_4$ +0.1% solubor as boron source+0.5% $MgSO_4$) such as flowering duration (100.25 days), nut weight (7.24g), shelling percent (30.55%), nut yield plant⁻¹ (8.53 kg plant⁻¹) and cumulative nut yield (69.32 kg plant⁻¹). The tea mosquito bug (TMB) (Table 2) infestation was low in irrespective of treatments. During the period of experimentation, the least values yield parameters were recorded in control treatment (T_6) as compare to other treatments.

In the present findings, Urea, DAP and MAP were more effective in increasing the nut yield, because of their action in increasing the nut set at pea and marble stage and increase the nut weight. The enhanced nut yield in cashew due to urea spray has also been reported by Sapkal *et al.* 2000 [29] and Rajendra *et al.*, 2023 [25]. Better retention of nuts would have also been facilitated the higher adsorption of nutrients and subsequently enhances the utilization

of nutritional resources within the tree resulting in maximum yield (Kumar and Reddy, 2008) [14]. Foliar nutrient application significantly influenced the leaf nutrients in cashew at flowering as well as nut development stages. The increased supply of major nutrients through foliar spray may trigger their absorption directly through phloem, resulting in higher nutrient content in leaves of treated cashew trees (Nanthakumar *et al.*, 1997) [19]. The gradual reduction in leaf nutrient content was observed over the nut growth and maturation stage, regardless fertilizers and their spray concentration, which may be resulted due to the translocation of ionic substances to the developing nuts (Babu *et al.*, 2010) [3].

Foliar application promotes growth parameters like plant height and canopy spread it may be directly effect on leaf activity, which triggers water absorption by the plant's vascular system, thereby increasing nutrient uptake from the soil. Nutrient foliar spray facilitated the timely supply of nutrients in adequate quantities to plants which significantly increases leaf nutrient content and fruit yield (Ullasa *et al.*, 2016) [33]. The above results were in accordance with the research findings of Talang *et al.* (2017) [31] in mango fruit crop and Palsande *et al.* (2015) [20], Dhanasekaran *et al.* (2018) [6], Gavit *et al.* (2020) [10], Gajbhiye *et al.* (2022) [9], Preethi, *et al.*, 2021 [23], Ramteke *et al.* (2022) [26] and Rajendra *et al.*, 2023 [25] in cashew. Since it is highly immobile in the plant, hence it requires continuously, meanwhile reproductive parts need more boron. Hence treatment-5 was the best treatment among the six imposed treatments and this treatment certainly helpful in enhance the cashew productivity and production, and also very helpful in uplifting of the stages of cashew growing farming community.

Table 1: Effect of major nutrients on growth parameters of cashew (Pooled mean of three years)

Treatments	Plant height (m)	Stem girth (cm)	Canopy spread (E-W) (m)	Canopy spread (N-S) (m)	Average canopy spread (m)
T ₁	3.98	70.05	6.86	6.76	6.81
T ₂	4.03	72.35	7.10	7.01	7.05
T ₃	4.12	74.09	7.30	7.31	7.31
T ₄	4.31	76.01	7.41	7.43	7.42
T ₅	4.40	80.00	7.73	7.57	7.65
T ₆	3.80	65.62	6.43	6.61	6.52
S.EM+	0.15	2.13	0.20	0.21	0.17
CD@5%	0.45	6.42	0.59	0.64	0.50
CV	8.36	8.45	6.63	6.85	7.09

Table 2: Effect of major nutrients on yield parameters of cashew (Pooled mean of three years)

Treatments	Flowering duration (days)	Apple weight (g)	Nut weight (g)	Shelling (%)	Nut yield (kg plant ⁻¹)	Cumulative yield (kg plant ⁻¹)	Infestation of TMB
T ₁	90.50	34.66	7.02	29.79	6.83	59.59	Low
T ₂	94.00	35.75	7.09	29.97	7.46	63.11	Low
T ₃	97.08	36.87	7.20	30.23	8.11	67.50	Low
T ₄	100.25	37.56	7.24	30.55	8.53	69.32	Low
T ₅	104.75	38.99	7.32	30.85	9.15	75.79	Low
T ₆	85.33	34.08	6.97	29.26	6.16	50.16	Low
S.EM+	3.02	1.51	0.15	0.53	0.35	1.92	
CD@5%	9.12	4.54	0.46	1.60	1.06	5.79	
CV	7.50	9.01	4.31	3.52	10.70	5.83	



Plate 1: Performance of T₅ cashew plant



Plate 2: Raw cashew nut with apple in Chintamani-1 variety

4. Conclusion

The treatment combined with a foliar application of major nutrients (3% Urea + 0.5% MAP + 1% K₂SO₄) alongside secondary and micronutrients (0.5% ZnSO₄ + 0.1% Solubor + 0.5% MgSO₄). It recorded significantly superior results for most growth and yield parameters compared to other treatments. Furthermore, its performance was statistically on par with treatment T₄, which utilized the same baseline soil application but only included the secondary and micronutrient foliar spray.

5. Acknowledgement

The authors express their sincere gratitude to the Director of Research at the University of Horticultural Sciences, Bagalkot, Karnataka, India, as well as the Director and Project Coordinator at the ICAR-Directorate of Cashew Research, Puttur, for providing the necessary funds, facilities, and support to conduct this research experimentation and great full to the scientists who previously worked under the All India Coordinated Research Project (AICRP) on Cashew at the Horticultural Research and Extension Centre (HREC), Hogalagere.

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