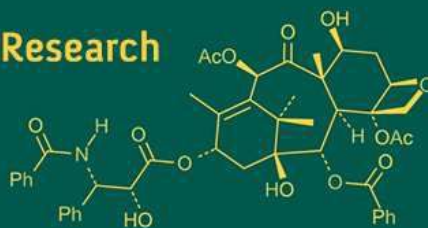


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; SP-8(10): 288-291
www.biochemjournal.com
Received: 02-06-2024
Accepted: 05-07-2024

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Application of different levels of NPK along with soil and foliar application of zinc and boron on yield, quality and nutrient content of cashew nut for increasing quality parameter, in lateritic soil of Konkan

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DOI: <https://doi.org/10.33545/26174693.2024.v8.i10Sd.2463>

Abstract

An attempt has been made to study the effect of different levels of nitrogen, phosphorus and potassium along with soil and foliar application of zinc and boron on yield and quality of cashew nut (*Anacardium occidentale* L.) Variety Vengurla-4 in lateritic soil of Konkan during May 2015 to April 2016 in Randomized Block Design with four levels of NPK (1.0:0.25:0.25, 1.0:0.50:0.50, 1.5:0.75:0.75 and 2.0:1.0:1.0 kg NPK per tree) with or without soil application of boron through borax @ 50 g + zinc through zinc sulphate @ 125 g/tree or foliar application of boron through borax @ 0.25% + zinc through zinc sulphate @ 0.5% /tree, an absolute control (To judge the fate of native nutrients) comprising thirteen treatments replicated thrice. It is revealed from the study that 22.36 to 57.97 percent increase in the yield of cashew nut was recorded during 2015-16 with application of different levels of nitrogen, phosphorus and potassium along with soil or foliar application of boron through borax and zinc through zinc sulphate. The highest yield of cashew nut per tree (11.80 kg tree⁻¹) and number of nuts per kg were recorded with the application of recommended dose of fertilizer + soil application of boron through borax @ 50 g + zinc through zinc sulphate @ 125 g/tree (treatment T₆). Application of 1.5:0.75:0.75 kg /tree + boron through Borax @ 0.25% + zinc through zinc sulphate @ 0.5% /tree (T₁₂) exhibited significantly higher total N, P and K as well as protein and oil content of cashew kernel. Application of 1.0:0.50:0.50 NPK kg/tree + foliar application of boron through borax @ 0.25% + zinc through zinc sulphate @ 0.5% / tree (T₁₁) recorded significantly higher total nitrogen and copper in cashew nut leaves, while Application of 2.0:1.0:1.0 NPK kg/ tree + boron through borax @ 0.25% + zinc through zinc sulphate @ 0.5%/tree (T₁₃) recorded significantly higher total micronutrient (viz., Mn, Zn and B) in cashew nut leaves and also micronutrient (viz., Fe, Mn, Zn and Cu) in cashew kernel. By considering the higher yield of cashew nut, protein and oil content, NPK and micro-nutrient (i.e. Fe, Mn, Cu, Zn and B) content in leaf at different growth stages of cashew (i.e. at new emergence shoot stage, flowering stage, nut setting stage and at harvest), application 1.0:0.50:0.50 kg NPK per tree along with spraying of foliar application of boron through borax @ 0.25% + zinc through zinc sulphate @ 0.5% was to be beneficial in lateritic soils of Konkan.

Keywords: Cashewnut, NPK, Zn, B, foliar spray, lateritic soil

Introduction

Cashewnut is one of the most important dollar earning crop among the horticulture and plantation crops in the country. The total export of cashew kernels from India during 2015-16 was 96,346 MT valued at Rs. 4952.12 Crore (Anonymous 2016) ^[1]. In India, cashew is mainly grown in Maharashtra, Karnataka, Kerala and Goa along the west coast Tamilnadu, Andhra Pradesh, Orissa and West Bengal along the east coast. Maharashtra is ranking first in area, production and productivity in the country with 1.75 lakh ha area, 1.90 lakh MT production and about 1186 kg ha⁻¹ productivity, respectively. The cashew production in Maharashtra is mainly concentrated in Konkan region particularly in Ratnagiri, Sindhudurg, and Raigad and west part of Kolhapur district.

An attempt has to be made by managing strategies which are essential for the successful maintenance of commercial cashew plantation. The nutrients applied to cashewnut orchards are subjected to leaching due to high rainfall. Therefore, nutrient management under such

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condition deserves proper attention. Therefore, it was decided to choose another way to increase yield per plant by providing nutrients by foliar sprays at different stages with an aim to assess the effect of different levels of inorganic fertilizers with soil and foliar application of Zn and B on yield, quality and leaf nutrient status of cashew nut.

Materials and Methods

The experiment was laid out at Rukhi Block of Irrigation Water Management, Central Experimental Station, Wakawali during May 2016 to April 2017 in Randomized Block Design with four levels of NPK (1.0:0.25:0.25, 1.0:0.50:0.50, 1.5:0.75:0.75 and 2.0:1.0:1.0 kg NPK per tree) with and without soil application of boron through borax @ 50 g + zinc through zinc sulphate @ 125 g/tree or foliar application of boron through borax @ 0.25% + zinc through zinc sulphate @ 0.5% /tree, an absolute control (to judge the fate of native nutrients) comprising thirteen treatments replicated thrice. Two trees were selected for each treatment. Total seventy eight uniform cashew trees of variety *Vengurla-4* were selected from the orchard at the slope of the hill.

Four levels of NPK (1.0:0.25:0.25, 1.0:0.50:0.50, 1.5:0.75:0.75 and 2.0:1.0:1.0 kg NPK per tree) through urea, single super phosphate and muriate of potash along with FYM @ 40 kg tree⁻¹ and soil application of boron through borax @ 0.25% and zinc through zinc sulphate @ 0.5% were applied in corresponding treatments in the month of June 2015. The spraying of boron through borax @ 0.25% and zinc through zinc sulphate @ 0.5% in the pertinent treatments (T₁₀ to T₁₃) were under taken at time of flowering and nut setting stage in June 2016. The boron and zinc solutions for foliar application were prepared by using borax @ 0.25% and zinc sulphate @ 0.5% /tree fertilizer by dissolving the respective weight of chemical fertilizers in 1L of water by continuous stirring. Further, insecticides (Endosulphon, rogar and carboxyl) were also added to these spraying solutions for control of pest incidence. The spraying was carried out early in the morning by using Gatoor pump. The cashew nuts were picked when the cashew apple were fully ripened and harvested in 5-6 picking.

Results and Discussion

22.36 to 57.97 percent increase in the yield of cashew nut was recorded with the application of different levels of inorganic fertilizers with soil and foliar application of Zn

and B significantly increased the yield of cashew nut per tree over the absolute control i.e. no fertilizer application. The yield of cashew nut varied from 7.19 to 10.38 kg tree⁻¹ and the number of nut per kg varied from 138 to 142 kg⁻¹ (Table 1). Application of recommended dose of fertilizer + soil application of boron through borax @ 50 g + zinc through zinc sulphate @ 125 g/tree (treatment T₆) recorded the highest cashew nut per tree (10.38 kg tree⁻¹), which was at par with the treatment T₄ (1.5:0.75:0.75 kg NPK), T₅ (2.0:1.0:1.0 kg NPK), T₇ (1.0:0.50:0.50 kg NPK + Soil application of B + Zn), T₈ (1.5:0.75:0.75 kg NPK + soil application of B + Zn), T₉ (2.0:1.0:1.0 kg NPK + Soil application of B + Zn), T₁₀ (1.0:0.25:0.25 kg NPK + Foliar application of B + Zn), T₁₁ (1.0:0.50:0.50 kg NPK + Foliar application of B + Zn), T₁₂ (1.5:0.75:0.75 kg NPK + Foliar application of B + Zn) and T₁₃ (2.0:1.0:1.0 kg NPK + Foliar application of B + Zn).

No specific trend of increase in the yield of cashew nut per tree with the increasing doses of NPK was observed during both years of experimentation. But, it is clearly evident from the above results that both zinc sulphate and boron either by soil application or by foliar application had stimulating effect on fruit yield. In this connection, Lakshmipathi *et al.* (2014) [6] explained that zinc influences flowering and fruit set through its role in auxin biosynthesis as auxins play a major role in flowering and fruit set. Sexual reproduction is more sensitive to low B than vegetative growth and marked reduction in fruit set can occur without expression of B deficiency symptoms in vegetative parts. Maintaining high B levels in reproductive parts is a vital component of efficient B management for yield in horticultural crops (Raja 2009) [3]. The improvement of yield due to micro-elements may be ascribed to better photosynthesis, less fruit drop, improved fruit size and fruit weight (Singh 2012) [11].

Beneficial effect of nitrogen in increasing the nut yield may be due to the fact that the higher level of nitrogen application in soil in the form of urea increases the activity of the enzyme urease (Harishu kumar *et al.* 1985) [4] which is responsible for hydrolysis of urea to ammonia, readily available to plant (Webster *et al.* 1955) [13]. Nitrogen being the component of amino acid, nucleotide, nucleic acid, number of co enzyme, auxin and cytokinin can induce cell elongation, enlargement and development and thereby improved the nut production. Nitrogen also helps to synthesis of carbohydrate (Raheja 1971) [9] the protein and other metabolism (Kanwar 1976) [5] resulted in increased nut weight.

Table 1: Effect of different levels of NPK along with soil and foliar application of Zn and B on yield of cashew nut

Treatments	Nut yield kg/tree	No. of nut/kg	Average wt. of nut
T ₁ (Absolute control)	7.19	138	6.58
T ₂ (1.0:0.25:0.25 kg NPK)	8.11	141	6.70
T ₃ (1.0:0.50:0.50 kg NPK)	8.28	141	6.72
T ₄ (1.5:0.75:0.75 kg NPK)	9.32	140	6.87
T ₅ (2.0:1.0:1.0 kg NPK)	8.82	141	6.84
T ₆ (1.0:0.25:0.25 kg NPK + Soil application of B + Zn)	10.36	142	6.79
T ₇ (1.0:0.50:0.50 kg NPK + Soil application of B + Zn)	9.86	141	6.84
T ₈ (1.5:0.75:0.75 kg NPK + Soil application of B + Zn)	9.72	140	6.91
T ₉ (2.0:1.0:1.0 kg NPK + Soil application of B + Zn)	10.04	140	6.80
T ₁₀ (1.0:0.25:0.25 kg NPK + Foliar application of B + Zn)	9.50	140	7.07
T ₁₁ (1.0:0.50:0.50 kg NPK + Foliar application of B + Zn)	9.80	142	6.80
T ₁₂ (1.5:0.75:0.75 kg NPK + Foliar application of B + Zn)	8.93	140	6.86
T ₁₃ (2.0:1.0:1.0 kg NPK + Foliar application of B + Zn)	9.41	141	6.87
Mean	9.21	140	6.82
SE±	0.512	1.929	0.043
C.D.(P=0.05)	1.494	N.S.	0.125

Potassium plays a vital role in the formation or synthesis of amino acid and proteins from ammonium ions which are absorbed from the soil (Raheja 1971) ^[9]. It also plays an importance role in the maintenance of cellular organization by regulating the permeability of cellular membranes and keeping the protoplasm in a proper degree of hydration by stabilizing the emulsion of highly colloidal particles (Kanwar 1976) ^[5]. Nitrogen in combination with the phosphorus (NxP) and potassium (NxK) significantly improved the nut yield. It is known that nitrogen acts as a regulator for the utilization of phosphorus and potassium in the plants (Bukman and Brady 1969) ^[2].

Protein content in the kernel varied from 19.48 percent to 26.42 percent. Significantly highest protein content (28.41%) was observed in the treatment T₁₂ where

application of NPK fertilizer levels + foliar application of boron through borax @ 0.25% + zinc through zinc sulphate @ 0.5% per tree, but this treatment was at par with T₅ (2.0:1.0:1.0 kg NPK), T₈ (1.5:0.75:0.75 kg NPK + Soil application of B + Zn), T₁₁ (1.0:0.50:0.50 kg NPK + Foliar application of B + Zn) and T₁₃ (2.0:1.0:1.0 kg NPK + Foliar application of B + Zn). The beneficial effect of foliar spray of boron through borax @ 0.25% + zinc through zinc sulphate @ 0.5%, per tree on fruit quality were attributed to their vital role in stimulating both cell division as well as biosynthesis and translocation of organic food in favors of enhancing growth and fruiting of tree (Sarrwy *et al.* 2010) ^[10]. Tandon (1992) ^[1], in addition to this, reported the positive interaction of N and S in plant as both these nutrients are vital constituents of protein.

Table 2: Effect of different levels of NPK along with soil and foliar application of Zn and B on quality parameters of cashew kernel

2016-17		
Treatment	Protein	Oil
	%	
T ₁ (Absolute control)	19.48	37.17
T ₂ (1.0:0.25:0.25 kg NPK)	21.77	38.83
T ₃ (1.0:0.50:0.50 kg NPK)	19.72	38.57
T ₄ (1.5:0.75:0.75 kg NPK)	23.73	41.93
T ₅ (2.0:1.0:1.0 kg NPK)	23.61	38.87
T ₆ (1.0:0.25:0.25 kg NPK + Soil application of B + Zn)	23.07	39.13
T ₇ (1.0:0.50:0.50 kg NPK + Soil application of B + Zn)	20.39	41.40
T ₈ (1.5:0.75:0.75 kg NPK + Soil application of B + Zn)	25.58	42.63
T ₉ (2.0:1.0:1.0 kg NPK + Soil application of B + Zn)	22.40	37.23
T ₁₀ (1.0:0.25:0.25 kg NPK + Foliar application of B + Zn)	21.06	42.13
T ₁₁ (1.0:0.50:0.50 kg NPK + Foliar application of B + Zn)	23.30	42.71
T ₁₂ (1.5:0.75:0.75 kg NPK + Foliar application of B + Zn)	26.42	42.97
T ₁₃ (2.0:1.0:1.0 kg NPK + Foliar application of B + Zn)	24.67	39.30
Mean	22.71	40.22
SE±	1.46	1.43
C.D. (P=0.05)	4.26	4.18

The oil content in the kernel varied from 37.17 to 42.97 percent. The treatment T₁₂ (application of NPK fertilizer levels + foliar application of boron through borax @ 0.25% + zinc through zinc sulphate @ 0.5% per tree) produced significantly higher oil content (51.00%) in kernel, over T₁, T₂, T₆, T₇, T₈, T₁₀ and T₃, but observed to be at par with T₃ (1.0:0.50:0.50 kg NPK), T₄ (1.5:0.75:0.75 kg NPK), T₅ (2.0:1.0:1.0 kg NPK), T₉ (2.0:1.0:1.0 kg NPK + Soil application of B + Zn) and T₁₁ (1.0:0.50:0.50 kg NPK + Foliar application of B + Zn).

The N, P and K content in cashew kernel varied from 2.339 to 4.424 percent, 0.160 to 0.937 percent and 0.137 to 0.927 percent, respectively. Total Fe, Mn, Zn, Cu and B content in cashew kernel ranged between 133.50 to 194.10 mg kg⁻¹, 26.43 to 35.03 mg kg⁻¹, 12.57 to 22.97 mg kg⁻¹, 18.27 to 22.23 mg kg⁻¹ and 29.63 to 43.64 mg kg⁻¹, respectively.

Similar ranges of N, P, K, Fe, Mn, Zn, Cu and B content in cashew kernel of cashew Cv. Vengurla-4 grown on lateritic soils of Konkan were reported by Palsande (2011) ^[8]. The treatment T₁₂ (application of NPK fertilizer levels + foliar application of boron through borax @ 0.25% + zinc through zinc sulphate @ 0.5% per tree) showed highest N (4.90%), P (1.19%) and K (0.870%) in cashew kernel.

Significantly highest Fe content (204.50 mg kg⁻¹), Mn content (34.83 mg kg⁻¹), Zn content (23.20 mg kg⁻¹), Cu content (22.63 mg kg⁻¹), B content (43.03 mg kg⁻¹) was observed in treatment T₁₃, where 2.0:1.0:1.0 NPK kg/tree + foliar application of boron through borax @ 0.25% + zinc through zinc sulphate @ 0.5% was applied. No fertilizer application or absolute control (Treatment T₁) associated with the lowest micronutrient content in cashew kernel.

Table 3: Effect of different levels of NPK along with soil and foliar application of Zn and B on total NPK content% in cashew kernel

Treatments	Nitrogen (%)	Phosphorus (%)	Potassium (%)
T ₁ (Absolute control)	2.339	0.160	0.187
T ₂ (1.0:0.25:0.25 kg NPK)	3.825	0.657	0.373
T ₃ (1.0:0.50:0.50 kg NPK)	3.159	0.847	0.457
T ₄ (1.5:0.75:0.75 kg NPK)	3.938	0.853	0.350
T ₅ (2.0:1.0:1.0 kg NPK)	4.237	0.263	0.557
T ₆ (1.0:0.25:0.25 kg NPK + Soil application of B + Zn)	3.117	0.283	0.667
T ₇ (1.0:0.50:0.50 kg NPK + Soil application of B + Zn)	3.262	0.698	0.400
T ₈ (1.5:0.75:0.75 kg NPK + Soil application of B + Zn)	4.093	0.784	0.247
T ₉ (2.0:1.0:1.0 kg NPK + Soil application of B + Zn)	3.584	0.468	0.780
T ₁₀ (1.0:0.25:0.25 kg NPK + Foliar application of B + Zn)	3.370	0.640	0.617
T ₁₁ (1.0:0.50:0.50 kg NPK + Foliar application of B + Zn)	3.727	0.865	0.837
T ₁₂ (1.5:0.75:0.75 kg NPK + Foliar application of B + Zn)	4.424	0.937	0.927
T ₁₃ (2.0:1.0:1.0 kg NPK + Foliar application of B + Zn)	4.177	0.627	0.370
Mean	3.635	0.622	0.521
SE±	0.38	0.08	0.09
C.D.(P=0.05)	1.11	0.26	0.28

Conclusion

By considering the higher yield of cashew nut, protein and oil content, NPK and micro-nutrient (*i.e.* Fe, Mn, Cu, Zn and B) content in cashew kernel, application 1.0:0.50:0.50 kg NPK per tree along with spraying of foliar application of boron through borax @ 0.25% + zinc through zinc sulphate @ 0.5% was to be beneficial in lateritic soils of Konkan.

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