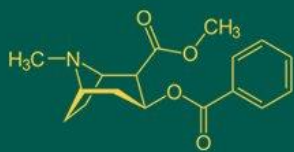


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Yield, nutrient content and quality response of yam bean (*Pachyrhizus erosus* L.) to integrated nutrient management in lateritic soils of Konkan

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Abstract

The effect of combine application of organic, inorganic fertilizers and biofertilizers on yield and nutrient content as well as quality parameters such as reducing sugars, non-reducing sugars, starch, crude fiber, protein and TSS of yam bean (*Pachyrhizus erosus* L.) tuber was investigated in lateritic soils of Konkan region during Kharif 2025 at research farm of Central Experiment Station, Wakavali, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri in a randomized block design comprising nine treatments with three replications. The treatments consisted of combinations of vermicompost, Recommended Dose of Fertilizers (RDF), different phosphorus sources, Konkan Annapurna Briquettes (KAB), *Azotobacter* and VAM. Among the treatments, treatment T₈ i.e. vermicompost @ 7.5 t ha⁻¹ + RDF with phosphorus supplied through basic slag + *Azotobacter* + VAM recorded the significantly highest tuber yield (21.17 t ha⁻¹) and straw yield (2.50 t ha⁻¹) with highest N (0.69%), P (0.14%) and K (0.51%) concentrations in tubers, together with Fe (60.67), Mn (24.00), Zn (19.53) and Cu (0.53 mg kg⁻¹) along with superior quality attributes, recording 13.72% starch, 1.56% reducing sugar, 4.64% non-reducing sugar, 5.97 °Brix TSS, 1.92% crude fibre and 4.31% protein. Overall, the integrated application of organic, inorganic and biological nutrient sources, application of vermicompost @ 7.5 t ha⁻¹ + RDF with phosphorus supplied through basic slag + *Azotobacter* + VAM, proved effective in enhancing the productivity, nutritional composition and quality of yam bean under lateritic soil conditions of the Konkan region.

Keywords: Lateritic soil, yam bean, basic slag, yield, azotobacter, VAM, nutrient content

Introduction

Root and tuber crops constitute an important component of global food systems because of their high carbohydrate production, adaptability to diverse agro-ecological conditions and contribution to food and nutritional security. Global production of roots and tubers has continued to increase, reflecting their growing importance as food, feed and industrial raw materials (FAO, 2024) [8]. Among the underutilized root crops, yam bean (*Pachyrhizus erosus* L.) is a promising leguminous tuber crop with considerable potential for food, nutrition and sustainable agriculture. The crop is believed to have originated in tropical America and is now cultivated in several tropical and subtropical regions, particularly in Southeast Asia and parts of India. In India, it is locally known as *mishrikand* or *sankalu* and is cultivated mainly in eastern and northeastern states, with considerable potential for cultivation in other suitable agro-climatic regions.

Yam bean produces a carbohydrate-rich, succulent tuberous root and is nutritionally valuable because it contains appreciable amounts of carbohydrates, dietary fibre, protein, minerals and vitamin C, while being relatively low in fat and calories (Noman *et al.*, 2007) [20]. In addition to its nutritional value, the crop has agronomic significance as a legume capable of biological nitrogen fixation, thereby contributing to nutrient cycling and potentially improving nutrient-use efficiency. The crop also has considerable potential for diversification of root and tuber-based farming systems and for utilization in fresh consumption and value-added food products (Ravi *et al.*, 2025) [24]. However, despite these attributes, yam bean remains an underexploited crop compared with major tuber crops. Their ability to thrive under marginal conditions, low-input farming and mixed cropping systems makes them particularly

important for smallholder farmers. The crop has good stress resistant capacity for both biotic and abiotic stresses. It comes up well in comparatively marginal land and does not require great care (Nath *et al.*, 2008) ^[18].

In Maharashtra, yam bean has particular relevance under the agro-climatic conditions of the Konkan region, where lateritic soils are widespread. The region receives high rainfall, which promotes intense weathering and leaching and consequently results in acidic soils with constraints related to nutrient availability. Lateritic soils of Konkan are generally characterized by low available phosphorus and variable potassium status, with phosphorus availability being particularly restricted because of its strong association with iron and aluminium oxides (Talashilkar *et al.*, 2006) ^[26]. The fixation of applied phosphorus in these soils can reduce its availability to crops and consequently limit root development, nutrient uptake and yield.

Nutrient management is therefore a critical factor in realizing the production potential of yam bean in lateritic soils. Vermicompost supplies stabilized organic matter and nutrients and can improve soil aggregation, porosity, water-holding capacity and rhizosphere biological activity, thereby promoting root development and nutrient acquisition. In acidic soils, rock phosphate can be an effective phosphorus source because its dissolution is favoured under low-pH conditions (Basha *et al.*, 2018; Gite *et al.*, 2019) ^[2, 9]. Basic slag, containing calcium, magnesium, silicon and phosphorus, can help ameliorate soil acidity through its liming effect and thereby improve the soil chemical environment for root growth and nutrient availability (Datta *et al.*, 1972) ^[6]. Konkan Annapurna Briquettes (KAB) provide concentrated nutrients through localized placement in the root zone, which may enhance nutrient-use efficiency. Biofertilizers such as *Azotobacter* and VAM further complement organic and inorganic nutrient sources by contributing to biological nitrogen availability, enhancing phosphorus acquisition and promoting root proliferation and rhizosphere activity. Thus, the integrated use of these nutrient sources offers a promising approach for improving nutrient availability, crop growth and productivity of yam bean under the acidic lateritic soils of Konkan.

Materials and Methods

The field experiment was conducted during the *kharif* season 2025 at Central Experiment Station, Wakawali, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra in a randomized block design (RBD) comprising nine nutrient management treatments with three replications. Yam bean (*Pachyrhizus erosus* L.) cv. Rajendra Mishrikand-1 (RM-1) was sown in June with the onset of monsoon at a spacing of 60 × 30 cm.

The nitrogen, phosphorus and potassium were supplied through urea, single super phosphate and muriate of potash, respectively, at 80:40:100 kg N:P₂O₅:K₂O ha⁻¹. Nitrogen was applied in two equal splits, with 50% at sowing and the remaining 50% at 45 days after sowing, whereas P and K were applied basally at sowing. Vermicompost was applied before planting at 5.0 or 7.5 t ha⁻¹ as per treatment. Rock phosphate and basic slag were uniformly broadcast and incorporated into the surface soil before planting. Konkan Annapurna Briquettes (34% N, 14% P₂O₅ and 6% K₂O) were applied by point placement, one briquette per plant at sowing and a second application at 45 days after sowing. *Azotobacter* and VAM were applied at 5 kg ha⁻¹ by

mixing with well-decomposed manure and incorporating into the upper soil layer.

At harvest, straw yield and tuber yield were recorded and expressed on a hectare basis. Tuber nutrient, micronutrient content and quality was assessed using standard analytical procedures. Total nitrogen content in tuber samples was estimated by the micro-Kjeldahl method (Tandon, 1993) ^[27] after digestion of 0.25 g oven dried sample with concentrated H₂SO₄ (15 mL) and H₂O₂, followed by steam distillation using a Kjeldahl apparatus. Total phosphorus, potassium and micronutrient content in the tuber samples was determined from the di-acid digest prepared by digesting 0.5 g of sample with 15 mL of concentrated nitric acid and perchloric acid in ratio 9:4. Phosphorus was estimated by the vanado-molybdate yellow colour method (Tandon, 1993) ^[27], using a suitable aliquot of the digest. The yellow vanado-molybdate complex developed was measured spectrophotometrically at 420 nm. Potassium concentration was determined using a flame photometer against standard potassium solutions (Tandon, 1993) ^[27]. The content of Fe, Mn, Zn and Cu were determined using an Atomic Absorption Spectrophotometer (AAS) as described by McLaren and Crawford (1973) ^[16].

Total sugar content was estimated by the method of Moorthy and Padmaja (2002) ^[17]. Fresh tuber (2 g) was extracted overnight with 20 mL of 80% ethanol, filtered, hydrolysed with 1 mL concentrated HCl at 100°C for 30 min and made up to 50 mL. A suitable aliquot was titrated against boiling alkaline potassium ferricyanide using methylene blue as indicator. The determination of reducing sugars was undertaken by the method of Lane and Eynon (1923) ^[13] as described by Ranganna (1977) ^[23]. Non-reducing sugars were calculated considering the difference between total and reducing sugars. Sample preparation for starch was done as explained by Ranganna (1977) ^[23] and calculated using formula,

$$\% \text{ Starch} = \% \text{ Reducing sugars} \times 0.90$$

Crude fibre content was estimated by washing of fat free dried tuber sample first with sulphuric acid and then with sodium hydroxide and percent fibre content was calculated by estimating loss in weight after ignition of sample in muffle furnace by method of AOAC (1975).

$$\text{Crude fibre content (\%)} = \frac{\text{Loss of weight}}{\text{Weight of sample}} \times 100$$

The protein content of tuber sample was calculated by multiplying the estimated total nitrogen content of tuber by 6.25, as it is considered that in most proteins nitrogen constitutes about 16 percent of the total composition. A known quantity of tuber sample was oven dried at 105°C to estimate the moisture content by calculating difference in initial and final weight on percent basis. Total soluble solids (TSS) were determined using a hand refractometer. Fresh tuber juice was extracted and few drops of clear juice were placed on prism of the refractometer.

$$\text{TSS (\%)} = \text{Refractometer reading (°Brix)}$$

The experimental data were subjected to statistical analysis using analysis of variance (ANOVA) technique appropriate for a randomized block design (RBD). The critical

difference (CD) at 5% probability level was calculated to compare and interpret treatment means (Panse and Sukhatme, 1967)^[21].

Results and Discussions

Total tuber and straw yield of yam bean

The application of different combinations of inorganic fertilizers, vermicompost, alternative phosphorus sources and biofertilizers significantly influenced the yield of yam bean tuber (Table 1). The highest straw yield (2.50 t ha⁻¹) and tuber yield (21.17 t ha⁻¹) were recorded with T₈ receiving vermicompost @ 7.5 t ha⁻¹ + recommended dose of fertilizers (P through basic slag) + *Azotobacter* + VAM. However, the tuber yield under T₈ was statistically at par with T₇ (20.64 t ha⁻¹) and T₉ (20.40 t ha⁻¹), indicating a comparable response among the integrated nutrient treatments. The lowest straw (1.20 t ha⁻¹) and tuber yield (9.95 t ha⁻¹) were recorded under the control (T₁). Thus, T₈ increased tuber yield by about 113 per cent over the control. Datta *et al.* (1972)^[6] reported that the calcium and silicate components of basic slag can help modify the acidic soil environment and reduce the intensity of phosphorus

fixation, thereby improving the availability of P to yam bean.

The use of basic slag as a phosphorus source may have further contributed to nutrient availability under the acidic conditions of lateritic soils. The present findings are in agreement with Biradar and Salvi (2024)^[3], who reported significantly higher yam bean yield with combined application of inorganic fertilizers and organic manure under the lateritic soils of Konkan. Their maximum tuber yield of 23.02 t ha⁻¹ was obtained with 120:80:100 kg N:P₂O₅:K₂O ha⁻¹ + 20 t FYM ha⁻¹. Mamatha *et al.* (2018)^[14] who recorded significantly higher straw yield (65.93 q ha⁻¹) under treatment 100% RDF + basic slag @ 2 t ha⁻¹ in acidic soils of Karnataka. Kaswala *et al.* (2013)^[11] who reported that integrated application of FYM @ 10 t ha⁻¹ along with NPK @ 80:60:80 kg ha⁻¹ resulted in the highest tuber yield (16.40 t ha⁻¹) and vine yield (3.47 t ha⁻¹) in greater yam. The vermicompost-based treatment comprising vermicompost @ 7.08 t ha⁻¹ + castor cake @ 0.68 t ha⁻¹ also recorded a higher tuber yield of 16.30 t ha⁻¹ and vine yield of 3.32 t ha⁻¹, demonstrating the beneficial effect of combined organic and inorganic nutrient management on biomass and yield production.

Table 1: Yield and nutrient content of yam bean tuber as influenced by biofertilizers and inorganic fertilizers

Tr. No.	Yield (t ha ⁻¹)		Nutrient content of yam bean tuber (%)			Micronutrient content in yam bean tuber (mg kg ⁻¹)			
	Straw	Tuber	N	P	K	Fe	Mn	Zn	Cu
T ₁	1.20	9.95	0.27	0.10	0.23	17.33	10.00	6.27	0.16
T ₂	1.32	14.91	0.48	0.10	0.29	24.33	13.00	7.20	0.21
T ₃	1.52	17.74	0.50	0.11	0.38	33.67	17.00	9.43	0.25
T ₄	1.60	18.89	0.53	0.11	0.45	38.67	18.67	10.80	0.26
T ₅	1.37	17.23	0.49	0.10	0.35	27.00	15.33	8.53	0.23
T ₆	1.73	19.90	0.64	0.12	0.48	43.00	19.00	12.50	0.31
T ₇	2.24	20.64	0.68	0.14	0.49	49.67	23.33	18.03	0.46
T ₈	2.50	21.17	0.69	0.14	0.51	60.67	24.00	19.53	0.53
T ₉	2.21	20.40	0.66	0.12	0.48	45.33	20.00	13.40	0.36
SE (m) ±	0.21	0.56	0.05	0.006	0.038	1.36	1.05	1.83	0.038
CD (P=0.05)	0.63	1.70	0.16	0.019	0.113	4.06	3.15	5.48	0.115

T₁ = Control; T₂ = VC @ 5.0 t ha⁻¹ + RDF (80:40:100 NPK kg ha⁻¹) (P through SSP); T₃ = VC @ 5.0 t ha⁻¹ + RDF (P through Rock Phosphate); T₄ = VC @ 5.0 t ha⁻¹ + RDF (P through Basic slag); T₅ = VC @ 5.0 t ha⁻¹ + RDF (N through KAB); T₆ = VC @ 7.5 t ha⁻¹ + RDF (P through SSP) + *Azotobacter* + VAM; T₇ = VC @ 7.5 t ha⁻¹ + RDF (P through Rock Phosphate) + *Azotobacter* + VAM; T₈ = VC @ 7.5 t ha⁻¹ + RDF (P through Basic slag) + *Azotobacter* + VAM; T₉ = VC @ 7.5 t ha⁻¹ + RDF (N through KAB) + *Azotobacter* + VAM.

Nutrient content of yam bean tuber

The values of nutrient content of yam bean tubers after harvest showed significant difference in nitrogen, phosphorous and potassium content over absolute control (Table 1). Treatment T₈ receiving VC @ 7.5 t ha⁻¹ + RDF (P through Basic slag) + *Azotobacter* + VAM recorded the highest nitrogen (0.69%), phosphorus (0.14%) and potassium (0.51%) concentrations in tubers. The corresponding minimum values were observed in the control, with 0.27% N, 0.10% P and 0.23% K. Although T₈ recorded the maximum N, P and K contents were statistically at par with T₇ (0.68, 0.14 and 0.49%, respectively).

The increased N concentration under integrated nutrient application may be associated with improved nitrogen availability and enhanced root activity, particularly through the complementary contribution of organic nutrient mineralization and *Azotobacter*. Similarly, the higher P concentration may be related to improved phosphorus acquisition through VAM-mediated root exploration and the

use of basic slag as the phosphorus source. Increased K concentration could be attributed to improved overall nutrient availability and vigorous root development under integrated nutrient supply. Similar enhancement of N, P and K concentration in yam bean tubers under combined application of inorganic fertilizers and organic manure was reported by Biradar and Salvi (2024)^[3], who recorded maximum tuber N, P and K concentrations of 0.61, 0.24 and 0.24%. Kasawala *et al.* (2013) and Koodi *et al.* (2017)^[12] reported maximum nutrient content of N, P, K in tubers of greater yam and sweet potato, respectively under integrated nutrient supply. The lowest values of NPK content were noted in absolute control treatment. Kadam *et al.* (2026)^[10], who reported that integrated application of 100% recommended dose of fertilizers with *Azotobacter* + PSB @ 10 kg ha⁻¹ each significantly enhanced nutrient accumulation in elephant foot yam corms. The highest N, P and K contents were 0.68, 0.27 and 1.18%, respectively, during 2023-24, while corresponding values during 2024-25 were 0.72, 0.25 and 1.18%, respectively.

Micronutrient content of yam bean tuber

Treatment T₈ recorded the highest concentrations of Fe (60.67 mg kg⁻¹), Mn (24.00 mg kg⁻¹), Zn (19.53 mg kg⁻¹) and Cu (0.53 mg kg⁻¹), whereas the control recorded the lowest concentrations of Fe (17.33 mg kg⁻¹), Mn (10.00 mg kg⁻¹), Zn (6.27 mg kg⁻¹) and Cu (0.16 mg kg⁻¹). The Fe concentration under T₈ was significantly superior than the other treatments, while Mn, Zn and Cu concentrations were statistically at par with T₇ (49.67 mg kg⁻¹ Fe, 23.33 mg kg⁻¹ Mn, 18.03 mg kg⁻¹ Zn and 0.46 mg kg⁻¹ Cu) indicating that the integrated nutrient treatment enhanced micronutrient accumulation. The application of inorganic fertilizers supplied the major nutrients required for vigorous plant growth, while the improved nutritional status of the crop likely increased root growth and the plant's capacity to absorb micronutrients from soil.

Organic amendments can enhance nutrient availability and rhizosphere activity, while a more favourable root environment may facilitate uptake and translocation of micronutrients. The substantially greater Fe concentration under T₈ may also reflect the combined influence of improved root activity and the use of basic slag, which supplies several secondary and micronutrient elements. The similar findings reported by Yesaware (2014) [28] reported that elephant foot yam, *xanthosoma*, *colocasia* and arrowroot were comparatively good sources of Fe, whereas *Colocasia* and elephant foot yam showed relatively higher Zn and Mn contents.

Quality parameters of yam bean tuber

The quality attributes of yam bean tubers were significantly influenced by the integrated application of organic, inorganic and biological nutrient sources (Table 2). Among the treatments, T₈ receiving vermicompost @ 7.5 t ha⁻¹ + RDF (P through basic slag) + *Azotobacter* + VAM recorded the highest values for all the quality parameters studied, indicating the beneficial effect of integrated nutrient management on the biochemical quality of yam bean tubers. The starch content ranged from 7.76% in the control (T₁) to 13.72% in T₈. The maximum starch content under T₈ was significantly higher than that of T₇ (12.72%) and the remaining treatments. The higher starch accumulation under integrated nutrient management may be attributed to improved nutrient availability and enhanced photosynthetic activity, resulting in greater synthesis and translocation of photosynthates towards the developing tubers. Yesaware (2014), Mane (2020) [15], Biradar (2021) [4] and Deshmukh (2019) [7] recorded the higher starch content of 12.14%, 11.74%, 14.67% and 11.44% in yam bean variety RM-1. Sheth *et al.* (2017) [25] also recorded higher starch content (14.43%) and higher sugar content (2.97%) with the treatment receiving 50% RDN + 50% N from vermicompost. A similar increase in starch content due to integrated nutrient management was reported by Kadam *et al.* (2026) [10] in elephant foot yam. The combined application of 100% RDF with *Azotobacter* + PSB recorded the highest starch content,

Reducing sugar content increased from 0.68% in T₁ to 1.56% in T₈, representing an increase of about 129% over the control. The treatment T₈ was statistically superior over all. The progressive increase in reducing sugars with improved nutrient supply may be associated with enhanced carbohydrate metabolism and accumulation of soluble sugars in the developing tubers. Similar improvement in

quality attributes with nutrient application has been reported by Kadam *et al.* (2026) [10], who reported an increase in total sugar content of elephant foot yam with integrated application of fertilizers and biofertilizers. The highest total sugar content of 2.21 and 2.33% was recorded with 100% RDF + *Azotobacter* + PSB during 2023-24 and 2024-25, respectively. In sweet potato, Pushpalatha *et al.* (2017) [22] recorded 0.231% reducing sugar under 100 kg K₂O ha⁻¹. Deshmukh (2019) [7] and Mane (2020) [15] who recorded increasing reducing sugar content (1.24% to 1.39%) and (1.34% to 1.45%) with graded doses of FYM i.e. 10, 15 and 20 t ha⁻¹, respectively in yam bean in lateritic soil in coastal region of Maharashtra.

Similarly, non-reducing sugar content increased from 2.07% in the control to 4.64% under T₈, representing an increase of approximately 124% over T₁. However, T₈ was statistically at par with T₇ (4.51%). The higher accumulation of non-reducing sugars under integrated nutrient management may reflect enhanced synthesis and translocation of assimilates to the storage tubers. Biradar and Salvi (2024) [3] reported a similar response specifically in yam bean grown in Konkan region. Their highest treatment, 120:80:100 kg N:P₂O₅:K₂O ha⁻¹ + 20 t FYM ha⁻¹, recorded 1.46% reducing sugar and 4.68% non-reducing sugar, compared with 1.13 and 2.88%, respectively, in the control. Deshmukh (2019) [7] and Mane (2020) [15] recorded the highest non-reducing sugar content 4.39% and 4.26%, respectively with higher dose of inorganic and FYM application.

Total Soluble Solids (TSS) showed a similar response, increasing from 3.20 °Brix in T₁ to 5.97 °Brix in T₈. The increase of approximately 86.6% over the control indicates enhanced accumulation of soluble constituents in the tubers under integrated nutrient management. T₈ was statistically at par with T₉ (5.90 °Brix), but was significantly superior to T₇ (5.57 °Brix). The improvement in TSS may be associated with greater accumulation of soluble sugars and other soluble metabolites resulting from improved nutrient availability. The present finding is supported by Chaiyachet (2023) [15] reported 6.33 ± 0.58 °Brix in yam-bean juice.

Crude fibre content varied from 0.49% in T₁ to 1.92% in T₈. Treatment T₈ recorded significantly higher crude fibre than T₇ (1.80%). The increased fibre content may be related to enhanced synthesis and deposition of structural carbohydrates during tuber development under adequate and balanced nutrient supply. The present finding is supported by Yesaware (2014) [28], Mane (2020) [15] and Biradar (2021) [4] recorded the maximum crude fiber content of 1.60%, 1.80% and 3.04% in yam bean variety RM-1 grown under Konkan conditions. Nersekar (2016) [19] who reported a maximum crude fiber content of 0.66% in yam bean under an NPK-based fertilizer treatment. Kadam *et al.* (2026) [10] also observed an increase in crude fibre content of elephant foot yam with increasing fertilizer levels and biofertilizer application. The highest crude fibre value under the combined treatment was 1.67 g 100 g⁻¹ in 2023-24 and 1.64 g 100 g⁻¹ in 2024-25.

Protein content exhibited a pronounced response to integrated nutrient management, increasing from 1.69% in the control to 4.31% under T₈. However, T₈ was statistically at par with T₇ (4.23%), T₉ (4.13%) and T₆ (4.00%). Enhanced phosphorus and potassium nutrition may have further supported metabolic activity and efficient utilization of absorbed nitrogen for protein synthesis. The present findings are close agreement with Biradar and Salvi (2024)

[3] who reported an increase in protein content of yam bean tubers from 1.75% under the absolute control to a maximum of 3.81% under treatments receiving higher levels of inorganic nitrogen and FYM. Kadam *et al.* (2026) [10], who reported that application of 100% RDF along with Azotobacter + PSB @ 10 kg ha⁻¹ each resulted in the highest crude protein content of 3.76 and 3.93 g 100 g⁻¹ during 2023-24 and 2024-25, respectively, with a pooled value of 3.92 g 100 g⁻¹.

Table 2: Quality parameters of yam bean tubers as influenced by biofertilizers and inorganic fertilizers

Tr. No.	Starch	Reducing sugar (%)	Non-reducing sugar (%)	TSS (°Brix)	Crude fiber (%)	Protein (%)
T ₁	7.76	0.68	2.07	3.20	0.49	1.69
T ₂	9.13	0.88	2.71	4.53	0.51	2.98
T ₃	9.97	1.07	3.05	5.10	1.23	3.13
T ₄	10.65	1.16	3.41	5.43	1.41	3.29
T ₅	9.63	0.98	2.95	4.70	0.84	3.04
T ₆	11.20	1.27	3.55	5.53	1.56	4.00
T ₇	12.72	1.48	4.51	5.57	1.80	4.23
T ₈	13.72	1.56	4.64	5.97	1.92	4.31
T ₉	11.54	1.38	3.79	5.90	1.70	4.13
SE (m) ±	0.31	0.01	0.13	0.08	0.02	0.33
CD (P=0.05)	0.94	0.05	0.41	0.25	0.07	1.00

T₁ = Control; T₂ = VC @ 5.0 t ha⁻¹ + RDF (80:40:100 NPK kg ha⁻¹) (P through SSP); T₃ = VC @ 5.0 t ha⁻¹ + RDF (P through Rock Phosphate); T₄ = VC @ 5.0 t ha⁻¹ + RDF (P through Basic slag); T₅ = VC @ 5.0 t ha⁻¹ + RDF (N through KAB); T₆ = VC @ 7.5 t ha⁻¹ + RDF (P through SSP) + Azotobacter + VAM; T₇ = VC @ 7.5 t ha⁻¹ + RDF (P through Rock Phosphate) + Azotobacter + VAM; T₈ = VC @ 7.5 t ha⁻¹ + RDF (P through Basic slag) + Azotobacter + VAM; T₉ = VC @ 7.5 t ha⁻¹ + RDF (N through KAB) + Azotobacter + VAM.

The superior quality under T₈ may be attributed to the complementary effects of vermicompost, balanced mineral nutrition, basic slag as the phosphorus source, *Azotobacter* and VAM. Vermicompost may have improved nutrient availability and rhizosphere conditions, while *Azotobacter* and VAM may have enhanced nutrient acquisition and root activity. The integrated nutrient supply consequently favoured photosynthate production, translocation and biochemical accumulation in the developing tubers.

Observation figures

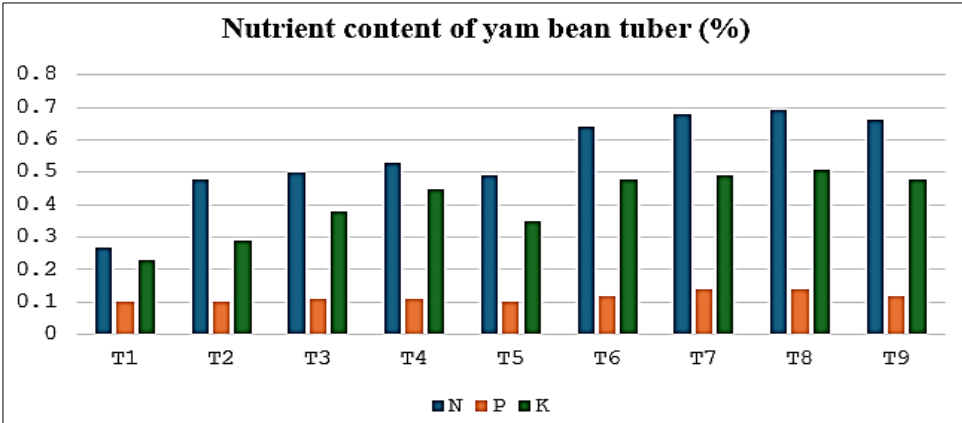


Fig 1: Effect of different treatments (T₁-T₉) on nutrient content of yam bean tubers (%)

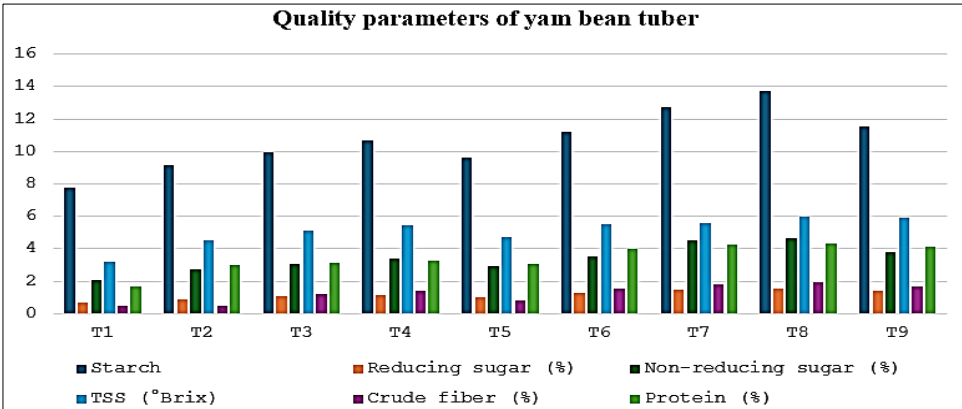


Fig 2: Quality parameters of yam bean tubers as influenced by different treatments

Conclusion: The present study demonstrated that integrated nutritional composition and quality of yam bean under lateritic soil conditions of the Konkan region. Among the

treatments, vermicompost @ 7.5 t ha⁻¹ combined with RDF, with phosphorus supplied through basic slag, along with *Azotobacter* and VAM (T₈), performed best, resulting in higher tuber and straw yields and superior accumulation of macro and micronutrients in the tubers. The treatment also showed favourable improvement in starch, sugars, TSS, crude fibre and protein contents. Thus, the integrated application of organic, inorganic and biological nutrient sources, application of vermicompost @ 7.5 t ha⁻¹ + RDF with phosphorus supplied through basic slag + *Azotobacter* + VAM, offers a promising nutrient management strategy for improving the yield, nutritional value and quality of yam bean in the lateritic soils of the Konkan region.

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