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Effect of integrated nutrient management on growth and yield of pigeonpea (*Cajanus cajan* L.)

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Abstract

A field experiment entitled “Effect of Integrated Nutrient Management on growth and yield of Pigeonpea (*Cajanus cajan* L.)” was conducted during the *kharif* season of 2025–26 at the Experimental Farm, Department of Agronomy, College of Agriculture, Latur, Maharashtra. The experimental field was laid out in a Randomized Block Design (RBD) with seven treatments replicated three times. The treatments were T₁- Control, T₂- 100% RDF (25:50:00), T₃- 100% RDF + FYM @ 5t ha⁻¹, T₄- T₃ + FeSO₄ @ 25kg ha⁻¹, T₅- T₃ + ZnSO₄ @ 25kg ha⁻¹, T₆- T₃ + Multi micronutrient grade-I @ 25kg ha⁻¹, T₇- T₃ + Multi micronutrient grade-I @ 25kg ha⁻¹ + Biomix @ 10kg ha⁻¹. The results showed that the application of 100% RDF + FYM @ 5t ha⁻¹ + Multi micronutrient grade-I @ 25kg ha⁻¹ + Biomix @ 10kg ha⁻¹ (T₇) showed significantly highest growth attributes viz. plant height (178.73 cm), number of functional leaves plant⁻¹ (239.33), leaf area plant⁻¹ (9.21 dm²), total dry matter accumulation (153.53 g), number of primary branches (10.70) and number of secondary branches plant⁻¹ (15.57) which was at par with 100% RDF + FYM @ 5t ha⁻¹ + FeSO₄ @ 25 kg ha⁻¹ (T₄) and 100% RDF + FYM @ 5t ha⁻¹ + Multi micronutrient Grade-I @ 25 kg ha⁻¹ (T₆) and significantly superior over rest of the treatments. Similarly the highest number of pods plant⁻¹ (269.87), number of seeds pod⁻¹ (4.20), number of seeds plant⁻¹ (1151.07), seed yield plant⁻¹ (93.27 g), seed index (13.00 g) seed yield (3110 kg ha⁻¹), stalk yield (9996 kg ha⁻¹), biological yield (13105 kg ha⁻¹) and harvest index (23.74%) was recorded from the application of 100% RDF + FYM @ 5t ha⁻¹ + Multi micronutrient Grade-I @ 25 kg ha⁻¹ + Biomix @ 10 kg ha⁻¹ (T₇), it was at par with 100% RDF + FYM @ 5t ha⁻¹ + FeSO₄ @ 25 kg ha⁻¹ (T₄) and 100% RDF + FYM @ 5t ha⁻¹ + Multi micronutrient Grade-I @ 25 kg ha⁻¹ (T₆). Treatment control (T₁) recorded lowest in both growth and yield attributes.

Keywords: Integrated, nutrient, management, pigeonpea, FYM, zinc sulphate, growth, yield, and soil fertility

Introduction

Pulses play an important role in improving the soil fertility by adding organic matter ranging from 0.5 to 1.5 tons per hectare to the soil in the form of leaves and roots. Besides this, pulses are better known for their capacity to fix atmospheric nitrogen by root nodule bacteria i.e. Rhizobium. In a country like India, where the people are predominantly vegetarian, pulses form an indispensable part of the diet. In general, pulses have two to three times more protein in their grains than cereals or any other group of plants, besides having plenty of micro nutrient, high dietary fiber and complex carbohydrates. The pigeonpea production of India was 4.34 million tones (leading producer) from an acreage of 5.05 million hectare with a productivity of 859 kg ha⁻¹. India is the leading importer (92.65% Share in global pigeonpea import in 2021) with an import volume of 674.44 million kg. India contributed to 77.61% of the global pigeon pea production during 2020 (Tridge, 2023) [6]. The global pigeonpea market reached a volume of 13.3 million tons in 2020 as per FMI, a market research organization. In 2024-25 India produced 3.51 million tons of pigeonpea from 4.199 million hectares (yield: 836 kg ha⁻¹) with major growing states including Maharashtra, Karnataka, Uttar Pradesh, Gujarat, Jharkhand and Telangana.

The market is projected to reach 23.6 million tons by 2027, exhibiting a CAGR of 9.51% during 2022-2027. The area allocation for pigeonpea have increased by 144.87 per cent and production by 313.48 percent to the base year 1960-61 whereas, productivity increased by 69.98 per cent in Maharashtra. Among the various production factors, proper fertilizer management plays a pivotal

role in increasing the pigeon pea production, next to variety and irrigation. Optimum fertilizer application either in the form of organic or inorganic is one of the well-established techniques for increasing crop production. Biomix - a microbial or organic formulation containing beneficial microorganisms (such as *Trichoderma*, *Azospirillum* and *Pseudomonas*). Biomix enhances nutrient availability, promotes root development, and stimulates plant physiological activity by producing growth-promoting substances such as Indole-3-Acetic Acid (IAA) and gibberellins. The combined application of Biomix with or without chemical fertilizers has been reported to improve nodulation, biomass accumulation, nutrient uptake, and yield in leguminous crops.

Therefore the present research entitled “Effect of Integrated Nutrient Management on growth and yield of Pigeonpea (*Cajanus cajan* L.)” was undertaken to study the effect of various micronutrients and biomix in combination with RDF and FYM on the growth, yield and economics of pigeonpea. The results are expected to contribute to the sustainable and eco-friendly nutrient management strategies for pulse based production system.

Materials and Methods

The experiment was conducted during *kharif* season, 2025-2026 at Agronomy field, College of Agriculture, Latur (Maharashtra) to study the Effect of integrated nutrient management on growth and yield of Pigeonpea (*Cajanus cajan* L.).

The experimental field was laid out in Randomized Block Design (RBD) with seven treatments replicated three times. The treatments were, T₁ - Control, T₂ - 100% RDF (25:50:00 kg NPK ha⁻¹), T₃ - 100% RDF + FYM @ 5t ha⁻¹, T₄ - T₃ + FeSO₄ @ 25 kg ha⁻¹, T₅ - T₃ + ZnSO₄ @ 25 kg ha⁻¹, T₆ - T₃ + Multi micronutrient grade-I @ 25 kg ha⁻¹, T₇ - T₃ + Multi micronutrient grade-I @ 25 kg ha⁻¹ + Biomix @ 10 kg ha⁻¹. The gross plot size of each experimental unit was 5.4 m x 4.5 m and net plot size was 3.6 m x 3.9 m. Sowing was done on 18th July 2025 by dibbling method with spacing 90 cm x 20 cm. BDN-716 variety of pigeonpea was used for sowing. The recommended dose of fertilizer 25:50:00 kg NPK ha⁻¹, FYM @ 5t ha⁻¹, FeSO₄ @ 25 kg ha⁻¹, ZnSO₄ @ 25 kg ha⁻¹, Multi micronutrient grade-I @ 25 kg ha⁻¹ and Biomix @ 10 kg ha⁻¹ were applied as per the treatments. The soil was slightly alkaline in reaction and having pH 7.6. The mean total of rainfall received during the period of research was (67.2 mm). The mean maximum temperature during crop growth period was 27.51 °C while the mean minimum temperature was 17.55 °C. The mean humidity during morning was 87.99% while mean humidity

during evening was 48.70%.

The height (cm) of the five plants, selected randomly from each net plot was measured from ground level to the tip of the main shoot. Their mean height was calculated and expressed in cm. Similarly, the observations for No. of functional leaves plant⁻¹, leaf area plant⁻¹(dm²), No. of primary branches plant⁻¹, number of secondary branches plant⁻¹, total dry matter plant⁻¹ (g) were recorded from the same five randomly selected plants from each plot at all the growth stages of pigeonpea. No. of seeds pod⁻¹, No. of seeds plant⁻¹, seed yield plant⁻¹ (g), seed index (g), seed yield (kg ha⁻¹), straw yield (kg ha⁻¹), biological yield (kg ha⁻¹) and harvest index (%) were calculated at the time of harvest. The data collected on various growth and yield parameters was statistically analysed by using analysis of variance (Panse & Sukhatme)

Results and Discussion

Growth attributes

The data of plant height, number of functional leaves plant⁻¹, leaf area plant⁻¹, number of primary branches plant⁻¹, secondary branches plant⁻¹ and total dry matter plant⁻¹(g) of pigeonpea was recorded at 30, 60, 90, 120, 150 DAS and at harvest. The maximum plant height (178.73 cm), number of functional leaves plant⁻¹ (239.33), leaf area plant⁻¹ (9.21 dm²), number of primary branches (10.70), number of secondary branches plant⁻¹ (15.57) and total dry matter plant⁻¹ (153.53 g) was obtained from the application of 100% RDF + FYM @ 5t ha⁻¹ + Multi micronutrient Grade-I @ 25 kg ha⁻¹ + Biomix @ 10 kg ha⁻¹ (T₇) which was at par with the application of 100% RDF + FYM @ 5 t ha⁻¹ + FeSO₄ @ 25 kg ha⁻¹ (T₄) and 100% RDF + FYM @ 5 t ha⁻¹ + Multi micronutrient Grade-I @ 25 kg ha⁻¹ (T₆) and was significantly superior over rest of the treatments. Lowest values for growth parameters were obtained for the treatment control (T₁).

The micronutrients in multi micronutrient grade-I fulfill the needs of the plant by acting as vital catalysts for hormone production, cell elongation and enzyme activation. The biomix application in introduces beneficial microorganisms into the soil, which help in plant root elongation, solubilize locked nutrients in soil and make it available for the plants uptake, enhance the photosynthetic efficiency by optimizing the plant metabolism, which in turn helps in accumulation of biomass helping in overall growth of the plant. These results were similar with the findings of Yamank *et al.* (2017)^[7], Priyanka *et al.* (2024)^[4], Kharkongor *et al.* (2020)^[2] and Kumar *et al.* (2020)^[3].

Table 1: Mean of growth attributes as influenced by various treatments at different growth stages of pigeonpea

Treatment	Plant height (cm)	Number of functional leaves plant ⁻¹	Leaf area plant ⁻¹ (dm ²)	Number of primary branches plant ⁻¹	Number of secondary branches plant ⁻¹	Total dry matter plant ⁻¹ (g)
	AH	120 DAS	120 DAS	AH	AH	AH
T ₁ - Control	137.90	149.67	7.26	8.37	11.90	110.77
T ₂ - 100% RDF	140.80	154.60	7.56	8.53	12.20	116.97
T ₃ - 100% RDF + FYM @ 5t ha ⁻¹	144.40	166.27	7.79	9.03	12.90	125.97
T ₄ - T ₃ + FeSO ₄ @ 25 kg ha ⁻¹	173.40	213.27	9.14	10.53	15.00	143.37
T ₅ - T ₃ + ZnSO ₄ @ 25 kg ha ⁻¹	151.47	182.67	7.86	9.30	13.17	124.87
T ₆ - T ₃ + Multi micronutrient Grade-I @ 25 kg ha ⁻¹	170.00	209.67	9.08	10.50	14.90	140.03
T ₇ - T ₃ + Multi micronutrient Grade-I + Biomix @10 kg ha ⁻¹	181.07	239.33	9.21	10.70	15.57	153.53
SE ±	7.593	10.70	0.40	0.43	0.70	5.90
CD @ 5%	22.761	32.09	1.18	1.30	2.12	17.69
General mean	157	187.92	8.27	9.57	13.74	130.70

*AH-at harvest *DAS- days after sowing

Yield and yield attribute

The yield attributes were recorded at the time of harvest. The highest number of pods plant⁻¹ (269.87), number of seeds pod⁻¹

(4.20), number of seeds plant⁻¹ (1151.07), seed yield plant⁻¹ (93.27 g), seed index (13.00 g), seed yield (3110 kg ha⁻¹), stalk yield (9996 kg ha⁻¹), biological yield (13105 kg ha⁻¹) and harvest index

(23.74%) was recorded from the application of 100% RDF + FYM @ 5t ha⁻¹ + Multi micronutrient Grade-I @ 25 kg ha⁻¹ + Biomix @ 10 kg ha⁻¹ (T₇), it was found at par with 100% RDF + FYM @ 5t ha⁻¹ + FeSO₄ @ 25 kg ha⁻¹ (T₄) and 100% RDF + FYM @ 5t ha⁻¹ + Multi micronutrient Grade-I @ 25 kg ha⁻¹ (T₆), and was found to be significantly superior over rest of the treatments. The treatment control (T₁) recorded lowest values of yield and yield attribute.

The application of biomix @ 10 kg ha⁻¹ and multi micronutrient grade-I @ 25 kg ha⁻¹ supplies the essential nutrients and optimizes

the physiological process in pigeonpea plant, which increases the production and filling of pods, enhancing the uptake of nutrients from soil, improving crop's capacity for photosynthetic activity and assimilation through their involvement in the enzymatic and other biochemical processes. Efficient nutrient transfer from source to sink resulted in betterment of yield characteristics and ultimately increases the yield of pigeonpea leading to higher seed yield plant⁻¹, biological yield and harvest index. These findings were similar with Priyanka *et al.* (2024) [4], Kharkongor *et al.* (2020) [2], Tiwari *et al.* (2012) and Kumar *et al.* (2020) [3].

Table 2: Number of pods plant⁻¹, number of seeds pod⁻¹, number of seeds plant⁻¹, seed yield plant⁻¹ (g) and seed index (g) of pigeonpea as influenced by different treatments

Treatment	No. of pods plant ⁻¹	No. of Seeds pods ⁻¹	No. of seeds plant ⁻¹	Seed yield plant ⁻¹ (g)	Seed index (g)
T ₁ - Control	201.67	3.50	723.20	57.00	11.67
T ₂ - 100% RDF	225.20	3.57	806.88	59.73	12.00
T ₃ - 100% RDF + FYM @ 5t ha ⁻¹	229.87	3.77	869.23	74.93	12.00
T ₄ - T ₃ + FeSO ₄ @ 25 kg ha ⁻¹	249.17	4.03	1022.13	85.73	12.50
T ₅ - T ₃ + ZnSO ₄ @ 25 kg ha ⁻¹	233.40	3.83	909.57	76.20	12.17
T ₆ - T ₃ + Multi micronutrient Grade-I @ 25 kg ha ⁻¹	245.83	3.97	1016.16	83.13	12.33
T ₇ - T ₃ + Multi micronutrient Grade-I + Biomix @ 10 kg ha ⁻¹	269.87	4.20	1151.07	93.27	13.00
SE ±	10.64	0.15	50.94	4.59	0.98
CD @ 5%	31.89	NS	152.70	13.75	NS
General mean	236.43	3.84	928.32	75.71	12.24

Table 3: Seed yield, stalk yield, biological yield (kg ha⁻¹) and harvest index of pigeonpea as influenced by different treatments

Treatment	Seed yield (kg ha ⁻¹)	Stalk Yield (kg ha ⁻¹)	Biological yield (kg ha ⁻¹)	Harvest Index (%)
T ₁ - Control	1692	7434	9126	18.54
T ₂ - 100% RDF	1982	8416	10398	19.06
T ₃ - 100% RDF + FYM @ 5t ha ⁻¹	2287	8563	10850	21.14
T ₄ - T ₃ + FeSO ₄ @ 25 kg ha ⁻¹	2825	9805	12630	22.40
T ₅ - T ₃ + ZnSO ₄ @ 25 kg ha ⁻¹	2449	8785	11234	21.91
T ₆ - T ₃ + Multi micronutrient Grade-I @ 25 kg ha ⁻¹	2773	9610	12383	22.36
T ₇ - T ₃ + Multi micronutrient Grade-I + Biomix @ 10 kg ha ⁻¹	3110	9996	13106	23.74
SE ±	117	368	520	-
CD @ 5%	350	1104	1559	-
General mean	2446	8944	11414	21.31

*AH-at harvest *DAS- days after sowing

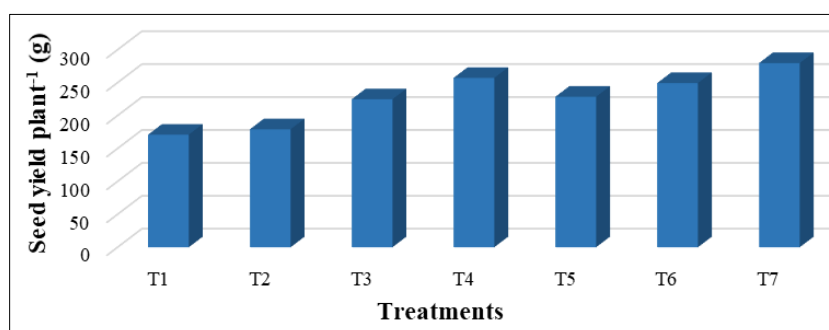


Fig 1: Seed yield plant⁻¹ (g) of pigeonpea as influenced by different treatments at harvest

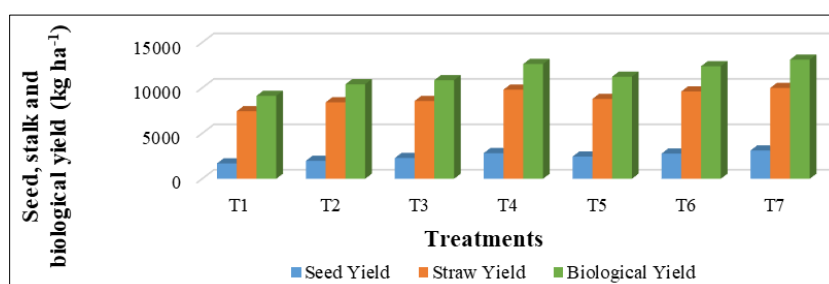


Fig 2: Seed yield, stalk yield, biological yield (kg ha⁻¹) of pigeonpea as affected by various treatments at harvest.

Conclusion

The application of 100% RDF + FYM @ 5 t ha⁻¹ + Multi micronutrient Grade-I @ 25 kg ha⁻¹ + Biomix @10 kg ha⁻¹ (T₇) showed significantly highest growth, yield and quality parameters in pigeonpea crop. This treatment was in close significance with the application of 100% RDF + FYM @ 5t ha⁻¹ + FeSO₄ @ 25 kg ha⁻¹ (T₄) and 100% RDF + FYM @ 5t ha⁻¹ + Multi micronutrient Grade-I @ 25 kg ha⁻¹ (T₆).

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