



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(8): 1509-1512
Received: 14-06-2026
Accepted: 18-07-2026

LK Duveio

PG Scholar, Department of
Agronomy, College of Agriculture,
Latur, VNMKV, Parbhani,
Maharashtra, India

VP Suryavanshi

Professor, Department of
Agronomy, College of Agriculture,
Latur, VNMKV, Parbhani,
Maharashtra, India

MJ Patange

Assistant Professor, Department of
Agronomy, College of Agriculture,
Latur, VNMKV, Parbhani,
Maharashtra, India

OR Patne

PG Scholar, Department of
Agronomy, College of Agriculture,
Latur, VNMKV, Parbhani,
Maharashtra, India

K Chandana

PG Scholar, Department of
Agronomy, College of Agriculture,
Latur, VNMKV, Parbhani,
Maharashtra, India

K Anusha

PG Scholar, Department of
Agronomy, College of Agriculture,
Latur, VNMKV, Parbhani,
Maharashtra, India

Corresponding Author:

LK Duveio

PG Scholar, Department of
Agronomy, College of Agriculture,
Latur, VNMKV, Parbhani,
Maharashtra, India

Studies on the effect of different methods of microbial consortia application on growth and yield of pigeon pea [*Cajanus cajan* (L.) Millsp.] under integrated nutrient management

LK Duveio, VP Suryavanshi, MJ Patange, OR Patne, K Chandana and K Anusha

DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i8s.6451>

Abstract

A field trial was conducted during *kharif* season, 2025-26 at the Experimental Farm, Department of Agronomy, College of Agriculture, Latur (Maharashtra), to study the effect of different methods of microbial consortia application on growth and yield of pigeon pea [*Cajanus cajan* (L.) Millsp.] under integrated nutrient management. The experimental field was laid out in a Randomized Block Design (RBD) with seven treatments and replicated three times. The treatments were T₁: RDF; T₂: RDF + FYM @ 5 t ha⁻¹; T₃: T₂ + seed treatment of microbial consortia @ 6 ml kg⁻¹ seed; T₄: T₂ + soil application of microbial consortia @ 10 kg ha⁻¹; T₅: T₂ + foliar spray of microbial consortia @ 1% at 60 and 90 DAS; T₆: T₂ + drenching with microbial consortia @ 2% at 60 and 90 DAS; and T₇: Control. The results showed that the application of RDF + FYM @ 5 t ha⁻¹ + soil application of microbial consortia @ 10 kg ha⁻¹ (T₄) showed significantly highest growth attributes viz. plant height, number of functional leaves plant⁻¹, leaf area plant⁻¹, number of primary and secondary branches and total dry matter accumulation plant⁻¹ which was at par with application of RDF + FYM @ 5 t ha⁻¹ + drenching with microbial consortia @ 2% at 60 and 90 DAS (T₆) and was found to be significantly superior over rest of the treatments. Highest seed yield was recorded by the application of RDF + FYM @ 5 t ha⁻¹ + soil application of microbial consortia @ 10 kg ha⁻¹ (T₄) which was at par with RDF + FYM @ 5 t ha⁻¹ + drenching with microbial consortia @ 2% at 60 and 90 DAS (T₆).

Keywords: Pigeon pea, microbial consortia, integrated nutrient management, FYM, soil application, foliar application, growth and yield

Introduction

Pigeon pea (*Cajanus cajan* L.), widely known as tur, arhar, or red gram, is an important pulse crop cultivated primarily for its edible seeds. It belongs to Fabaceae (or Leguminosae) family. Owing to its adaptability and diverse uses, the crop is extensively grown in semi-arid and tropical regions across the world. It originated from the Indian subcontinent roughly 3500 years ago (Van der Maesen, 1980) [12]. Pigeon pea is a nutritionally important pulse crop, with seeds containing approximately 18-25% protein, 45-60% carbohydrates, about 8% crude fibre, and 2-3% fat. Its favourable nutritional composition makes it an important complement to cereal-based diets, as legumes and cereals provide complementary amino-acid profiles (Haji *et al.*, 2024) [6]. India is the major producer and consumer of pigeon pea, however, fluctuations in production due to climatic variability and other production constraints necessitate improved and sustainable crop management practices.

The excessive reliance on chemical fertilizers has contributed to soil degradation, reduced microbial activity and declining soil organic carbon content (Ghosh *et al.*, 2020) [5]. Integrated Nutrient Management (INM), which combines organic manures, inorganic fertilizers and microbial consortia such as biomix, has emerged as a sustainable approach for enhancing crop productivity, improving nutrient-use efficiency and maintaining soil fertility. The integration of chemical fertilizers with organic manures has been reported to sustain soil health and productivity while stabilizing crop production compared with the use of individual components alone (Yadav

& Prasad, 1992) ^[13]. A microbial consortium (Biomix) was developed at VNMKV, Parbhani, comprising a combination of fourteen beneficial microorganisms viz., *Trichoderma* spp., *Pseudomonas* spp., *Paecilomyces*, *Beauveria*, *Gluconacetobacter*, *Bacillus*, *Verticillium lecanii*, *Azospirillum*, *Aspergillus*, *Metarhizium* spp. and pink-pigmented facultative methylotrophs (PPFM). The use of microbial consortia can enhance nutrient availability, promote plant growth, reduce dependence on chemical inputs while improving crop productivity and soil health and contribute to the biological management of pests and diseases. (Neware *et al.*, 2025) ^[8]. However, the effectiveness of microbial consortia may vary depending on the method of application, including seed treatment, soil application and foliar spray. Therefore, the present study was undertaken to identify an effective method of microbial consortia application on the growth and yield of pigeon pea [*Cajanus cajan* (L.) Millsp.] under integrated nutrient management.

Materials and Methods

An experiment was conducted during *kharif* season, 2025-2026 at the Experimental Farm of Agronomy, College of Agriculture, Latur, which is situated on an elevation of 633.5 m above the mean sea level, between 18° 5' to 18° 24' N and 77° 36' E latitude under semi-arid region of Maharashtra state. The mean maximum temperature during crop growth period was 26.54 °C while the mean minimum temperature was 17.18 °C. The mean humidity during morning was 87.59% while mean humidity during evening was 49.92%. The soil of experimental plot was clayey in texture with chemical composition such as low in available nitrogen (140.61 kg ha⁻¹), medium in available phosphorous (16.56 kg ha⁻¹) and very high in available potassium (694.72 kg ha⁻¹). The soil was slightly alkaline in reaction and having pH 7.64. The experimental field was laid out in a Randomized Block Design (RBD) with seven treatments replicated three times. The treatments were T₁: RDF; T₂: RDF + FYM @ 5 t ha⁻¹; T₃: T₂ + seed treatment of microbial consortia @ 6 ml kg⁻¹ seed; T₄: T₂ + soil application of microbial consortia @ 10 kg ha⁻¹; T₅: T₂ + foliar spray of microbial consortia @ 1% at 60 and 90 DAS; T₆: T₂ + drenching with microbial consortia @ 2% at 60 and 90 DAS; and T₇: Control.

Sowing was done by dibbling with seed rate of 15 kg/ha. Pigeon pea variety BDN 716 (Godawari) was sown with recommended fertilizer dose of 25:50:00 NPK kg/ha. Gross plot was of size 5.4 m x 4.5 m and net plot of 3.6 m x 3.9 m. Soil application of nitrogen and phosphorous was applied through urea and SSP respectively at the time of sowing and FYM was applied at 15 days before sowing. Microbial consortia (biomix) application was given as per treatment. Standard package of practices was followed as per VNMKV guidelines. The recommended cultural practices and plant protection measures were taken. Five plants were randomly selected and tagged from each net plot to record biometric observations at various growth stages. These same plants were later harvested individually for post-harvest analysis. The data collected from various observations were organized into tables and analyzed using analysis of variance (Panse and Sukhatme, 1967) ^[9].

Result and Discussion

Growth attributes

Plant height (cm)

The application of RDF + FYM @ 5 t ha⁻¹ + soil application of microbial consortia @10 kg/ha (T₄) recorded significantly higher plant height at all growth stages of the crop which was at par with application of RDF +FYM @ 5 t ha⁻¹+ drenching with microbial

consortia @ 2% at 60 and 90 DAS (T₆) and was also found significantly superior over rest of the treatments. The results indicated that the combined effect of chemical fertilizers, FYM and soil-applied microbial consortia improves nutrient availability, enhances microbial activity in the rhizosphere, promotes root proliferation, and facilitates greater uptake of essential nutrients throughout the crop growth period. The present findings are in agreement with Devaraj *et al.*, (2024) ^[4] and Aiholli *et al.*, (2025) ^[1] who observed enhanced vegetative growth of pigeon pea under integrated nutrient management involving FYM and biofertilizer inoculation due to improved nutrient availability and enhanced microbial activity in the root zone.

Number of functional leaves and leaf area plant⁻¹

The application of RDF + FYM @ 5 t ha⁻¹ + soil application of microbial consortium @10 kg/ha (T₄) recorded significantly higher number of leaves and leaf per plant at all growth stages of the crop which was at par with application of RDF + FYM @ 5 t ha⁻¹+ drenching with microbial consortia @ 2% at 60 and 90 DAS (T₆) and was also found significantly higher over rest of the treatments from 90 DAS onwards. The integrated activity of beneficial microorganisms, together with FYM enhances biological nitrogen fixation, phosphorus solubilization, and the availability of essential nutrients. Plant growth promoting microorganisms also produced phytohormones such as auxins, gibberellins, and cytokinins, which stimulated leaf initiation, cell division, and leaf expansion. Furthermore, *Trichoderma* species improved root growth and nutrient uptake, while FYM enhanced soil physical properties, moisture retention, and microbial proliferation. The combined effects of these factors resulted in greater leaf expansion and a larger photosynthetic surface area. These findings are in agreement with the findings of Maskar *et al.*, (2018) ^[7] and Devaraj *et al.*, (2024) ^[4].

Number of primary branches and secondary branches per plant

The application of RDF + FYM @ 5 t ha⁻¹+ soil application of microbial consortia @10 kg/ha (T₄) recorded the highest number of primary branches and was at par with RDF + FYM @ 5 t ha⁻¹+ drenching with microbial consortia @ 2% at 60 and 90 DAS (T₆) which also found to be significantly superior over all other treatments. The superior performance of soil application over drenching, seed treatment and foliar spray indicates that direct incorporation of microbial consortia into the soil provided prolonged microbial colonization and sustained nutrient release in the root zone, thereby enhancing vegetative growth throughout the crop growth period. These findings are in conformity with the results of Sahay *et al.*, (2016) ^[11] and Devaraj *et al.*, (2024) ^[4].

Total dry matter accumulation per plant

The application of RDF + FYM @ 5 t ha⁻¹+ soil application of microbial consortia@10 kg/ha (T₄) recorded significantly higher plant dry matter plant⁻¹ at all growth stages of the crop which was at par with application of RDF +FYM @ 5 t ha⁻¹+ drenching with microbial consortia @ 2% at 60 and 90 DAS (T₆) and was also found significantly superior over rest of the treatments at 90, 120, 150 and at harvest. The superior performance of soil application over seed treatment, foliar spray, and drenching indicates that direct incorporation of the microbial consortium into the soil facilitated better microbial establishment in the rhizosphere, ensuring sustained nutrient release and enhanced nutrient uptake throughout the crop growth period. The present findings are in agreement with Parimala Kumar *et al.*, (2022) ^[10] and Devaraj *et al.*, (2024) ^[4].

Table 1: Mean of growth attributes of pigeon pea as influenced by various treatments

Treatments	Mean plant height plant ⁻¹ AH (cm)	No. of functional leaves plant ⁻¹ at 120 DAS	Mean leaf area plant ⁻¹ at 120 DAS (dm ²)	No. of primary branches plant ⁻¹ at harvest	No. of secondary branches plant ⁻¹ at harvest	Total dry matter plant ⁻¹ AH (g)
T ₁ - RDF	146.33	158.93	11.99	9.17	11.93	127.83
T ₂ - RDF + FYM @ 5 t/ha	153.33	162.40	12.34	9.20	12.67	138.80
T ₃ - T ₂ + seed treatment of microbial consortia @ 6 ml/kg	163.33	164.67	13.06	10.10	13.80	152.00
T ₄ - T ₂ + soil application of microbial consortia @10 kg/ha	184.33	187.87	14.83	11.70	16.03	176.00
T ₅ - T ₂ + foliar spray of microbial consortia @ 1% at 60 and 90 DAS	157.03	163.00	12.62	9.50	12.90	148.00
T ₆ - T ₂ + drenching with microbial consortia @ 2% at 60 and 90 DAS	170.07	179.47	13.90	10.50	15.13	164.23
T ₇ - Control	135.00	135.40	11.70	7.73	10.43	125.27
SE ±	4.81	7.25	0.52	0.54	0.545	6.55
CD @ 5%	14.43	21.75	1.57	1.52	1.634	19.64
General Mean	168.49	164.53	12.92	9.60	13.14	147.45

Yield (kg/ha)

The highest seed yield (2975 kg ha⁻¹), stalk yield (8633 kg ha⁻¹) and biological yield (11602 kg ha⁻¹) were recorded with the application of treatment RDF + FYM @ 5 t ha⁻¹ + soil application of microbial consortia @ 10 kg ha⁻¹ (T₄) which was at par with the

application of RDF + FYM @ 5 t ha⁻¹ + drenching of microbial consortia @ 10 kg ha⁻¹ (T₆) and was found to be significantly superior over rest of treatments. Highest harvest index (25.65) was observed with the application of RDF + FYM @ 5 t ha⁻¹ + soil application of microbial consortia @ 10 kg ha⁻¹ (T₄).

Table 2: Mean of yield of pigeon pea as influenced by various treatments

Treatments	Seed yield (kg/ha)	Stalk yield (kg/ha)	Biological yield (kg/ha)	Harvest index (%)
T ₁ - RDF	1939	6477	8416	23.06
T ₂ - RDF + FYM @ 5 t/ha	2276	7053	9330	24.41
T ₃ - T ₂ + seed treatment of microbial consortia @ 6 ml/kg	2551	7566	10117	25.34
T ₄ - T ₂ + soil application of microbial consortia @10 kg/ha	2975	8633	11602	25.65
T ₅ - T ₂ + foliar spray of microbial consortia @ 1% at 60 and 90 DAS	2431	7400	9831	24.78
T ₆ - T ₂ + drenching with microbial consortia @ 2% at 60 and 90 DAS	2700	7881	10606	25.56
T ₇ - Control	1750	6058	7808	22.47
SE ±	96	354	367	-
CD @ 5%	289	1061	1102	-
General Mean	2374	7295	9673	24.46

The integrated application of RDF, FYM and soil application of microbial consortia greater plant height, higher leaf area index, increased crop growth rate, better dry matter accumulation and improved yield components such as the number of pods and seeds per plant. The enhanced photosynthetic efficiency and efficient partitioning of assimilates during pod development resulted in better seed filling and ultimately higher grain yield and accumulation of dry matter in both vegetative and reproductive plant parts. These findings were in line with the conclusions of De *et al.*, (2025)^[3], Devaraj *et al.*, (2024)^[4] and Parimala Kumar *et al.*, (2022)^[10].

Conclusion

From above results it is concluded that the application of treatment RDF + FYM @ 5 t ha⁻¹ + soil application of microbial consortia @ 10 kg ha⁻¹ (T₄) was found to be remunerative for getting higher growth and yield attributes as well as yield of pigeon pea which was closely followed by the application of RDF + FYM @ 5 t ha⁻¹ + drenching of microbial consortia @ 10 kg ha⁻¹ (T₆).

Acknowledgement

We are grateful to Department of Agronomy, College of

Agriculture Latur, VNMKV, Parbhani for the financial assistance and infrastructural facilities provided for the conduct of this research work.

References

1. Aiholli SG, Wadile SC, Jagtap PM, Pawar PP, Bhalerao VP, Surywanshi RT. Effect of integrated nutrient management on growth, yield and economics performance of pigeon pea (*Cajanus cajan* L. Millsp.). *Int J Res Agron*. 2025;8(9):1018-1024.
2. Bathula V, Malla MR, Sarada C, Vijayakumar S, Kumar NV, Yakadri M, *et al.* Integrated agronomic practices and their impact on hybrid pigeonpea productivity. *Plant Sci Today*. 2025;12(2):1-7.
3. De B, Saha D, Das P, Awasthi DP, Thangjam B, Das RC, *et al.* Long-term assessment of organic nutrient management on the productivity, resilience, and profitability of pigeonpea (*Cajanus cajan*) in the North Eastern Region, India. *Indian J Agron*. 2025;70(Special Issue):S68-S74.
4. Devaraj AG, Isaac SR, Rajasree G. Nutrient management in short duration pigeon pea [*Cajanus cajan* (L.) Millsp.] in the southern laterites of Kerala. *J Trop Agric*. 2024;62(1):127-130.

5. Ghosh A, Das A, Das D, Ray P, Bhattacharyya R, Biswas DR, *et al.* Contrasting land use systems and soil organic matter quality and temperature sensitivity in North Eastern India. *Soil Tillage Res.* 2020;199:104573.
6. Haji A, Teka TA, Bereka TY, Andersa KN, Nekera KD, Abdi GG, *et al.* Nutritional composition, bioactive compounds, food applications, and health benefits of pigeon pea (*Cajanus cajan* L. Millsp.): A review. *Legume Sci.* 2024;6:e233.
7. Maskar SL, Bhosale AM, Syed SJ. Impact of bio-fertilizers and inorganic fertilizers on growth parameters of sapota [*Manilkara achras* (Mill.)] cv. Kalipatti. *Int J Chem Stud.* 2018;6(4):1056-1063.
8. Neware RA, Bhagat YS, Ambadkar CV, Salunkhe VN, Nirwal KP, Chavhan RL, *et al.* Morphological and molecular characterization of fungal isolates in VNMKV produced 'Biomix': A biocontrol consortium. *J Pure Appl Microbiol.* 2025;19(3):2154.
9. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. 2nd ed. New Delhi: Indian Council of Agricultural Research; 1967.
10. Parimala Kumar M, Suneetha Devi KB, Balaji Naik B, Jayasree G, Sreekanth PD. Response of super early pigeonpea to varied sowing windows and integrated nutrient management in Southern Telangana Zone. *Int J Bio-resour Stress Manag.* 2022;13(12):1488-1495.
11. Sahay A, Pratap T, Singh SS. Effect of integrated nutrient management on growth, yield and quality of pigeonpea (*Cajanus cajan* L. Millsp.) cv. Pusa 9. *Bioscan.* 2016;11(Supplement 1):293-296.
12. Van der Maesen LJG. India is the native home of the pigeonpea. In: Arends JC, Boelema G, de Groot CT, Leeuwenberg AJM, editors. *Liber gratulatorius in honorem H. C. D. de Wit. Miscellaneous Papers No. 19.* Wageningen: Landbouwhogeschool; 1980. p. 257-262.
13. Yadav RL, Prasad SR. Conserving the organic matter content of the soil to sustain sugarcane yield. *Exp Agric.* 1992;28(1):57-62.