Research Article

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Influence of VAM fungi on growth of jackfruit (*Artocarpus heterophyllus* L.) cv. Rudrakshi, soil parameters and microbial population of soil

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ABSTRACT

The soil application of various VAM treatments significantly influenced the growth of jackfruit (*Artocarpus heterophyllus* L.) cv. Rudrakshi. Among the treatments, T_6 (RDF + 70g VAM) was found to be significantly superior to all others with respect to plant growth and soil parameters. T_6 recorded the highest plant height (1.40 m), plant girth (148.42 mm), number of leaves per shoot (48.00) and number of shoots per plant (29.67). In addition, it also resulted in improved soil characteristics, including optimal pH (7.23) and population of fungi (10.67×10^3 cfu g^{-1}).

Introduction

The jackfruit (*Artocarpus heterophyllus* L.) is a valuable fruit tree in tropical and subtropical area belonging to the family Moraceae. It has a lot of potential for adding value. Both ripe and mature green jackfruit can be used to make over 100 processed items. As per NHB second advance estimates (2024-25), the total area in India under jackfruit cultivation is 1.86 lakh hectares, and production is 32.84 lakh metric tonnes (Anonymous, 2024-25).

Research highlights that soil microbes including VAM improves soil structure and microbial activity around the rhizosphere, creating favorable conditions for long-term growth and sustainability. Rhizosphere soil has been reported useful in improving the soil microorganism for plants and subsequently growth and development (Hodge *et al.*, 2001; Tippannavar and Singh, 2023 and Gahlot *et al.*, 2024). Hence, the study aims to evaluate the effect of VAM on jackfruit growth, soil properties, and soil microbial populations.

Material and Methods

The study was conducted during 2024–25 on jackfruit (*Artocarpus heterophyllus* L.) cultivar Rudrakshi, with the objective of evaluating the effect of Vesicular Arbuscular Mycorrhiza (VAM) on plant growth, soil parameters, and microbial population dynamics. The experiment consisted of 7 treatments, viz. T_0 (control), T_1 (RDF + 20g VAM), T_2 (RDF + 30g VAM), T_3 (RDF + 40g VAM), T_4 (RDF + 50g VAM), T_5 (RDF + 60g VAM) and T_6 (RDF + 70g VAM). The investigation was carried out at the Instructional Farm, Department of Fruit Science, College of Horticulture and Forestry, Jhalrapatan, Jhalawar. The age of the plants was two and a half years. The treatments were administered in the root zone of the plants at the start of the experiment. These treatments were applied after recording the initial growth and development parameters of the plants, just before the treatment application.

The experiment was laid out in a Randomized Block Design with three replications. The plant growth parameters

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were recorded initially during April, 2024 and then after every four-month interval till April, 2025. Thus, during the experiment, right from April, 2024 to April, 2025, observations were recorded four times (including initial and intermediate observations) during April, August, December, 2024 and April, 2025 for different plant parameters.

Soil parameters were recorded initially and at the termination of the experiment during April, 2025. The undisturbed soil samples were drawn from 0-30 cm depth with the help of auger from rhizosphere of plant. These soil samples were processed and stored in polyethylene bags till their analysis for various parameters. The pH and electrical conductivity of the soil were analyzed using the procedure described by Richards (1954). Soil organic carbon and microbial populations were estimated following the methods of Walkley and Black (1934) and Schmidt and Caldwell (1967), respectively.

Results and Discussion

The data presented in the Table 1 & 2 clearly demonstrate a significant effect of VAM application on growth parameters of jackfruit. A consistent increase in plant height was observed with the progressive application of higher VAM doses in combination with the recommended dose of fertilizer (RDF). There was a progressive increase in plant height across all treatments during the study period. The highest plant height was observed in T_6 (RDF + 70g VAM), which reached 1.40 m in April 2025. This represented an 18.64% **increase** over the initial height (1.18 m in April 2024) and was significantly higher than all other treatments. A similar trend was observed in plant girth. The maximum girth was recorded in T_6, reaching 148.42 mm by April 2025, showing a 23.40% increase over the initial measurement (120.7 mm in April 2024). This was significantly higher than all other treatments.

A progressive increase in the number of leaves per shoot was observed from April 2024 to April 2025 across all treatments. The maximum number of leaves per shoot was recorded in T_6 (RDF + 70g VAM), which reached 48.00 leaves per shoot in April 2025, showing a 453.63**%** increase over the control (T_0, 23.67 leaves per shoot). This was followed by T_5 (RDF + 60g VAM) with 42.33 leaves (429.12%), and T_4 (RDF + 50g VAM) with 40.33 leaves (425.81%). Similarly, the number of shoots per plant increased significantly with higher levels of VAM application. The maximum number of shoots per plant was observed in T_6, with 29.67 shoots in April 2025, representing a 128.23% increase over the control (14.00 shoots). This was followed by T_5 (28.67 shoots; 126.28%) and T_4 (26.33 shoots; 119.41%). These findings suggest that the application of VAM, particularly at 70g per plant (T_6), in conjunction with RDF, significantly enhances the vegetative growth of jackfruit. The results are in close conformity to the findings of Wu *et al.* (2010) and Kumari *et al.* (2017).

The study indicated that VAM significantly influenced the soil parameters like pH and population of fungi (Table 3). The minimum soil pH (7.33) was observed in treatments T_2 (RDF + 30g VAM) and T_5 (RDF + 60g VAM), which was comparable to T_6 (RDF + 70g VAM), with a pH of 7.34 at termination of the experiment. Throughout the various observation periods, the treatments had a non-significant impact on electrical conductivity. The amount of organic carbon in the soil varied considerably; however, it was not significantly affected by the various VAM treatments.

The treatment T_6 (RDF + 70g VAM) recorded the highest microbial population (Fungi: 10.67×10^3 cfu g^{-1} soil), which was significantly higher than all other treatments at the end of the experiment (April 2025). The bacterial population was not significantly affected by the various VAM treatments throughout the experiment. The beneficial effect of VAM on different soil parameters was also reported by several researches in different crops and the findings of this study are in line with those of Singh *et al.* (2010), Dutta and Kundu (2012), Sharma *et al.* (2017) and Nandish *et al.* (2020).

Table 1. Effect of VAM on height of plant and plant girth of jackfruit cv. Rudrakshi

Treatments	Plant height (m)*				Plant girth (mm)*			
	Apr-24	Aug-24	Dec-24	Apr-25	Apr-24	Aug-24	Dec-24	Apr-25
T_0 (Control) RDF	1.15	1.17 (1.73%)	1.21 (5.21%)	1.23 (6.95%)	120.08	122.06 (1.64%)	126.09 (5.00%)	130.14 (8.37%)
T_1 (RDF + 20g VAM)	1.16	1.19 (2.58%)	1.24 (6.89%)	1.28 (10.34%)	120.1	123.08 (2.47%)	128.12 (6.66%)	132.20 (10.06%)
T_2 (RDF + 30g VAM)	1.16	1.20 (3.44%)	1.26 (8.62%)	1.30 (12.06)	120.4	124.11 (3.30%)	130.14 (8.32%)	135.24 (12.56%)
T_3 (RDF + 40g VAM)	1.17	1.22 (4.27%)	1.29 (10.25%)	1.34 (14.52%)	120.8	125.14 (4.12%)	132.17 (9.97%)	138.28 (15.06%)

T_4 (RDF + 50g VAM)	1.17	1.22 (4.27%)	1.29 (10.25%)	1.35 (15.38%)	120.1	127.17 (5.78%)	134.21 (11.67%)	142.33 (18.40%)
T_5 (RDF + 60g VAM)	1.18	1.24 (5.08%)	1.31 (11.01%)	1.37 (16.10%)	120.3	128.17 (6.60%)	136.24 (13.31%)	145.37 (20.90%)
T_6 (RDF + 70g VAM)	1.18	1.25 (5.93%)	1.33 (12.71`%)	1.40 (18.64%)	120.7	129.24 (7.45%)	138.28 (14.97%)	148.42 (23.40%)
SEm (±)		0.002	0.004	0.004	-	0.013	0.004	0.003
CD (5%)		0.007	0.012	0.012	-	0.041	0.013	0.010

*Per cent increase in parentheses

Table 2. Effect of VAM on the number of leaves per shoot and the number of shoots per plant in jackfruit cv. Rudrakshi

Treatments	Number of leaves per shoot*				Number of shoots per plant*			
	Apr-24	Aug-24	Dec-24	Apr-25	Apr-24	Aug-24	Dec-24	Apr-25
T_0 (Control) RDF	6.33	10.33 (63.19%)	18.67 (194.94%)	23.67 (273.93%)	10.3	11.00 (6.48%)	13.33 (29.04%)	14.00 (35.52%)
T_1 (RDF + 20g VAM)	6.67	11.67 (74.96%)	26.67 (289.80%)	32.00 (379.76%)	10.7	13.33 (24.92%)	16.00 (49.95%)	19.33 (81.16%)
T_2 (RDF + 30g VAM)	7.0	13.00 (85.71%)	27.33 (290.42%)	34.33 (390.42%)	11.0	14.67 (33.36%)	18.33 (66.63%)	22.33 (103.00%)
T_3 (RDF + 40g VAM)	7.3	13.67 (86.49%)	28.67 (291.13%)	37.00 (404.77%)	11.3	15.67 (38.30%)	19.00 (67.69%)	24.67 (117.74%)
T_4 (RDF + 50g VAM)	7.7	14.67 (91.26%)	30.33 (295.43%)	40.33 (425.81%)	12.0	16.67 (38.91%)	21.33 (77.75%)	26.33 (119.41%)
T_5 (RDF + 60g VAM)	8.0	16.00 (100.00%)	32.33 (304.12%)	42.33 (429.12%)	12.7	17.67 (39.46%)	22.67 (78.92%)	28.67 (126.28%)
T_6 (RDF + 70g VAM)	8.7	17.67 (103.80)	35.33 (307.49%)	48.00 (453.63%)	13.0	18.33 (41.00%)	23.33 (79.46%)	29.67 (128.23%)
SEm (±)		0.304	0.549	0.321	-	0.477	0.192	0.236
CD (5%)		0.938	1.692	0.990	-	1.470	0.593	0.726

*Per cent increase in parentheses

Table 3. Soil parameters of jackfruit cv. Rudrakshi orchard as affected by soil application of VAM

Treatments	pH	Electrical conductivity (dS m^{-1})	Organic carbon (%)	Bacteria (× 10^5 cfu/ g soil)	Fungi (× 10^3 cfu/ g soil)
Initial value	7.37	0.45	0.30	3.07	3.00
T_0 (Control) RDF	7.36	0.44	0.31	3.07	3.00
T_1 (RDF + 20g VAM)	7.35	0.45	0.32	3.12	3.67
T_2 (RDF + 30g VAM)	7.33	0.47	0.34	3.26	4.67
T_3 (RDF + 40g VAM)	7.34	0.47	0.34	3.24	6.00
T_4 (RDF + 50g VAM)	7.34	0.48	0.34	3.23	7.33
T_5 (RDF + 60g VAM)	7.33	0.50	0.34	3.29	8.67
T_6 (RDF + 70g VAM)	7.34	0.51	0.35	3.36	10.67
SEm (±)	0.003	NS	NS	NS	0.35
CD (5%)	0.010	NS	NS	NS	1.08

Conclusion

Based on the findings from the field experiment, treatment T_6 (RDF + 70g VAM) proved to be significantly superior to all other treatments in terms of vegetative growth of jackfruit and soil parameters. The plant growth characters viz., plant height (1.40 m), plant girth (148.42 mm), number of leaves per shoot (48.00), number of shoots per plant, (29.67), increased significantly under T_6 (RDF + 70g VAM) treatment over other treatments. The treatment T_6 (RDF + 70g VAM) significantly improved the soil attributes such as pH (7.34) and microbial population (fungi 10.67 × 10^3 cfu g^{-3}) as compared to other treatments. Overall, the soil application of T_6 treatment (RDF + 70g VAM) in jackfruit cv. Rudrakshi plant was found highly effective to enhance the plant growth and soil attributes.

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Conflict of Interest

The authors declare no conflict of interest.

Data Sharing

All relevant data are within the manuscript.

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