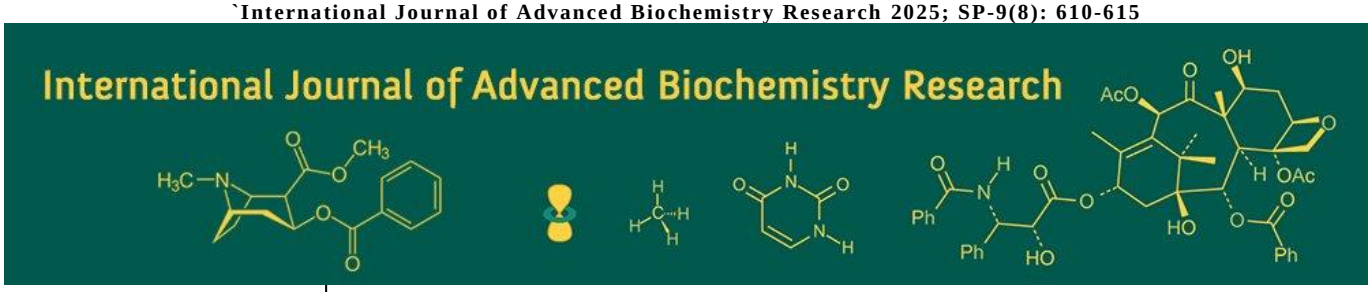

ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2025): 5.29
IJABR 2025; SP-9(8): 610-615
www.biochemjournal.com
Received: 23-06-2025
Accepted: 25-07-2025

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Study of different varieties of Jackfruit (*Artocarpus heterophyllus*) for morphological characterization under Prayagraj agro-climatic condition

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DOI: https://www.doi.org/10.33545/26174693.2025.v9.i8Sj.5215

Abstract
Aim: Study of different varieties of Jackfruit (*Artocarpus heterophyllus*) for morphological characterization under Prayagraj agro-climatic condition.
Study design: Randomized block design (RBD)
Place and duration of study: Horticulture Research Field, Naini Agricultural Institute, Sam Higginbottom University of Agriculture Technology and Sciences (SHUATS), Prayagraj, Uttar Pradesh, India during 2024-25
Methodology: The experiment constitutes of 20 different varieties *viz*., V_1: Janagere, V_2: Vietnam SE, V_3: Nagachandra, V_4: G11, V_5: Prashanthi, V_6: Sampoorna, V_7: Singapore, V_8: Rudrakshi Red, V_9: Mankala Red, V_{10}: Varashree Y, V_{11}: Thailand New, V_{12}: Ramchandra, V_{13}: Red moon, V_{14}: Honey Jack, V_{15}: Kini Singapore, V_{16}: Shankara, V_{17}: Nagadaka, V_{18}: Wild Jack, V_{19}: Harishchandra, and V_{20}: Gumless.
Results: Among the varieties, maximum height(117.67cm), leaf area (72.80 cm), leaf width (70.40 cm) and chlorophyll content (65.33) was recorded in Nagachandra and maximum leaves (1055.33), branches (103), buds (119.66), stem girth(10.4mm) and survival percentage (98%) was recorded in Harishchandra. It is be concluded that variety Harishchandra was found to be most suitable variety followed by var. Nagachandra with respect to percentage increase in number of buds and survival percentage.

Keywords: Jackfruit, varieties, morphological character, growth parameters, and survival percentage

Introduction
The jackfruit (*Artocarpus heterophyllus* Lam.) is a tropical evergreen tree belonging to the Moraceae family. The jackfruit is native to India and is renowned for its large fruit, which is a staple food in many parts of the country. The fruit is often referred to as the "poor man's food" due to its affordability and nutritional value.

Jackfruit is a versatile fruit that can be used in various culinary preparations. The immature fruit can be used as a vegetable, while the ripe fruit is eaten fresh or used to make canned products, nectar, preserves, jam, jelly, squash, fruit bar, and candy. The seeds are also edible and can be roasted or boiled

Traditional uses of jackfruit for medicinal purposes are well-documented in ethno-botanical studies, highlighting its potential health benefits. Notably, jackfruit contains isoflavones, antioxidants, and phytonutrients that contribute to its anti-carcinogenic properties, particularly in its ripe fruits (Shrikant, 2012) [18]. These findings underscore the importance of jackfruit not only as a nutritious food but also as a potential source of health benefits.

India is the largest producer of jackfruit, accounting for a significant portion of global production. According to recent data, India produced 1.8 million tonnes of jackfruit, followed by Bangladesh, Thailand, and Indonesia (Julia, 2016) [10]. The country's jackfruit production is concentrated in states like Odisha, Kerala, Assam, and West Bengal.

Morphological characterization is essential for understanding the diversity of jackfruit varieties and their adaptability to different agro-climatic conditions. This study will focus on evaluating the physical characteristics of different jackfruit varieties grown under Prayagraj agro-climatic conditions. The morphological traits to be studied include fruit size, shape, color, and texture, as well as leaf and tree characteristics.

The study will provide valuable insights into the morphological diversity of jackfruit varieties and their potential for cultivation in different regions. By identifying the most suitable varieties for specific agro-climatic conditions, farmers and researchers can develop more effective breeding and cultivation strategies.

Material and methods/Experimental details/Methodology

The present investigation "Study of different varieties of Jackfruit (*Artocarpus heterophyllus*) for morphological characterization under Prayagraj agro-climatic condition)" was carried out in the Horticulture Research Field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agricultural, Technology and Sciences, Prayagraj (Uttar Pradesh) during 2024-2025, SHUATS, Prayagraj. The details of materials used and techniques adopted during the course of investigation are mentioned below:

Experimental site

The experimental site of the research farm which falls under Geographical Co-ordinates of Prayagraj District which is located at $25^{0}58^{''}$ N latitude and 81^{0} 52^{1} E longitude with an altitude of 98 meter above mean sea level and is situated 5km away on the right bank of Yamuna-river. It represents the agro-ecological Sub Region [North Alluvial plain Zone (0-1% slope)] and Agro-Climatic Zone (Upper-Gangetic Plain Region).

Climate

The area of the region which is characterized by sub-tropical and has semi-arid type of climate, which experience extremely hot and dry summer spells from April to June where temperature reaches maximum up to 46 °C and touches 48 °C followed by relative humidity during July to September ranged from 20-90 percent, fairly seldom falls of cold with frosty spells as low as 4 °C and dips 2 °C is noticed. The rainfall in this particular region starts from middle of July to end of September and commonly known as summer monsoon (South-West monsoon) which brings major portion of rainfall (75 percent) with mean annually around 900 to 1100 mm.

Experimental details

Crop	**Jackfruit (*Artocarpus heterophyllus*)**
Family	Moraceae
Design of Experiment	Randomized Block Design [RBD]
Experimental Site	Horticulture Research Farm, Department of Horticulture, SHUATS, Prayagraj, U.P., India
No. of Treatments	20
No. of Replications	3
No. of Plants per treatment	1
Total No. of Plants	60
Width of sub irrigation channel	0.50 m
Width of main irrigation channel	1.00 m
Width of Ring	0.30 m
Total length of the Area	46 m
Total width of the Area	8.8 m

Design and layout

The experiment was laid out in Randomized Block Design comprising of 20 treatments with three replications. The treatments in each replication were allotted randomly.

Details of the treatment

The 20 varieties jackfruit plants are 2 years old seedlings which were purchased from Jackfruit King Agro Producer Company and were already planted during 2023 for another research purpose.

Application of manure

The recommended dose fertilizer of N, P, K, FYM, bone meal, vermicompost, neem-cake and soil are mixed together and applied as basal application on the 1st week of March at the initial stage of the trial and the observations parameters were taken at the interval of 45days each.

R.D.F for N:P:K 600:300:240g and 50kg of FYM per plant

Varieties description

Janagere

The Janagere variety, along with NSP, has been recognized for its commercial potential due to its ellipsoid fruit shape. Studies have been conducted using RAPD markers to assess the genetic diversity among high-yielding jackfruit varieties. These studies have revealed varying degrees of genetic dissimilarity among the genotypes, with some exhibiting closer genetic relationships.

Vietnam SE

Vietnam SE jackfruit variety is distinguished by its exceptional early fruiting capability, bearing fruit in less than a year. Additionally, it exhibits a compact growth pattern, requiring minimal space, which makes it an ideal choice for small gardens or container cultivation.

Nagachandra

The Nagachandra Jackfruit variety is distinguished by its unique flavor profile, firm-fleshed and sweet, with a strong aromatic flavor. The fruit size ranges from small to medium, weighing 4-6 kilograms, with golden-yellow sweet flesh that's crispy.

G 11

The G-11 jack variety was developed by the Indian Council of Agricultural Research (ICAR) and is now widely available across India. This variety produces orange-colored fruits that are sweet to taste and yields in May-June.

Prashanthi

The Prashanthi variety of jackfruit is cultivated by Gabriel Stany Veigas, a retired district forest officer, in Neerakere, a village near Moodbidri.

Sampoorna
This variety is distinguished by its compact fruit size, dark green skin, and vibrant coppery red-colored flakes that become visible when the fruit is ripe

Singapore (or) Ceylon Jack
The Singapore or Ceylon Jack variety, introduced from Sri Lanka, is characterized by its medium-sized fruits weighing 7-10 kg, with crisp, sweet, yellow carpels. This variety is notable for its precocious bearing trait, starting to bear fruit 3 years after planting, and is available from March to June and September to December.

Rudrakshi Red Red
The Rudrakshi Red Red Jackfruit variety produces small-sized fruits weighing 4-5 kilograms, with deep-red flesh and a sweet taste. This variety is utilized in various culinary applications, including jams, jellies, and chutneys, and is also recognized for its potential health benefits.

Mankala Red
The Mankala Red Jackfruit variety is renowned for its striking scarlet color and exceptional sweetness. This variety is highly suitable for commercial cultivation, yielding up to 450 fruits per tree, with an estimated yield of 1098 kg per tree.

Varashree y
The Varashree Jack variety, developed in Karnataka, is considered one of the best jackfruit varieties available in the market. It is renowned for its pleasant taste, crisp texture, and exceptional sweetness. The fruits are medium-sized and yield in May-June.

Thai New
The Thai New Jackfruit variety is characterized by its vigorous growth pattern, forming a conical canopy with uniform fruit growth. Each jackfruit has a dark-green skin and blunt spines, and once ripe, the flesh is a deep-orange with a sweet aroma and rich flavor. One Thai new jackfruit can weigh up to 16 pounds and has 38% edible flesh.

Ramchandra
The Ramchandra jackfruit is a variety introduced from Sri Lanka, characterized by its vibrant orange pulp, medium-sized flakes, and substantial fruit size of 8-10 kilograms. This variety is notable for its twice-bearing trait, yielding fruit twice annually, and commencing production approximately three years post-planting. The fruit is available in two distinct seasons, from March to June and September to December.

Red moon
The Redmoon variety is rich in vitamins A and C, as well as minerals. It originates from the Western Ghats of India and is commonly found in Asia, Africa, and some regions of South America.

Honey Jack (Thenvarikka)
The Honey Jack, also known as Thenvarikka, is a traditional variety from Kerala, celebrated for its luscious taste and juicy texture. This variety is notable for its extended shelf life, lasting many days even after fully ripening, which makes it a preferred choice among farmers and marketers.

Kini Singapore
The Singapore Jack variety is native to Singapore and typically takes 2 years to bear fruit. The fruits are generally large in size and have a pleasant, sweet taste. The yielding season is May-June.

Shankara
The Shankara variety is a selection from a mature tree, characterized by its medium-tall growth habit and semi-spreading nature. The leaves of this variety are fairly large and dark green in color. Shankara jackfruits are known for their small size, weighing between 2-5 kg, and have a dark green skin color that turns brownish to black at the tip of the spine when ripe. Each fruit contains a substantial number of flakes, which are edible, sweet, and aromatic. The Shankara variety typically yields in April-June, with well-managed trees producing a considerable amount of fruit.

Nagadaka
The Nagadaka Jackfruit variety originates from Malaysia and is characterized by its compact growth pattern. It produces blocky jackfruits with golden color and fleshy spines, which tend to flatten and open up when the fruit matures.

Wild Jack
Artocarpus hirsutus, commonly known as Wild Jack, is a tropical evergreen tree species native to India, primarily found in Kerala, Karnataka, Maharashtra, and Tamil Nadu. It grows in moist, deciduous to partially evergreen woodlands.

Harishchandra
The Harishchandra jackfruit variety is a hybrid developed by Sir Harishchandra Desai and Sir Mithilesh Desai. This variety produces blocky-shaped fruits weighing 5-10 kilograms, with bright orange, firm, and sweet flesh. The plant exhibits a notable level of disease resistance, although it is susceptible to certain calamities.

Gumless
The Gumless Jackfruit variety is notable for its low latex levels, making it an ideal choice for various culinary applications. It produces blocky fruits weighing 13 pounds each, with deep-orange flesh that's firm and has a sweet aroma. The pulp from the Gumless Jackfruit is also sweet and 35% edible, with a crunchier texture.

Results and Discussion
The investigation titled “Study of different varieties of Jackfruit (*Artocarpus heterophyllus*) for morphological characterization under Prayagraj agro-climatic condition” was conducted at the experimental site of Department of Horticulture, Sam Higginbottom University of Agriculture, Technology, and Sciences, Allahabad, Uttar Pradesh. The data collected throughout the experiment were recorded in details in this section, with tables and illustrations provided to enhance the clarity and understanding of the results.

In terms of plant height, the maximum was recorded in treatment V3: Nagachandra (117.67 cm). This finding is in agreement with the results reported by Alavekar *et al*. (2024) [2] followed by treatment V12: Ramchandra (109.67).
In terms of number of leaves per plant, the maximum was recorded in treatment V19: Harishchandra (1055.33) followed by V3: Nagachandra.
In terms of number of branches, the maximum was recorded in V19: Harishchandra (103) followed by V9: Mankala red (76.33).
In terms of number of buds, the maximum was recorded in V19: Harishchandra (119.66) followed by V12: Ramchandra (106).
In terms of stem girth, the maximum recorded in V19: Harishchandra (10.50 mm) followed by V3: Nagachandra (10.4mm.).
In terms of leaf are, the maximum was recorded in V3: Nagachandra (72.80 cm). This finding is in agreement with the results reported by Alavekar *et al*. (2024) [2] followed by V12: Ramchandra (69.33 cm).
In terms of leaf width, the maximum was recorded in V3: Nagachandra (70.40 cm). This finding is in agreement with the results reported by Alavekar *et al*. (2024) [2] followed by V19: Harishchandra (67.96 cm).
In terms of chlorophyll content, the maximum was recorded in V3: Nagachandra (65.33). This finding is in agreement with the results reported by Alavekar *et al*. (2024) [2] followed by V12: Ramchandra (59.43 cm).
In terms of mortality percentage, the maximum was recorded in treatment V4: G11, V6: Sampoorna (100%), V15: Kini Singapore (100%) and V20: Gumless (100%) and minimum was recorded in treatment V19: Harishchandra (2%).
In terms of survival percentage, the maximum was recorded in treatment V19: Harishchandra (98%) and minimum was recorded in treatment V4: G11, V6: Sampoorna, V15: Kini Singapore and V20: Gumless V4: G11, V6: Sampoorna (0.00), V15: Kini Singapore (0.0) and V20: Gumless (0.00).
The variety Harishchandra and Nagachandra shows good adaptability in most of the growth parameters based on morphological characters under varying climatic conditions of Prayagraj. Further investigation can be done for yield and fruit quality to be recommended to the farmers for economic productions.

Table 1: Data on plant height, number of leaves, branches, buds and stem girth with statistical significance indicated.

Treatment	Plant height (cm) (180 DAT)	No. of leaves (180 DAT)	No. of branches (180 DAT)	No. of buds (180 DAT)	Stem girth (mm) (180 DAT)
V_1: Janagere	94.33	256	31.33	29.67	9.70
V_2: Vietnam SE	72	85	14	20.33	7.00
V_3: Nagachandra	117.67	673.33	69	84.67	10.40
V_4: G11	0	0	0	0	0.00
V_5: Prashanthi	85.33	471	36.67	42	8.17
V_6: Sampoorna	0	0	0	0	0.00
V_7: Singapore	95.33	168.33	28.67	36	8.70
V_8: Rudrakshi Red	86	213.67	38.33	26	8.33
V_9: Mankala Red	96	422.33	76.33	47	10.00
V_{10}: Varashree Y	83.67	73.67	15	53.33	6.83
V_{11}: Thailand New	72	51.33	41.33	42.33	7.50
V_{12}: Ramchandra	109.33	601.33	66	106	10.10
V_{13}: Red moon	93.33	143	9	33	5.17
V_{14}: Honey Jack	75.67	507	63.67	51	9.07
V_{15}: Kini Singapore	0	0	0	0	0.00
V_{16}: Shankara	105.67	196.67	18.33	28	6.83
V_{17}: Nagadaka	99	208.33	20.67	21	6.50
V_{18}: Wild Jack	96.67	428.67	30.67	38	10.00
V_{19}: Harishchandra	132.33	1054.33	103	119.67	10.50
V_{20}: Gumless	0	0	0	0	0.00
F Test	S	S	S	S	S
$CD_{@5\%}$	20.55	75.67	14.26	12.99	1.14
S.Ed.(±)	10.15	37.38	7.04	6.42	0.56
CV	16.42	16.48	26.06	20.20	10.20

Table 2: Data on leaf area, leaf width, chlorophyll content, mortality and survival percentage with statistical significance indicated.

Treatment	Leaf area (cm)	Leaf width(cm)	Chlorophyll content (SPAD)	Mortality percentage	Survival percentage
V_1: Janagere	55.33	.23	54.63	23.34	76.66
V_2: Vietnam SE	48.33	61.3355	53.5	19.00	81
V_3: Nagachandra	72.8	70.4	65.33	3.78	97.5
V_4: G11	0	0	0	100.00	0
V_5: Prashanthi	58.53	63	56.93	22.00	78
V_6: Sampoorna	0	0	0	100.00	0
V_7: Singapore	63.23	64.97	53.63	24.70	75.3
V_8: Rudrakshi Red	56.73	58.4	54.07	24.60	75.4
V_9: Mankala Red	57.33	66.93	56.43	21.78	78.3
V_{10}: Varashree Y	54.1	60.03	53.37	21.00	79
V_{11}: Thailand New	61.3	65.37	53.53	24.60	75.4
V_{12}: Ramchandra	69.33	59.63	59.43	2.60	96
V_{13}: Red moon	62.86	54.3	56.53	25.00	75
V_{14}: Honey Jack	64.85	50.7	57.9	21.50	78.5
V_{15}: Kini Singapore	0	0	0	100.00	0
V_{16}: Shankara	49.31	65.17	55.97	23.50	76.5
V_{17}: Nagadaka	56.87	56.53	54.6	21.50	78.5
V_{18}: Wild Jack	66.33	67.33	56.8	23.30	76.7
V_{19}: Harishchandra	68.43	67.97	51.97	4.50	98
V_{20}: Gumless	0	0	0	100.00	0
F Test	S	S	S		
$CD_{@5\%}$	4.85	2.6	3.73		
S.Ed.(±)	2.39	1.28	1.84		
CV	6.06	4.58	3.52		

Conclusion

From the above investigation it can be concluded that variety Harishchandra (T_{19}) was found to be most suitable variety followed by var. Nagachandra (T_3) with respect to percentage increase in number of buds and survival percentage under Prayagraj Agro-climatic condition.

Whereas, it can be concluded that var. G11 (T_4), Sampoorna (T_6), Kini Singapore (T_{15}) and Gumless (T_{20}) could not survive and the plants started dying during the hot summer of the Prayagraj agro-climatic condition.

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