Assessment of morphological diversity and vegetative growth parameters of fifteen betel vine varieties cultivated along the Odisha coast

ABSTRACT

Betel vine (Piper betle) is a tropical evergreen plant renowned for its cultural and medicinal significance. With origins in Southeast Asia, its heart-shaped leaves, vibrant colors and aromatic properties contribute to its widespread cultivation. The study investigates the morphological diversity and vegetative growth parameters of fifteen betel vine varieties cultivated along the Odisha coast, with a focus on vine elongation, leaf dimensions, internodal length, leaf area, weight of fresh leaves, number of adventitious root production and the number of leaves per meter of vine. The results revealed significant variation among the varieties. Notably, vine elongation ranged from 39.5 to 68.8 cm/month, with the Golabandha varieties showing the highest rate. Leaf length varied from 8.84 to 20.24 cm, and the Chandrakana varieties displayed the longest leaves. Leaf breadth ranged from 4.46 to 15.3 cm, with the widest leaves found in Chandrakana varieties. Internodal length varied from 3.06 to 6.46 cm, with Gunthuni having the lowest internodes. Leaf area ranged from 38.04 to 177.37 cm^2, with Chandrakana exhibiting the largest leaf area. Weight of fresh leaves varied significantly, with Chandrakana and Ralaba varieties having the highest and lowest weights, respectively. Cluster analysis grouped varieties based on their morphological characteristics, revealing distinct clusters related to leaf dimensions and growth parameters. Understanding the morphological diversity of betel vine varieties is crucial for identifying the superior varieties for sustainable cultivation and ensuring the quality of this culturally and economically significant crop.

Keywords: Betel vine, Cluster analysis, Growth parameters, Morphological parameters Odisha coast

1. INTRODUCTION

Piper betle, commonly known as 'Pan,' is a member of the Piperaceae family. This evergreen and perennial creeper has its origins in Malaysia and is now cultivated across the globe [1]. It possesses notable ethnomedicinal importance and finds extensive usage in diverse Southeast Asian nations. Traditionally, the cultivation of this crop is predominant in Southeast Asian countries such as Taiwan, Malaysia, Thailand, Sri Lanka, and India [2]. The betel vine has earned the title of the "green gold of India" due to its significance in the livelihoods of approximately 20 million individuals who are directly or indirectly involved in its production, processing, handling, transportation, and marketing within India [3]. Notable Indian states where betel vine is extensively grown include Odisha, Tamil Nadu, Madhya Pradesh, West Bengal, Maharashtra, and Uttar Pradesh [4]. It is commonly utilized in South Asia, often as betel quid or pan, frequently combined with areca nut or tobacco [5]. In Odisha's coastal districts like Balasore, Jagatsinghpur, Puri, Cuttack, Khordha, and Ganjam, betel vine is primarily grown [6]. However, India cultivates around 100 betel varieties, known as landraces, each named after the specific locality or region where they are cultivated [7]. Hence Betelvine cultivation encounters numerous challenges a rising from the presence of synonymous terms. In certain areas, identical betel plants are grown under various names, while in other regions, distinct betel plants share identical names. As a result, varieties carry the prefix 'Desi' in their names [8]. Hence, it is consistently challenging to distinguish between varieties, often labelled with local names by the farmers. To enhance betel vine production for its cultural and medicinal significance, it is crucial to identify superior landraces or germplasm that can be used to develop high-yielding varieties of the crop. Based on the information provided, the current study was initiated to morphologically and vegetatively differentiate the varieties cultivated along the Odisha coast.

2. MATERIAL AND METHODS

2.1 Plant material collection

The farmers cultivate the betel vine in the betel vineyards which is locally known in the odia vernacular “Pana Baraja”. One such “Pana Baraja” has been established at F.M. University, Balasore Campus in which different varieties of betel vine cultivated among the farmers along the Odisha coast have been collected (Table 1).

2.2 Study area

The “Pana Baraja” of the F.M. university campus is practically working as a betel vine germplasm conservatory. The “Pana Baraja” is geographically located at 21º54’N latitude, 86º81’ E longitude and at an altitude of 17 m above MSL (Mean Sea Level).

2.3 Experimental Design

The morphological characters i.e.; leaf length, leaf breadth, vine internode, petiole length, adventitious root production was measured from the 6^{th} to 10^{th} node position from the tip of betel vine by taking 10 randomly selected betelvine of same variety from the “Pana Baraj” with 5 replications [9&12]. Fresh harvestable leaves were collected which are present on 6^{th} to 10^{th} node from the tip of vine to measure the leaf area and fresh weight. The vine elongation was measured from the initially marked height of betelvine after 30days intervals. Morphological characteristics including leaf color, leaf apex shape, leaf softness, and leaf lamina orientation along the midrib were visually assessed and recorded [12].

2.3Statistical Analysis

One-way ANOVA was applied using Minitab 17 software to analyze all the data followed by the turkey HSD (Honestly Significance Difference) test which showed the variation in morphological characteristics of fifteen betel vine varieties cultivated along the Odisha coast [10]. The data matrix consists of fifteen betel vine varieties and eleven morphological characters of betel vine. Data within the row with different superscript letters were considered to be significantly different at $p < 0.05$. Hierarchical cluster analysis (HCA) was also carried out to assess the similarity and relationship between betel vine varieties. Ward's variance-minimizing method was used to evaluate the betel vine varieties dissimilarity and hierarchical clustering by using Euclidean distance [11].

Table 1. The betel vine varieties collected from different locations

No	Name of the Variety	Place of collection
1	Haldipan	Rampur Village, Purba Medinpur, West Bengal
2	Birkuli	Bhogarai, Balasore, Odisha
3	Chandrakana	Bhogarai, Balasore, Odisha
4	Aima	Baliapal, Balasore, Odisha
5	Nuagan pan	Paradeep, Odisha
6	Dhinkia pan	Paradeep, Odisha
7	Niali pan	Cuttack, Odisha
8	Golabandha	Berhampur, Odisha
9	Jugudi	Berhampur, Odisha
10	Ralaba	Berhampur, Odisha
11	Gunthuni	Puri, Odisha
12	Kakatpur Desi	Puri, Odisha
13	Bhainchigudi	Puri, Odisha
14	Balunga	Puri, Odisha
15	Mangalpur Desi	Puri, Odisha

Fig. 1. Outside and inside view of "Pana Baraja" project at F.M. University Balasore

Fig. 2. Morphological and vegetative variations of leaves in different betel vine varieties

3. RESULTS

Data presented in Table (2) showed that there were significant ($p < 0.05$) variations rated between the studied varieties of betel vine, related to its vegetative growth parameters and morphological features.

3.1 Vine Elongation

The vine elongation in different varieties of betel vine ranged from 39.5 to 68.8 cm/month. A maximum vine increment of 68.8 cm per month was recorded in the Golabandha varieties followed by Chandrakana (56.3 cm/month) and Aima (55.7 cm/month) varieties. On the other hand, the lowest vine increment of 39.5 cm was recorded in the Gunthuni varieties followed by Ralaba (40.9 cm/month) and Jugudi varieties (45 cm/month).

3.2 Leaf length

Studied varieties showed significant variation rates concerning leaf length (Table 2). Data presented the Chandrakana as the superior variety, which recorded the highest mean values of leaf length (20.24 cm), followed by Aima (20.04 cm) and Dhinkia (15.5 cm). While, the lowest mean values of leaf length were recorded by Ralaba variety (8.84 cm).

3.3 Leaf breadth

According to statistical analysis ($p < 0.05$) related to leaf breadth, data observed significant variation rates among the studied varieties (Table 2). Data presented no significant variation rates between Chandrakana (15.3 cm) and Aima (15.26 cm), which recorded the highest mean values. Whereas, the shortest leaf breadth was found in the Ralaba variety by 4.46 cm.

3.4 Internodal length

Data in (Table 2) presented the internodal length of 15 varieties varied from 3.06cm to 6.46cm. The shorter internodal length were found in Gunthuni (3.06 cm) followed by Ralaba (3.74 cm) and Jugudi (4.26cm). The Kakatpur Desi varieties was the superior variety and recorded the longest internode by 6.46 cm, while compared to the other studied varieties.

3.5 Petiole length

The petiole length of 15 betel vine varieties were varied significantly (Table 2) from 2.3 cm to 7.34cm. Bhainchigodi recorded the longest petiole (7.34 cm) followed by Aima (7.26 cm) and Niali (7.26 cm) and the shortest petiole found in the Ralaba varieties

3.6 Leaf area

Significant variation rates in leaf area among the varieties were recorded in Table 2. The highest mean value of leaf area (177.37 cm^2) was recorded in Chandrakana followed by Aima (174.18 cm^2) and Nuagan pan (170.5 cm^2), respectively, while compared to the lowest mean values of leaf area obtained by the Ralaba variety(38.04cm^2).

3.7 Weight of 100 fresh leaves

The fresh weight of 100 leaves were significantly varied among the studied varieties, as shown in Table 3. Significantly higher fresh leaf weight (521.35g) was observed in the Chandrakana followed by Aima (499.20g) and Gunthuni (446.32g) compared to the lowest fresh leaf weight observed by Ralaba varieties (70.07 g).

3.8 Adventitious root production

The adventitious roots of all the varieties varied from 2 to 10 numbers, as shown in Table 3. The maximum number of adventitious roots found in the Chandrakana varieties i.e., 10 followed by the Nuagan varieties and the lowest number of adventious roots was found in Ralaba i.e., 2.

3.9 Leaf lobe length

The leaf lobe length of 15 betel vine varieties were varied significantly as shown in the Table 3. Maximum leaf lobe length was found in Nuagan pan i.e., 5.12 cm while the lowest length found in Ralaba variety i.e., 2.26 cm.

3.10 Depth of leaf sinus

Significant variation rates in depth of leaf sinus among the varieties were recorded in Table 3. The variety Ralaba was found the lowest depth of leaf sinusi.e.,0.52cm, while no significant variation found in variety Nuagan pan, Dhinkia pan and Gunthuni which recorded the maximum depth of sinus i.e., 1.4 cm.

3.11 Number of leaves per meter of Vine

Significant variation ($p < 0.05$) in the number of leaves per meter of the vine was recorded in Table 3, which ranges from 13 to 24. The variety Gunthuni found a maximum of 24 leaves per meter of vine followed by Haldipan (19) and Ralaba (18) respectively.

3.12 Physio-Morphological features of the betel vine varieties

The betel vine varieties varied remarkably in morphological characteristics viz. leaf colour, leaf apex shape, leaf softness and leaf lamina orientation along the midrib were recorded in Table 4. The evaluation of fifteen betel vine varieties revealed that the betel leaf colour of the Haldipan varieties was yellowish green while the Mangalpur desi had dark green. The leaf apex shape of the Mangalpur desi varieties was acute while the other varieties were acuminate. Leaf lamina orientation along the midrib of all the varieties was V-shaped. The proximity of the basal lobe in varieties Niali and Kakatpur desi had closed and overlapped in the varieties of Gunthuni, while other varieties were separated. The leaf texture of Gunthuni, Kakatpur desi and Mangalpur desi was found coriaceous i.e., the leaf texture is thick and leathery while other varieties of betel vine were found membranaceous i.e., the leaf texture is thin

3.13 Cluster analysis

The relationships between the morphological characteristics and vegetative growth parameters of different betel vine varieties cultivated along the Odisha coast were derived by hierarchical clustering analysis (HCA). The relationship among them was analysed based on

the clustering pattern of the morphological characteristics of betel vine. The dendrogram obtained by HCA showed the morphological character and the Euclidean distance between the groups (fig. 3). The first main cluster (I) is again subdivided into three subcluster where the first subcluster (Ia) consist of varieties 1,12,14,2,6,7,5,13 and 11; subcluster (Ib) consist of varieties 9 while the subcluster (Ic) consist of varieties 3 and 4. The second main cluster consists of varieties 8,15 and 10. The first group (cluster I) represents the morphological characters like leaf length, leaf breadth, petiole size, and internode distance while the second group (cluster II) represents morphological characters like leaf area, leaf fresh weight and number of adventious root production as shown in (Table. 5).

Table. 2. Variation in vegetative growth parameters of different betel vine varieties grown in "Pana Baraja" at F.M. University Balasore

Varieties Name	Vine elongation(cm)/month	Leaf Length (cm)	Leaf breadth (cm)	Petiole Size (cm)	Length of internode (cm)	Leaf Area (cm^2)
Haldipan	45.5 ± 2.11^{g}	14.2 ± 0.79^{cd}	12.52 ± 0.36^{c}	5.32 ± 0.11^{de}	5.13 ± 0.32^{cd}	145.81 ± 4.14^{cd}
Birkuli	52.1 ± 1.91^{de}	15.02 ± 0.76^{bcd}	12.26 ± 0.56^{c}	6.16 ± 0.11^{bc}	6.34 ± 0.39^{a}	140.21 ± 3.42^{de}
Chandrakana	56.3 ± 2.11^{b}	20.24 ± 0.83^{a}	15.3 ± 0.37^{a}	6.08 ± 0.13^{bc}	6.46 ± 0.49^{a}	179 ± 8.39^{a}
Aima	55.7 ± 2.60^{bc}	20.04 ± 0.56^{a}	15.26 ± 0.48^{a}	7.26 ± 0.18^{a}	6.14 ± 0.36^{ab}	167 ± 8.65^{ab}
Nuagan pan	52.0 ± 0.96^{de}	15.24 ± 0.17^{bc}	12.24 ± 0.19^{c}	6.5 ± 0.14^{b}	6.12 ± 0.54^{ab}	175.17 ± 9.81^{a}
Dhinkia pan	51.8 ± 1.54^{de}	15.5 ± 0.24^{b}	13.08 ± 0.16^{bc}	6.72 ± 0.15^{ab}	6.24 ± 0.73^{a}	148.70 ± 7.67^{cd}
Niali	49.1 ± 0.60^{ef}	14.42 ± 0.67^{bcd}	11.2 ± 0.35^{d}	7.26 ± 0.15^{a}	5.36 ± 0.89^{bcd}	168.17 ± 6.74^{ab}
Golabandha	68.8 ± 0.82^{a}	14.86 ± 0.24^{bcd}	8.04 ± 0.15^{e}	4.62 ± 0.30^{ef}	5.77 ± 0.99^{abc}	121.10 ± 5.55^{f}
Jugudi	45.0 ± 1.18^{g}	12.36 ± 0.45^{f}	8.08 ± 0.16^{e}	4.14 ± 0.11^{f}	4.26 ± 0.40^{ef}	69.21 ± 4.41^{g}
Ralaba	40.9 ± 0.79^{h}	8.84 ± 0.15^{g}	4.46 ± 0.17^{f}	2.3 ± 0.23^{g}	3.74 ± 0.51^{fg}	46.25 ± 5.25^{h}
Gunthuni	39.5 ± 0.66^{h}	15.36 ± 0.15^{b}	12.66 ± 0.15^{c}	6.36 ± 0.40^{bc}	3.06 ± 0.16^{g}	130.42 ± 4.61^{ef}
Kakatpur desi	50.5 ± 0.55^{de}	15.16 ± 0.17^{bc}	13.06 ± 0.52^{bc}	5.66 ± 0.71^{cd}	5.04 ± 0.82^{cde}	155.93 ± 6.70^{bc}
Bhainchigodi	52.9 ± 0.90^{cd}	14.96 ± 0.32^{bcd}	13.58 ± 0.87^{b}	7.34 ± 0.76^{a}	6.13 ± 0.78^{ab}	168.69 ± 8.85^{ab}
Balunga	52.4 ± 1.06^{de}	14.04 ± 0.11^{de}	12.22 ± 0.38^{c}	6.06 ± 0.19^{bc}	5.84 ± 0.70^{abc}	148.65 ± 6.23^{cd}
Mangalpur desi	46.4 ± 0.48^{fg}	13 ± 0.71^{ef}	10.82 ± 0.12^{d}	5.68 ± 0.16^{cd}	4.69 ± 0.64^{de}	136.16 ± 6.84^{def}

Data in the column with distinct superscript letters are significantly different using One way ANOVA followed by Turkey HSD test ($p<0.05$)

Values are represented in the form Mean ±S.D.

Table. 3. Variation in vegetative growth parameters of different betel vine varieties grown in "Pana Baraja" at F.M. University Balasore

Varieties Name	Adventious root	Leaf depth of Sinus (cm)	Leaf lobe length (cm)	No. of Leaf/ meter of Vine	Weight of 100 fresh leaves with petiole(g)
Haldipan	7 ± 1.2^{de}	1.16 ± 0.05^{bcd}	4.44 ± 0.18^{bcd}	19 ± 0.55^{b}	393.35 ± 6.90^{efg}
Birkuli	7 ± 0.9^{de}	1.3 ± 0.07^{b}	5.08 ± 0.15^{a}	16 ± 0.55^{cd}	412.72 ± 6.57^{cde}
Chandrakana	10 ± 1.3^{a}	0.98 ± 0.08^{e}	4.16 ± 0.09^{d}	16 ± 0.71^{de}	519.13 ± 3.24^{a}
Aima	10 ± 1.0^{ab}	1.04 ± 0.05^{cde}	4.6 ± 0.12^{bc}	16 ± 0.84^{cde}	502.88 ± 5.73^{a}
Nuagan pan	11 ± 2.0^{a}	1.48 ± 0.08^{a}	5.12 ± 0.11^{a}	15 ± 0.55^{defg}	427.95 ± 8.84^{bc}
Dhinkia pan	6 ± 0.8^{e}	1.48 ± 0.08^{a}	2.32 ± 0.20^{f}	16 ± 0.45^{def}	415.57 ± 5.53^{cd}
Niali pan	6 ± 1.7^{e}	1.02 ± 0.08^{de}	4.34 ± 0.21^{cd}	16 ± 0.55^{defg}	376.33 ± 6.29^{g}
Golabandha	2 ± 0.5^{g}	0.7 ± 0.07^{f}	4.72 ± 0.20^{b}	15 ± 0.84^{defg}	223.57 ± 6.74^{i}
Jugudi	4 ± 1.0^{f}	1.48 ± 0.08^{a}	2.26 ± 0.11^{f}	17 ± 0.55^{bc}	376.51 ± 8.66^{fg}
Ralaba	2 ± 0.5^{g}	0.52 ± 0.08^{g}	2.74 ± 0.15^{e}	18 ± 0.55^{b}	73.64 ± 3.23^{j}
Gunthuni	7 ± 0.9^{cde}	1.48 ± 0.08^{a}	4.64 ± 0.11^{bc}	24 ± 0.55^{a}	447.07 ± 6.18^{b}
Kakatpur desi	7 ± 1.0^{de}	1.28 ± 0.08^{b}	4.26 ± 0.15^{d}	13 ± 0.45^{h}	395.96 ± 4.76^{ef}
Bhainchigodi	7 ± 1.7^{cde}	1.16 ± 0.09^{bcd}	4.46 ± 0.11^{bcd}	15 ± 0.55^{fg}	417.54 ± 6.36^{cd}
Balunga	9 ± 1.2^{bc}	1.2 ± 0.07^{bc}	4.48 ± 0.11^{bcd}	14 ± 0.55^{g}	402.57 ± 7.02^{de}
Mangalpur desi	8 ± 0.8^{bcd}	1.04 ± 0.05^{cde}	4.24 ± 0.11^{d}	15 ± 0.71^{efg}	283.98 ± 8.59^{h}

Data in the column with distinct superscript letters are significantly different using One way ANOVA followed by Turkey HSD test ($p<0.05$)

Values are represented in the form Mean ±S.D.

Table.4. Physio-morphological features of the different betel vine varieties cultivated in "Pana Baraja" at F.M. university Balasore

Varieties Name	Leaf colour	Leaf Apex	Leaf Lamina Orientation	Proximity of Basal Lobe	Leaf texture
Haldipan	Yellowish green	Acuminate	V shaped	Separate	Membranaceous
Birkuli	Green	Acuminate	V shaped	Separate	Membranaceous
Chandrakana	Green	Acuminate	V shaped	Separate	Membranaceous
Aima	Green	Acuminate	V shaped	Separate	Membranaceous
Nuagan pan	Green	Acuminate	V shaped	Separate	Membranaceous
Dhinkia pan	Green	Acuminate	V shaped	Separate	Membranaceous
Niali pan	Green	Acuminate	V shaped	Close	Membranaceous
Golabandha	Green	Acuminate	V shaped	Separate	Membranaceous
Jugudi	Green	Acuminate	V shaped	Separate	Membranaceous
Ralaba	Green	Acuminate	V shaped	Separate	Membranaceous
Gunthuni	Light green	Acuminate	V shaped	Overlapped	Coriaceous
Kakatpur desi	Green	Acuminate	V shaped	Close	Coriaceous
Bhainchigodi	Green	Acuminate	V shaped	Separate	Membranaceous
Balunga	Green	Acuminate	V shaped	Separate	Coriaceous
Mangalpur desi	Deep green	Acute	V shaped	Separate	Membranaceous

Table. 5. Variation of morphological characters of different betel vine varieties.

Sl. No.	Group	Morphological Characteristics
1	*Cluster Ia*	Leaf length (14.04-15.5 cm), leaf Breadth (11.2-13.58 cm), petiole size (7.34-5.66 cm), Internode size (3.06-6.34), No. of adventious root (6-11), Leaf area (130.42-175.17 cm^2), 100 fresh weights of leaf (393-447.07 g)
2	*Cluster Ib*	Leaf length (12.36 cm), leaf Breadth (8.08 cm), petiole size (4.14 cm), Internode size (4.26 cm), No. of adventious root (4), Leaf area (69.21cm^2), 100 fresh weights (376.51 g)
3	*Cluster Ic*	Leaf length (20.04-20.24 cm), leaf Breadth (15.26-15.3 cm), petiole size (6.08-7.26 cm), Internode size (6.14-6.46), No. of adventious root (10), Leaf area (167-179 cm^2), 100 fresh weights of leaf (412.72-519.13 g)
4	*Cluster II a*	Leaf length (8.84-14.86 cm), leaf Breadth (4.46-10.82 cm), petiole size (2.3-5.68 cm), Internode size (3.74-5.77 cm), No. of adventious root (2-8), Leaf area (46.25-136.16 cm^2), 100 fresh weights of leaf (73.64-283.98 g)

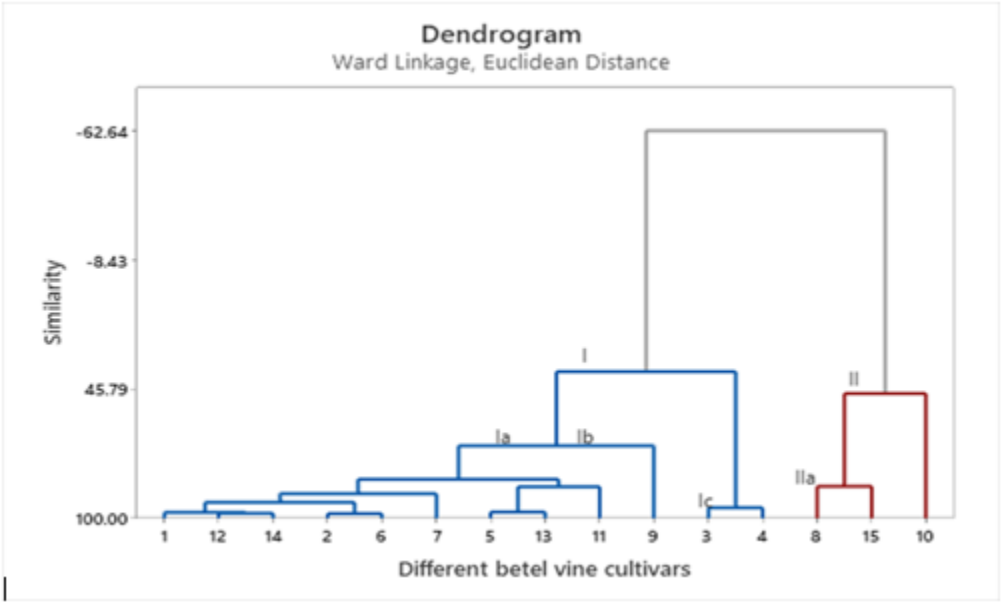

Fig. 3. Agglomerative Hierarchical Clustering (AHC) of fifteen betel vine varieties based on morphological characters.

4. DISCUSSION

The findings on various morphological parameters and vegetative growth parameters of betel vine varieties provide valuable insights into their growth and development patterns. In terms of vine elongation, significant variation was observed among the different varieties, with Golabandha exhibiting the highest rate of growth, followed by Chandrakana and Aima varieties, while Gunthuni, Ralaba, and Jugudi varieties showed comparatively lower rates of vine elongation. Leaf length and breadth also displayed significant variation among the studied varieties, with Chandrakana emerging as the superior variety in terms of both parameters. A longer vine with a shorter internode is a desirable character in betelvine [13] as it can produce a greater number of leaves due to an increase in the number of nodes. Internodal length varied notably across the varieties, with Kakatpur Desi exhibiting the longest internodes. Petiole length varied significantly, with Bhainchigodi recording the longest petioles, while Ralaba showed the shortest. Leaf area also exhibited substantial differences among the varieties, with Chandrakana demonstrating the highest leaf area. Moreover, the fresh weight of leaves varied significantly among the varieties, with Chandrakana showing the highest weight. In ideal conditions, betel vines can produce a significant number of leaves, which are the most valuable part of the plant for various purposes, including traditional and cultural practices and medicinal applications [14]. Ideal conditions for higher leaf production in betel vines include longer vines with shorter internodes, as this configuration allows for more leaves to be produced from each node. Additionally, faster vine growth results in obtaining a greater number of leaves in a shorter time frame [15]. When a stem or leaf node of a betel vine comes into contact with a suitable substrate, it readily forms adventitious roots, aiding in vegetative propagation. This process ensures efficient clonal reproduction, making betel leaf cultivation easier. Additionally, adventitious roots enhance nutrient and water uptake, aiding plant establishment. The hierarchical clustering analysis (HCA) performed on the morphological characteristics of different betel vine varieties cultivated along the Odisha coast revealed distinct relationships among the studied traits. The dendrogram generated from the HCA highlighted two main clusters, each representing a distinct set of morphological characteristics. The first main cluster (Cluster I) further divided into three subclusters (Ia, Ib, and Ic), illustrating the variability within this group. Subcluster Ia comprised several varieties exhibiting similar traits such as leaf length, leaf breadth, petiole size, and internode distance, the variety Chandrakana and Aima suggesting a close morphological relationship among these traits across these varieties. In contrast, subclusters Ib and Ic consisted of varieties with differing morphological characteristics, indicating the presence of distinct subgroups within Cluster I. The second main cluster (Cluster II) included varieties Jugudi, Ralaba and Mangalpur desi which are characterized by traits such as leaf area, leaf fresh weight, and the number of adventitious root productions, indicating a separate morphological profile from those in Cluster I. These findings provide valuable insights into the morphological diversity and vegetative growth parameters among betel vine varieties, highlighting the complex interplay between different traits and the potential implications for breeding and cultivation practices.

5.CONCLUSION

The present study conducted on fifteen different betel vine varieties cultivated along the Odisha coast provides valuable insights into the morphological variations and vegetative growth parameters of this economically significant crop. The findings reveal considerable diversity among the varieties. After meticulous evaluation, certain betel vine varieties like Chandrakana, Gunthuni and Golabandha have emerged as superior performers in key parameters. Notably, Chandrakana displays larger leaf dimensions and fresh leaf weights while the varieties Gunthuni and Golabandha show the maximum number of leaves per meter of the vine and maximum vine elongation per month respectively. The identification of superior varieties provides valuable insights for farmers, allowing them to enhance their overall productivity and quality of betel vine cultivation along the Odisha coast.

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