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## RESEARCH ARTICLE

# SPECTRUM OF VARIATION IN LAND RACES AND DIFFERENT MORPHOLOGICAL CHARACTERS OF BETEL VINE

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**ABSTRACT**

Betel vine (Piper betle L.) is a dioecious perennial cash crop and its cultivation is referred as most distinctive agricultural industry. This crop had been referred in the ancient Indian literature dating back to AD 473. Betel leaf had an esteemed position in human society from the dawn of civilization. The origin of betel vine is believed to be in Malaysia or in surrounding East Asian region. Eight crore sq. km. area in the whole of the world is estimated to be under betel vine cultivation. According to Mabberley (1997), of the 2000 cultivars of P. betle distributed in the whole world, ten were available in Nepal. Pakistan and Sri Lanka are the other important countries with respect to variability in land races. Based on the morphological characters and essential oil content, Singh (1994) grouped betel vine varieties in India into five main groups viz., Bangla, Desawari, Kapoori, Sanchi and Meetha. Meetha was grown on commercial scale in West Bengal only. The important morphological characters of betel vine include plant height internodal colour, number of lateral branches, number of leaves, leaf area and weight etc. All these characters influence yield and consumer acceptability.



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## INTRODUCTION

Betel vine (*Piper betle L.*) is a dioecious perennial cash crop and its cultivation is referred as most distinctive agricultural industry. This crop had been referred in the ancient Indian literature dating back to AD 473 (Singh, 1994). Chewing of betel leaf 'or *paan*' as it is called, was an ancient habit among all classes of people. In India this crop is mainly cultivated in West Bengal, Kerala, Karnataka and Tamil Nadu. Major portion of the betel vine cultivation of Kerala is in Malappuram district (FIB, 2014). The betel vine types grown in Malappuram district are generally known as *Tirur betel vine* and as indicated by the name, Tirur is the largest betel vine growing tract in Kerala. *Tirur betel vine* is one of the popular betel leaf exported from India to countries like Pakistan, Afghanistan, UAE and other Arab countries (Nair, 2010). However, the cultivation practices followed for *Tirur betel vine* are very conventional and developed by farmers themselves. Betel vine types from Tirur of Malappuram district are known for their characteristic pungency and fetch premium price in international markets. Consumer preference for *Tirur betel vine* is also due to superior morphological characters. Information on morphological characters will lead to successful evaluation of genotypes, which could be used for general cultivation and export purpose.

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### Variability in Betel Vine

Betel leaf had an esteemed position in human society from the dawn of civilization. The origin of betel vine is believed to be in Malaysia (Chattopadhyay and Maity, 1967) or in surrounding East Asian region. Eight crore sq. km. area in the whole of the world is estimated to be under betel vine cultivation. The major betel vine growing countries are India, Bangladesh, Sri Lanka, China, Indonesia, Malaysia, Nepal, Pakistan, South Africa, Philippines, Burma, South East Asia and Papua New Guinea (Khoshoo, 1981; Singh, 1994; Samanta, 1994; Jana, 1996; Sharma *et al.,* 1996; Ramji *et al*., 2002; Banerjee, 2012). It is believed that betel vine was introduced to Sri Lanka and other South Asian Countries by Chinese and Arab merchants (Department of Export Agriculture, Sri Lanka, 2012).

### Betel vine Cultivars of Different Countries

According to Mabberley (1997), of the 2000 cultivars of *P. betle* distributed in the whole world, ten were available in Nepal. Akther (2004) reported three main groups of betel vine varieties from Pakistan namely *Sanchi, Bangla* and *Meetha* and sub varieties like *Nuntia – Bantual, Ujani, Magai* and *Karpurkath*. Nearly ten wild relatives of betel vine and a large number of local accessions were reported from Sri Lanka (Arembewela *et al.,* 2005). *Kudamaneru*, *Mohamaneru*,

*Galdalu*, *Ratadalu*, *Nagawalli* and *Malabulath* were the common types of betel vine reported from Sri Lanka. Even though betel vine was grown all over Sri Lanka, the commercial production of export quality betel vine, with bigger leaves and dark green color combined with thickness, known as *Kalu bulath,* was significantly confined to few districts such as Kurunegala, Gampaha, Kegalle, Kalutara and Colombo (Sumanasena *et al.*, 2005). The other betel vine varieties with high export quality reported from Sri Lanka were *Maneru*, *Ratadalu* and *Galdalu.*

**Betel vine Cultivars of India**

Based on the morphological characters and essential oil content, Singh (1994) grouped betel vine varieties into five main groups *viz., Bangla, Desawari, Kapoori, Sanchi and Meetha. Bangla* had large thin leaves with nine main nerves and ovate lamina with cordate base. Leaf apex was pointed and short, not curved. Petiolar sinus of *Bangla* was more prominent than other varieties. *Desawari* had large thin leaves and cordate lamina with seven to nine nerves. Leaf of *Desawari* was pinkish in color and leaf apex was short, acuminate and curved. *Kapoori* leaves were more elliptical and lamina was thin with undulated margin. Leaf apex of *Kapoori* was acuminate and petiolar sinus was inconspicuous. Leaves of *Meetha* were large and lamina was cordate to broadly ovate and thick. *Meetha* leaf was waxy in texture with yellowish dots and three to five main nerves. Leaf apex of *Meetha* was short and pointed. It had prominent joint in the petiole. *Sanchi* had cordate leaf base with more elliptical lamina and long tapering apex. Normally seven nerves were seen in *Sanchi*. Among the above types, *Kapoori* and *Sanchi* were the principal cultivars in the peninsular India whereas *Bangla* and *Deswari* were common in North India. *Meetha* was grown on commercial scale in West Bengal only. The same classification was reported in an investigation carried out by Kumar (1999) with an additional group namely *Kasi*.

About 125 - 150 cultivars of betel vine were recognized by the cultivators and traders in India (Ranade *et al.*, 2002; Anjali *et al.,* 2004) and most of them were known by the name where they were cultivated. Ranade *et al.* (2002) reported that *Kapoori* cultivars were more heterogenous while the *Bangla* cultivars were mostly similar to each other. After evaluation of seven cultivars of betel vine in West Bengal, Sheet (2002) observed that cv. *Chandrakona* was superior with respect to most of the characters compared to other cultivars. Guha (2006) reported that 15 - 20 million people in the country consume betel leaves every day. It is cultivated in an area of 45,000 ha with an annual turnover worth Rs. 9,000 million, providing livelihood to millions of people. Betel vine has separate male and female plants. Usually the male plants are cultivated throughout India for harvesting green leaves (Lakshmi and Naidu, 2010). Betel vine cultivation is distributed in Andhra Pradesh, Assam, Bihar, Madhya Pradesh, Maharashtra, Karnataka, Kerala, Orissa, Tamil Nadu, Uttar Pradesh and West Bengal (Sugumaran *et al.,* 2011). The *Maghai* variety (literally from the Magadha region) grown near Patna in Bihar, India was reported to be the best betel leaf (Rani and Ramamurthy, 2012). Sengupta (2014) reported *Maghai* as one of the major betel vine types of India. *Piper nigrum* and *P. betle* are the widely cultivated species of *Piper* and these have attained an excellent commercial status in India. The state wise distribution of different betel vine cultivars is provided in Table 1.

**Betel vine Cultivars of Kerala**

Abraham (1986) reported three major cultivars *viz., Pozhikodi*, *Nadankodi* and *Thulasivettila* from Kerala. Out of the 42 taxa studied by Joseph (1999), five taxa were coming under *P. betle*, namely *P. betle* var. *aluva* from Kizhakambalam, *P. betle* var. *nadankodi* from Calicut, *P. betle* var. *salem* from Salem, *P. betle* var. *thekkankodi* from Idukki and *P. betle* var. *thulasikodi* from Thevera. Thomas (2004) reported *Chilanthikarpooram* as the most popular cultivated type of betel vine in Trivandrum. Nair (2010) reported *Venmony vettila* from Venmony near Chengannur as a famous cultivar from Kerala. Betel vine is cultivated in all districts of Kerala except Idukki, with a total area of 349 ha, out of this 183 ha is in Malappuram. The annual leaf production in Kerala is 21029 tonnes, of which 14071 tonnes is from Malappuram (FIB, 2014).

**Morphological Characters**

Wide variability was observed in betel vine for many morphological traits like plant vigour, leaf size, leaf shape, leaf color, internodal length and stem pigmentation (Sengupta, 2014).

**Plant Characters**

***Plant Height/ Vine Length***

In an investigation on management practices for betel vine conducted by Chandini (1989), it was found that *Chilanthikarpooram – Red, Tulasikodi, Mulamkodi, Chilenthivella, Chettankodi and Nadankodi* were the superior types with regard to plant height. *Chilanthikarpooram red* recorded a plant height of 386.83 cm at 12 months after planting (MAP). A study conducted at Kerala Agricultural University (KAU) on the yield and quality of betel vine revealed that vine length ranged from 0.31 - 0.57, 1.01 - 1.27, 2.05 -2.86, 3.0 – 3.64 and 4.12 - 4.94 m at 2, 4, 6, 8 and10 MAP respectively (Thomas, 2004). In a study conducted to evaluate betel vine cultivars in the gangetic alluvial plains of West Bengal by Pariari and Imam (2012a), vine length showed significant variation among different cultivars. During December – February, vine length was very less mainly due to low temperature. Maximum vine length (48.40 cm) was recorded in *Simurali Sanchi* which was at par with *Simurali Deshi* (48.01 cm) and *Simurali Bhabna* (45.91 cm). Observations recorded during March – May indicated that significantly higher vine length (92.23 cm) was observed in *Simurali Sanchi*. During June – August, length of vine in all the cultivars was maximum and significantly higher vine length (145.37 cm) was observed in *Simurali Sanchi*. The variation in vine length was probably due to changes in temperature and atmospheric humidity during various seasons and genetic variation among the cultivars. High humidity (84.70– 98.90%), moderate temperature (25.94$^0$C to 34.15$^0$C) and high rainfall (953.79 mm) prevailed during the period of investigation, influenced the growth of the vines.

**Table 1. Major betel vine cultivars reported from different states in India**

| States | Betel vine types/cultivars | References |
|---|---|---|
| Orissa | Godi Bangla, Nova Cuttak, Sanchi,Birkoli, Bangla, Bihari, Deshi local, Dhob Mahata , Kala Mahata, Mitha. | Singh, 1994. |
| Tamil Nadu | Pachaikodi, Vellaikodi, Thulasi, Venmani, Arikodi, Kalkodi, Karilanchi, Karpuram, Chelanthikarpuram, Koottakkodinandan, Perumkodi, Amaravila, Pramuttan, Kallarkodi, Revesi, Karpuri, SGM 1, Sirugamani 1, Anthiyur kodi, Kanyur kodi, Sirugamani, Karpoori, Vellakodi, Karuppu pachaikodi, Vellai Pachai Kodi. | Singh, 1994. |
| Uttar Pradesh | Deswari, Kapoori, Maghai, Bangla, Bihari, Deshi Bengla, Desi Desawari, Culcuttia, Kaker, Kapoori, Maghai, Mahoba, Kalkattia bangla. | Singh, 1994. |
| West Bengal | Kali Bangla, Simurali Bangla, Maharashtra Kallipatti, Kapoori, Bangla (Ramtek), Mitha, Sanchi, Gachapan, Simurali Sanchi, Simurali Deshi, Banarasi, Bhavan, Simurali Bhabna, Chamundai Bhabna, Chandrakona, Vishnupuri, Jaleswar, Ghanagette. | Singh, 1994; Das et al., 1995; Sheet, 2002; Pariari and Imam, 2012a; Pariari and Imam, 2012b; Sengupta, 2014. |
| Madhya Pradesh | Desi Bangla, Calcutta, Deswari, Jabalpur. | Singh, 1994. |
| Kerala | Kalkodi, Puthukodi, Venmani, Arikodi, Kalkodi, Karilanchi Karpuram, Chelanthikarpuram - Red, Chilanthikarpooram Kootak – kodinadan, Perumkodi, Amaravila, Pramuttan, Local, Kootakodi, Nadan, Theekan, Attukkirazhi, Pedu koti, Pozhikodi, Thulasivettila, Tulasikodi, Mulamkodi, Chilenthivella, Chettankodi, Nadankodi, Naravallie, Alwaye, Venmani vettila, Machary, Mundakam, Naravalie. | Abraham, 1986; Chandini, 1989; Singh, 1994; Joseph, 1990; Thomas, 2004; Nair, 2010; KAU, 2011. |
| Karnataka | Kariyale or Karibally, Nagabally or Yalakkiyele or Khasayele, Mysoreale, Ambadiale, Ambadi, Gangeri, Gidagap, Kumbala bally, Kanigale, Dodgya, Janabally, Hosakali, Shedgar, Lakkaballi, Chikodi, Chandrakona, Tellaka chinthalapudi, Shirpurkala, Halishahar sanchi, Gachi, Sirugamani, Malvi, Khasi, Culcuttia Bangla. | Nair et al., 1986; Singh, 1994; Shivashankara et al., 2012. |
| Bihar | Desi Pan, Calcutta, Paton, Maghai, Bangla, Kaker, Kapoori, Sanchi. | Singh, 1994. |
| Assam | Assam Patti, Awani pan, Bangla, Khasi Pan, Assamia pan, Awani pan, Bangla pan, Khasi pan, Mitha pan, Sanchi pan, Godi Bangla, Kodwa bangla, Banaras, Local bangla, | Singh, 1994; Saikia et al., 1995. |
| Andhra Pradesh | Karapaku, Chennor, Tellaku, Bangla, Kalli Patti, Gundu kammeri, Kapoori, Lawangi, Peddakammeri, Vasani Kapoori, Vuyyur kapoori, Sangli kapoori, Pedachapelli kapoori, Dodipatta kapoori, Chinachapelli kapoori, Bihar kapoori, Chuddappah kapoori, Simurali Jhal, Ghanagatte. | Singh, 1994; Lakshmi and Naidu, 2010. |
| Andaman& Nikobar islands | CARI-2, CARI-6. | Pariari and Imam, 2012a. |

### *Internodal Color and Internodal Length*

Chaveerach *et al*. (2006) reported that betel vine stem was stout with pinkish-stripe along, node dilated with roots. Internodal length varied significantly among cultivars and shortest was recorded in cultivar *Jabalpur* (3.38 cm). Longer vine with shorter internode is a desirable character in betel vine. Such vines produced more number of leaves due to increased number of nodes (Pariari and Imam, 2012a).

### *Total Number of Leaves*

Seshadri (1983) found that nitrogen applied in the form of organic manure improved the quality and yield of betel leaves. In an experiment carried out at Dharward, Karnataka to evaluate different cultivars, the highest yield was recorded by *Lakkaballi* followed by *Chikodi*. Acharya and Padhi (1987) reported that maximum number of marketable leaves was produced by the application of neem and sawdust. Das *et al*. (1995) evaluated eight cultivars of betel vine from Bengal and found that cv. *Ghanagette* produced highest number of leaves (88) per vine. Sheet (2002) recorded highest number of leaves (62.66 lakh/ha) in cv. *Chandrakona.* Number of marketable leaves in *Chilanthikarpooram* ranged from 12.28 – 30.87 lakh/ha during the first year of planting (Thomas, 2004). Guha (2006) reported that annual yield of a good crop of betel vine was 60 – 70 leaves/ plant and 6 – 7 millions/ha. Choudhary (2006) observed that *Simurali Sanchi* produced highest (46.73/vine) number of leaves followed by *Ghanagette* (41.70/vine) and *Simurali Jhal* (37.63/vine) among five cultivars. In a field experiment conducted by Hedge *et al.* (2012) to study the effect of different nutritional sources on growth, yield and quality of betel vine, less number of leaves were seen at the initial growth stage. Application of FYM (25 t/ha) along with recommended dose of fertilizer recorded higher growth and yield attributes resulting in significantly higher annual leaf yield (588.55 leaves/vine). The lowest yield (279.28 leaves/vine) was obtained in the treatment consisting of farmers' practice alone. The work conducted by Pariari and Imam (2012a) showed significant variation with respect to number of leaves/vine among different cultivars and *Simurali Deshi* produced maximum number of leaves (58.56/vine), which was statistically superior to other cultivars and minimum number of leaves (37.63/vine) was shown by *Simurali Jhal*.

### *Number of Lateral Branches*

Chandini (1989) conducted a study on different varieties of betel vine and *Chilanthikarpooram red* recorded significant difference in number of lateral branches. The number of lateral branches were 0.60, 1.78, 2.69, 3.59, 4.37 and 4.73 when recorded from two MAP to 12 MAP in two months interval. Thomas (2004) reported that the number of branches of *Chilnthikarpooram* ranged from 0.21 – 0.75, 0.82 -1.67, 0.80 - 2.28, 4.17- 6.84 and 7.92 - 10.09 at 2, 4, 6, 8 and 10 MAP respectively. Pradhan *et al.* (2013) reported that stem of betel vine was dichotomous, articulate, swollen and rooted at nodes with 3 mm diameter.

## Leaf Characters

### *Leaf Length*

Rahaman *et al*. (1997) observed variation in leaf length from 6.20 to 15.30 cm among 27 genotypes of betel vine. Lakshmi and Naidu (2010) conducted a comparative morpho-anatomical study in ten common cutivars of *P. betle* namely *Ghazipur,*

*Bangladeshi, Jaleswar, Vishnupuri, Kapoori, Saunfia pan, Culcuttia, Desipan, Desawari* and *Banarasi*. The minimum leaf length (7.50 cm) was observed for *Desipan* and maximum (15.00 cm) for *Vishnupuri* and *Jaleswar*. Significant variation in leaf length among different cultivars of betel vine was observed by Pariari and Imam (2012a). The longest leaf (16.73 cm) was recorded in *Ghanagette,* which was statistically at par with *Simurali Sanchi* (16.71 cm), *Simurali Jhal* (16.43 cm), CARI-2 (15.75 cm), CARI-6 (15.33 cm) and *Sanchi* (14.75 cm). A study was undertaken by Pariari and Imam (2012b) on physical and qualitative characters of leaves in betel vine (cv. *Simurali Deshi*) after application of different combination of organic manures. The results showed that leaf length ranged from 12.83 - 14.65 cm.

***Leaf Width***

Variation in leaf width between 4.20 cm and 11.60 cm was reported by Rahaman *et al*. (1997) from a study with 27 genotypes of betel vine. Herath and Rathnasoma (1998) indicated that the leaves with more than 16 cm length and 12 cm width were considered as large leaves. Sheet (2002) reported maximum leaf width (12.43 cm) in cv. *Chandrakona* among seven cultivars of betel vine. Nirambewela *et al*. (2005) found that the parameters such as stomatal index and leaf length to width ratio were similar in *Kudamaneru*, *Mohamaneru*, *Galdalu*, *Ratadalu* and *Nagawalli,* but these were different in *Malabulth*. Lakshmi and Naidu (2010) reported that the leaf width showed very wide range, starting from 5 cm to 14 cm. Pariari and Imam (2012b) conducted an investigation on betel vine and the result indicated that leaf width ranged from 8.65 - 10.45 cm. Leaves with 20 cm length and 15 cm width were preferred for export purpose (DMI, 2013).

***Leaf Area***

Saikia *et al.* (1995) conducted a field experiment with betel vine cultivar, *Local Bangla* at Assam Agricultural University and obtained a maximum leaf area of 116.41 $cm^2$. Rahaman *et al*. (1997) reported significant variation in leaf area from 22 to 147.20 $cm^2$ among 27 genotypes of betel vine. Among seven cultivars, Sheet (2002) observed highest leaf area (123.56 $cm^2$) in *Chandrakona*. Pariari and Imam (2012a) evaluated betel vine cultivars in the gangetic alluvial plains of West Bengal and the highest leaf area (167.82 $cm^2$) was recorded in *Ghanagette*, which was at par with *Simurali Jhal* (166.45 $cm^2$) and *Chamundai Bhabna* (164.37 $cm^2$). They conducted a study on physical and qualitative characters of leaves in betel vine (*Simurali Deshi*) after application of different combination of organic manures. The result showed that leaf area ranged from 114.17 - 129.00 $cm^2$ (Pariari and Imam, 2012b). Hedge (2012) reported that the maximum leaf size (127.30 $cm^2$) in betel vine was obtained in the treatment consisting of farmers' practice with foliar spray of 25 per cent vermiwash and lowest leaf size (78.27 $cm^2$) was obtained in the treatment consisting of existing farmers' practice alone.

***Leaf Brittleness***

A material is brittle if, when subjected to stress, breaks without significant deformation (strain). Leaf condition of soft, but not too brittle was preferred for tendu leaf (leaves used to wrap around tobacco to create the Indian *beedi*) marketing (Ministry of Agriculture, India, 2013).

***Leaf Color***

The evaluation of six betel vine cultivars in Sri Lanka revealed that *Malabulath, Galdalu, Mohamaneru* and *Kudameneru* had yellowish green leaves while *Ratadalu* had green coloured leaves. Green coloured leaves with yellow patches were seen in *Nagawalli* (Arambewela *et al.*, 2005). Similar observations were reported in a study conducted by Joseph (1990) in Kerala. In a study conducted by Lakshmi and Naidu (2010), most of the varieties had dark green leaves except *Kapoori* which had light green leaf. *Culcuttia* and *Jaleswar* varieties had yellowish green leaves. Well matured dark green leaves with high pungency were preferred for export purpose in Sri Lanka (DMI, 2013).

***Leaf Weight and Leaf Weight per Unit Area***

Due to lack of enough data in leaf weight per unit area and leaf weight, data related to weight of 100 leaves of betel vine was also reviewed. Reddy (1996) observed that the fresh weight of 100 leaves was 300.5 g in *Ramtek Bangla* and 246.5 g in *Godi Bangla*. Herath and Rathnasoma (1998) investigated the effect of support plants on morphological characters of betel vine and maximum mean weight (625.87 g) of 100 leaves of betel vine was achieved with glyricidia and the recorded minimum (496.13 g) was with *Kooratiya.* Das *et al*. (1995) evaluated the maximum fresh weight and dry weight of 100 fresh leaves of eight cultivars from Bengal and found maximum fresh (380.75 g) and dry weight (44.60 g) for *Ghanagette*. Leaf weight is considered as one of the important parameters, because the price of export leaves is determined by the leaf weight too. So the real quality of "Black betel" was reported to be correlated to weight (Sumanasena *et al*., 2005).

Evaluation of 14 cultivars of betel vine in the gangetic alluvial plains of West Bengal indicated that fresh and dry weight of 100 depetiolated leaves of *Simurali Sanchi* were 364.38 g and 52.29 g respectively (Pariari and Imam, 2012a). The fresh weight of 100 betel vine leaves ranged from 307.17 - 328.83 g for various combinations of organic and inorganic manures (Pariari and Imam, 2012b). A significant variation was observed in fresh weight of 100 leaves and same trend was also seen in dry weight of leaves among the cultivars.

**Petiole length**

The petiole of betel vine leaves was roughly triangular and outline had deep furrows and ridges with 5.5 - 6.5 cm length (Pariari and Imam, 2012a). Reddy (1996) reported that petiole length of betel leaves varied (5.2 - 6.6 cm) significantly among cultivars. Rahaman *et al*. (1997) reported variation in petiole length between 5.90 cm and 17.50 cm in 27 genotypes of betel vine. Chaveerach *et al.* (2006) reported that petiole had 2.0 - 2.5 cm length. Pariari and Imam (2012a) reported longest petiole (10.60 cm) for *Chamundai Bhabna.* Depetiolated betel leaves had better shelf life than leaves with petioles irrespective of seasons.

**Leaf shape**

Chaveerach *et al.* (2006) observed ovate lamina for betel vine leaves. According to Pariari and Imam (2012a), leaf lamina of betel vine was smooth and cordate with even surface. Chaveerach *et al.* (2006) reported leaf base in *P. betle* as cordate. Chaveerach *et al.* (2006) indicated that leaf apex was acuminate in betel vine. Lakshmi and Naidu (2010) indicated that among the 10 studied cultivars, seven cultivars showed acute type of leaf tip. Curved accuminate leaf tip was shown by *Desipan* and *Desawari* while *Saunfia pan* showed acuminate leaf tip. According to Mubeen *et al.* (2014), the apex of betel leaf was acuminate with often unequal base.

***Floral Morphology***

The flowers of plants coming under *Piper* L. genus were many, sessile, naked and compactly arranged on the inflorescence axis. A bract subtended each flower. In some species there were two stamens occupying on either side of the ovary, whereas in others, there were three stamens. Ovary was single, sessile, and sub globose or flask shaped, one - ovuled, orthotropous and the stigma was usually sessile. The fruit was a small one-seeded drupe (Vinay *et al*., 2012). CSIR (1969) reported that there were female and male plants separately in *P. betle.* The flowering and fruit setting of *P.betle* were very rare in Indian climate. The inflorescence of betel vine was an axillary spike. The fruit was a drupe embedded on rachis. According to Chaveerach *et al*. (2006), each female floret of *P. betle* had 4 - 6 stigmas with pubescent texture. In male plants, anther was with two stamens. A study in Thailand reported year round flowering and fruiting (Chaveerach *et al*., 2006). The investigation carried out by Sengupta (2014) in West Bengal showed that out of 70 collections of *P. betle*, flowering occurred in 16 female and 13 male clones. Among these, continuous and profuse flowering was observed in two cultivars *viz., SGM-1* (female) and *Swarna Kapoori* (male). Chaveerach *et al.* (2006) reported that betel spikes were 0.5 to 5.5 cm long and male spikes were larger and slender. Chaveerach *et al.* (2006) found that the diameter of betel vine spikes of male and female accessions were 0.50 cm. Pradhan *et al.* (2013) reported three millimeter diameter for betel vine spikes. Chaveerach *et al*. (2006) reported that peduncle length of betel vine varied from 2 to 3 cm.

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