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Comparative Morphology of Betelvine (*Piper betle* L.) cultivars in West Bengal

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Abstract: The experiment was conducted during 2012-13 and 2013-14 in a baroj of experimental farm of AICRP on Betelvine, Kalyani, Bidhan Chandra Krishi Vishwavidyalaya, Mohanpur, West Bengal, India. Total eight betelvine cultivars were collected from different locations of India and conserved. Remarkable variations in vegetative growth, morphological features and yield attributes of betelvine were recorded. The betelvine cultivars varied in intermodal length (6.35 cm – 8.49 cm), the leaf length (12.77 cm – 15.56 cm), leaf breadth (8.00 cm – 11.30 cm), petiole length (4.75 cm – 6.80 cm) among the cultivars throughout the year. Internodal length was highest in the month of January (8.00 cm) while July showed minimum (6.87 cm). September possessed maximum (14.79 cm) and May showed minimum (13.69 cm) leaf length. Leaf breadth was maximum in the month of January (9.97 cm) followed by May and September. Lowest petiole length was observed in the month of July (5.71 cm) followed by November and May. Interaction between the cultivars and time was found significant in all the morphological characteristics. Variations were also existed among the cultivars in vine colour, leaf colour, leaf shape, leaf tip and sex of cultivars.

Keywords: Betelvine, Morphological features, Variety, Kapoori, Sanchi.

INTRODUCTION

The scientific name of betelvine is *Piper betle* L. It belongs to the family Piperaceae, i.e. the black pepper family. Betelvine plays a significant role in the social and cultural aspects of India. Betel is cultivated on about 55000 hector with an annual production worth about Rs. 9000 million (Kaleeswari and Sridhar, 2013). The vast economic potentiality of the crop can be adequately established by the fact that about 15-20 million people consume betel leaves in India on a regular basis besides those in other countries of the world which may include over 2 billion consumers. Betelvine is an important cash crop grown in about 50,000 ha in India mainly for its leaves used for chewing (Maity and Shivashankara, 1998) in more than 12 states. These leaves are also in great demand in several other countries of the world. Consequently leaves worth about Rs. 30-40 million are exported to the other countries. The economic aspects of the crop as discussed above evidently prove that betel leaf is one of the most promising commercial crops capable of attracting substantial amount of foreign exchange to the country (Kaleeswari V. and Sridhar T., 2013). This adequately justifies its nomenclature as the **"Green Gold of India"**. In fact, the revenue generated by the crop may be further magnified by many folds like scientifically explored well agronomic practices and appropriate post-harvest technologies which can be made available to

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the betel leaf growers and traders. In spite of such tremendous economic potentiality of the crop, it remains neglected particularly by the scientists, technologists, administrators and the policymakers as well. Therefore, well-coordinated efforts by the farmers, traders, scientists, technologists, extension workers, physicians, administrators and policy makers are required to be initiated for boosting up the national economy as well as the national employment generation through proper exploitation of this green gold.

Characterization is the examination which generates a description of a variety using its relevant parameters (e.g. plant height, leaf shape, time of flowering etc.) by which it can be described as a variety. Morphology is the external appearance of the plant. Comparative morphology means the observation of distinguishing characteristics among the varieties throughout the year. Under such background the present investigation on "comparative morphology of betelvine (*Piper betle* L.) cultivars in west bengal" had been selected.

MATERIALS AND METHODS

The experiment was conducted during the year 2012-13 and 2013-14. Data were recorded in the month of July, September, November, January, March and May during both the years of study and pooled is calculated and analysed. The present investigation was completed to see the variations in morphological characteristics among the eight different cultivars of betelvine.

Site of experiment

For the present study, location having well drained fertile clay loam soils and cool, humid atmosphere with irrigation facilities was selected from All India Coordinated Research Project (AICRP) on Betelvine at Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, West Bengal, India.

Plant material used

The different betelvine cultivars, land races, wild types and related species of betelvine were collected and conserved for the study. Betelvine cultivars namely kapoori and sanchi from the different centres of the All India Coordinated Research Project (AICRP) on betelvine were used for the present study. Four varieties of kapoori and four varieties of sanchi were used for examination which are given as follows-

A. Kapoori type

1. Kapoori chinacheppali
2. Kapoori dodhipatla
3. Kapoori pedacheppali
4. Swarna kapoori

B. Sanchi type

1. Gangarampur sanchi
2. Halisahar sanchi
3. Simurali sanchi
4. Kalipatti

Statistical method implemented

Collected morphological data of both the years was calculated and analysed statistically by Randomized Block Design (RBD) method i.e. two factors RBD. Critical difference values were compared at 5% levels of significance and wherever 'F' was found significant, treatment means were compared.

RESULTS AND DISCUSSION

Results have been described individually for each year and also with pooled analysis.

Internodal length

Table 1 presents the variations in internodal length of kapoori and sanchi type of betelvine accessions for the purpose of morphological characterization. In the year 2012-13, internodal length was significantly low in kapoori pedacheppali (6.88 cm) as compare to kapoori

Table 1: Morphology of betelvine (*Piper betle* L.) cultivars with respect to internodal length (cm)

2012-13									
Varieties	*KAPOORI*				*SANCHI*				*Mean*
Months	*Kapoori chinacheppali*	*Kapoori dodhipatla*	*Kapoori pe-dacheppali*	*Swarna kapoori*	*Gangarampur sanchi*	*Halisahar sanchi*	*Simurali sanchi*	*Kalipatti*	
Jul-12	7.66	6.84	6.70	7.61	6.72	7.46	7.25	8.05	**7.29**
Sep-12	8.36	8.07	7.69	8.18	7.28	7.74	8.03	9.33	**8.09**
Nov-12	6.01	5.70	5.58	6.32	8.41	8.71	7.05	9.68	**7.18**
Jan-13	7.53	8.13	7.48	8.24	8.40	9.14	8.14	8.04	**8.14**
Mar-13	7.48	6.68	6.17	7.65	8.00	9.01	7.97	7.35	**7.54**
May-13	7.47	7.88	7.66	8.02	8.39	8.76	7.99	7.76	**7.99**
Mean	**7.42**	**7.22**	**6.88**	**7.67**	**7.87**	**8.47**	**7.74**	**8.37**	
		Factors		C.D.	SE(d)	SE(m)			
		Variety		0.45	0.23	0.16			
		Month		0.39	0.20	0.14			
		Interaction		1.10	0.56	0.39			
2013-14									
Jul-13	5.86	5.53	4.46	6.29	6.80	7.49	7.49	7.69	**6.45**
Sep-13	5.63	5.18	5.32	6.93	7.20	9.19	8.20	8.26	**6.99**
Nov-13	7.24	7.47	6.34	7.91	7.27	9.13	9.51	9.13	**8.00**
Jan-14	6.98	7.65	6.48	7.98	7.32	8.33	9.16	8.98	**7.86**
Mar-14	6.40	6.50	5.61	7.06	7.70	8.34	8.84	8.90	**7.42**
May-14	6.26	6.35	6.72	7.52	7.59	7.89	8.67	8.72	**7.46**
Mean	**6.39**	**6.45**	**5.82**	**7.28**	**7.31**	**8.40**	**8.65**	**8.62**	
		Factors		C.D.	SE(d)	SE(m)			
		Variety		0.41	0.21	0.15			
		Month		0.36	0.18	0.13			
		Interaction		NS	0.51	0.36			
Pooled									
July	6.76	6.19	5.58	6.95	6.76	7.47	7.37	7.87	**6.87**
September	7.00	6.63	6.51	7.55	7.24	8.47	8.11	8.80	**7.54**
November	6.62	6.58	5.96	7.12	7.84	8.92	8.28	9.41	**7.59**
January	7.25	7.89	6.98	8.11	7.86	8.74	8.65	8.51	**8.00**
March	6.94	6.59	5.89	7.35	7.85	8.68	8.41	8.13	**7.48**
May	6.87	7.11	7.19	7.77	7.99	8.33	8.33	8.24	**7.73**
Mean	6.91	6.83	6.35	7.48	7.59	8.43	8.19	8.49	
		Factors		C.D.	SE(d)	SE(m)			
		Variety		0.30	0.15	0.11			
		Month		0.26	0.13	0.09			
		Interaction		0.73	0.37	0.26			

chinacheppali (7.42 cm) and swarna kapoori (7.67 cm) while highest found in halisahar sanchi (8.47 cm) among all the varieties. Among kapoori cultivars, internodal lengths of kapoori chinacheppali, kapoori dodhipatla and swarna kapoori were at par with each other. However among sanchi types internodal length was lowest in simurali sanchi (7.74 cm) followed by gangarampur sanchi (7.87 cm) and kalipatti (8.37 cm). Kapoori cultivars possessed lower internodal length than sanchi cultivars; it varied significantly throughout the year and found maximum during January (8.14 cm) with significant interaction between months and varieties. Similar observations were recorded by John, 1996 and stated that internodal length ranged from 5.00 to 8.80 cm among 16 betelvine varieties. With respect to the year 2013-14, the maximum internodal length was found in simurali sanchi (8.65 cm) followed by kalipatti, halisahar sanchi and gangarampur sanchi. Among kapoori types, kapoori pedacheppali had significantly shorter internodes (5.82 cm) than that of kapoori chinacheppali (6.39 cm), kapoori dodhipatla (6.45 cm) and swarna kapoori (7.28 cm). On the other hand in sanchi types, at par results were found in the intermodal lengths of halisahar sanchi, simurali sanchi and kalipatti. The shortest internode was observed in gangarampur sanchi among the sanchi pan. Similar to 2012-13, 2013-14 also showed shorter internodes in kapoori cultivars than in sanchi cultivars. It was shorter significantly during July (6.45 cm) as compare to during September (6.99 cm), March (7.42 cm) and May (7.46 cm) while highest found during November (8.00 cm) with non significant interaction between months and varieties throughout the year (Medda et al., 2011; Dutta et al., 2009; Das et al., 2005).

The data demonstrated that kapoori pedacheppali had significantly lower internodal length as compare to other kapoori and sanchi cultivars. Kapoori type cultivars had lesser internodal length than that of sanchi type cultivars in both the experimental years and in pooled analysis.Pooled analysis showed that kalipatti had longest internode (8.49 cm) among all the varieties followed by halisahar sanchi (4.43 cm) and simurali sanchi (8.19 cm). Among kapoori type, swarna kapoori showed significantly more internodal length (7.48 cm) than that of rest of the kapoori varieties. It revealed that, there were significant variations in the maximum and minimum internodal lengths respectively during January and July throughout the year. The internodal length was ranged from 5.58 to 9.41 cm in all the betelvine cultivars throughout the year with significant interaction between months and varieties. The present results are parallel with the results of Das et al., 1995 by a way of internodal length of 6.10 to 8.05 cm among the different betelvine varieties.

Leaf length

Leaf is an important organ of plant as it plays vital role in the process of photosynthesis which results in the production of organic food stuff essential for normal growth and reproduction of the plant. There were significant variations in the leaf length of betelvine varieties throughout the experimental period. In the year 2012-13, the leaf lengths of kapoori pedacheppali (12.33 cm) and kapoori dodhipatla (12.64 cm) were at par with each other while comparable with kapoori chinacheppali (13.62 cm) and swarna kapoori (13.63 cm) which are also at par with each other. The leaf length during July to September was statistically more as compare to during residual period in a year. During November to March, leaf length changed more or less while lowest found during May (12.47 cm). Similar results were confirmed by Padmanabhan et al., 1995 with leaf length of 15.30 cm in kapoori variety of betelvine. The highest leaf length was observed in simurali sanchi (14.71 cm) followed by gangarampur

Table 2: Morphological variations among the betelvine (*Piper betle* L.) cultivars with respect to leaf length (cm)

2012-13									
Varieties	*KAPOORI*				*SANCHI*				*Mean*
Months	*Kapoori chinachep-pali*	*Kapoori dodhipatla*	*Kapoori pe-dacheppali*	*Swarna kapoori*	*Gangarampur sanchi*	*Halisahar sanchi*	*Simurali sanchi*	*Kalipatti*	
Jul-12	16.39	15.30	14.57	16.16	13.85	13.96	16.37	14.99	**15.20**
Sep-12	16.58	15.54	14.98	16.10	14.56	14.45	15.30	15.50	**15.38**
Nov-12	12.08	10.38	10.30	12.31	15.18	14.59	14.09	15.32	**13.03**
Jan-13	12.53	11.72	11.57	12.81	14.48	14.04	14.86	12.68	**13.09**
Mar-13	12.44	11.18	10.70	11.78	13.84	14.82	13.93	14.29	**12.87**
May-13	11.73	11.73	11.82	12.59	13.67	13.45	13.71	11.08	**12.47**
Mean	**13.62**	12.64	12.33	13.63	14.26	14.22	14.71	13.98	
		Factors		C.D.	SE(d)	SE(m)			
		Variety		0.66	0.33	0.24			
		Month		0.57	0.29	0.20			
		Interaction		1.61	0.82	0.58			
2013-14									
Jul-13	13.36	13.08	13.47	13.81	14.76	13.70	15.92	13.87	**14.00**
Sep-13	14.54	12.44	11.60	14.22	15.50	14.58	16.49	14.30	**14.21**
Nov-13	14.93	16.25	14.01	14.93	14.59	16.10	16.48	16.22	**15.44**
Jan-14	14.95	15.80	13.68	14.99	14.56	15.89	16.67	14.88	**15.18**
Mar-14	14.50	13.71	13.08	14.02	14.52	15.00	16.59	15.49	**14.61**
May-14	13.96	13.86	13.49	14.47	15.77	15.84	16.34	15.50	14.90
Mean	14.37	14.19	13.22	14.41	14.95	15.18	16.42	15.04	
		Factors		C.D.	SE(d)	SE(m)			
		Variety		0.57	0.29	0.20			
		Month		0.49	0.25	0.18			
		Interaction		1.38	0.70	0.50			
Pooled									
July	14.88	14.19	14.02	14.99	14.31	13.83	16.15	14.43	**14.60**
Septem-ber	15.56	13.99	13.29	15.16	15.03	14.51	15.89	14.90	**14.79**
Novem-ber	13.50	13.31	12.16	13.62	14.88	15.34	15.28	15.77	**14.24**
January	13.74	13.76	12.63	13.90	14.52	14.97	15.76	13.78	**14.13**
March	13.47	12.44	11.89	12.90	14.18	14.91	15.26	14.89	**13.74**
May	12.84	12.80	12.66	13.53	14.72	14.65	15.02	13.29	**13.69**
Mean	**14.00**	**13.42**	**12.77**	**14.02**	**14.61**	**14.70**	**15.56**	**14.51**	
		Factors		C.D.	SE(d)	SE(m)			
		Variety		0.41	0.21	0.15			
		Month		0.36	0.18	0.13			
		Interaction		1.01	0.51	0.36			

sanchi (14.26 cm) and halisahar sanchi (14.22 cm). Kapoori cultivars possessed smaller leaf length than sanchi cultivars. Medda et al., 2011 stated that sanchi cultivars have larger size leaves. Concerning 2013-14, the maximum leaf length was found in simurali sanchi (16.42 cm) and minimum found in kapoori pedacheppali (13.22 cm) among the different varieties. The leaf lengths of kapoori chinacheppali, kapoori dodhipatla and swarna kapoori were at par with each other. Similarly leaf lengths of gangarampur sanchi, halisahar sanchi and kalipatti were at par with each other among sanchi types of betelvine. The leaves of sanchi cultivars were lengthier than the leaves of kapoori cultivars. November to January was the best period for leaf growth throughout the year. Contrasting to 2012-13, the leaf length decreased significantly during July (14.00 cm) as compare to March (12.87 cm) and May (14.90 cm). The leaf length was ranged from 11.60 to 16.67 cm in all the varieties throughout the year. Homologous observations were recorded by Das et al. (2000) with leaf length of 7.40-14.47 cm in the cluster mean values of betelvine accessions and Rahaman et al. (1997) with leaf length of 12.0 and 13.2 cm in kapoori and sanchi type cultivars respectively.

According to pooled analysis the leaf length was the minimum in kapoori pedacheppali (12.77 cm) followed by kapoori dodhipatla, kapoori chinacheppali and swarna kapoori while maximum observed in simurali sanchi (15.56 cm). The leaves of sanchi cultivars found lengthier than the leaves of kapoori cultivars. Leaf length decreased significantly during March to May throughout the experimental period. The interaction of months and varieties was found significant during the experimental period with leaf length range of 11.89-15.89 cm. Similar findings were reported by Das et al. (2005) with leaf length of 7.78, 12.7 and 8.13 cm in bangla, sanchi and jhal cultivars of betelvine, Table 2.

Leaf width

Another leaf characteristic of betelvine i.e. leaf width changed significantly among the varieties. During 2012-13 the highest leaf width observed in kalipatti (10.83 cm) among all the varieties followed by in halisahar sanchi (10.45 cm) and in kapoori chinacheppali (9.22 cm) while minimum observed in kapoori pedacheppali (8.30 cm). It was lowest during November (8.73 cm) and highest during September (9.99 cm) throughout the year. The leaf width ranged significantly from 6.69 cm in kapoori pedacheppali during November to 12.19 in kalipatti during September throughout the year in all the varieties. Similar observations were recorded by Padmanabhan et al., 1995 with leaf width of 8-10 cm in kapoori and Das et al, 2005 with leaf breadth of 8.48, 8.37 and 6.38 cm respectively in bangla, sanchi and jhal cultivars of betelvine. With respect to 2013-14, the minimum leaf width was found in kapoori pedacheppali (7.70 cm) among all the cultivars which was significantly lower than other kapoori and sanchi type cultivars. The highest leaf width was recorded in kalipatti (11.78 cm) among all the kapoori and sanchi type betelvine followed by halisahar sanchi, simurali sanchi and gangarampur sanchi. The leaves of sanchi cultivars were wider than the leaves of kapoori cultivars.Leaf width reduced significantly during July to September throughout the year. Leaf widths of betelvine accessions during November, January, March and May were at par with each other with maximum value of 10.62 cm and interaction between months and varieties was found non significant. The present results are similar to the results of Das et al. (2000) in cluster mean values of betelvine accessions by means of leaf breadth (4.67-12.12 cm).

According to pooled analysis, kalipatti showed the maximum leaf width (11.30 cm) followed by halisahar sanchi, simurali sanchi and gangarampur sanchi. The leaf width

was lesser in kapoori cultivars than in sanchi cultivars. Leaf width during July (9.37 cm) was comparable with the leaf width during March (9.68 cm), September (9.77 cm), May (9.81 cm) and January (9.97 cm). The leaf width ranged from 7.43 to 12.30 cm in all the kapoori and sanchi type of cultivars throughout the year with significant interaction between months and varieties. Similar results were observed by Rahaman *et al*., 1997 with leaf breadth of 7.3 and 9.1 cm in kapoori and sanchi type cultivars respectively, Table 3.

Table 3: Comparative changes among the betelvine (*Piper betle* L.) cultivars with respect to leaf width (cm)

2012-13									
Varieties	*KAPOORI*				*SANCHI*				*Mean*
Months	*Kapoori chinacheppali*	*Kapoori dodhipatla*	*Kapoori pe-dacheppali*	*Swarna kapoori*	*Gangarampur sanchi*	*Halisahar sanchi*	*Simurali sanchi*	*Kalipatti*	
Jul-12	10.36	8.98	8.89	9.98	8.82	10.27	9.96	10.69	**9.75**
Sep-12	10.54	9.67	9.18	9.94	9.13	10.18	9.09	12.19	**9.99**
Nov-12	7.75	6.95	6.69	8.22	9.28	10.50	8.55	11.93	**8.73**
Jan-13	9.16	8.84	8.44	9.43	8.86	10.46	9.17	10.25	**9.33**
Mar-13	9.26	8.36	8.07	8.16	8.89	10.98	9.07	10.55	**9.17**
May-13	8.26	8.42	8.54	9.54	8.69	10.28	8.99	9.34	**9.01**
Mean	**9.22**	**8.54**	**8.30**	9.21	8.95	10.45	9.14	10.83	
		Factors		C.D.	SE(d)	SE(m)			
		Variety		0.54	0.27	0.19			
		Month		0.47	0.24	0.17			
		Interaction		1.33	0.67	0.48			
2013-14									
Jul-13	8.39	8.22	5.00	8.90	9.82	10.55	10.50	10.64	**9.00**
Sep-13	9.01	7.46	7.20	9.12	10.24	11.31	11.21	10.92	**9.56**
Nov-13	9.66	9.96	8.17	9.67	10.40	11.38	11.82	12.68	**10.47**
Jan-14	10.00	10.04	8.58	9.93	10.24	12.23	11.96	11.94	**10.62**
Mar-14	9.43	8.94	8.22	9.63	9.89	11.68	11.92	11.91	**10.20**
May-14	8.80	9.07	9.03	10.05	11.30	12.22	11.91	12.56	**10.62**
Mean	**9.22**	**8.95**	**7.70**	**9.55**	**10.31**	**11.56**	**11.55**	11.78	
		Factors		C.D.	SE(d)	SE(m)			
		Variety		0.52	0.26	0.19			
		Month		0.45	0.23	0.16			
		Interaction		NS	0.65	0.46			
Pooled									
July	9.38	8.60	6.95	9.44	9.32	10.41	10.23	10.66	**9.37**
Septem-ber	9.78	8.57	8.19	9.53	9.68	10.74	10.15	11.56	**9.77**
Novem-ber	8.71	8.45	7.43	8.94	9.84	10.94	10.19	12.30	**9.60**
January	9.58	9.44	8.51	9.68	9.55	11.35	10.57	11.10	**9.97**
March	9.34	8.65	8.14	8.89	9.39	11.33	10.49	11.23	**9.68**
May	8.53	8.74	8.79	9.80	9.99	11.25	10.45	10.95	**9.81**
Mean	**9.22**	**8.74**	**8.00**	**9.38**	**9.63**	**11.00**	**10.35**	**11.30**	
		Factors		C.D.	SE(d)	SE(m)			
		Variety		0.36	0.18	0.13			
		Month		0.31	0.16	0.11			
		Interaction		0.88	0.45	0.32			

Petiole Length

Morphological characterization of betelvine with respect to petiole length stated that in 2012-13, the petiole length fluctuated more in sanchi cultivars than in kapoori cultivars among all the varieties. Simurali sanchi showed low (4.37 cm) petiole length as compare to gangarampur sanchi, kalipatti and all kapoori cultivars while maximum was found in halisahar sanchi (6.45 cm) among all the varieties. Petiole lengths of all the kapoori types betelvine found at par with each other. Among sanchi cultivars, petiole length of halisahar sanchi (6.45 cm) and kalipatti (6.40 cm) as well as gangarampur sanchi and simurali sanchi recorded at par with each other. There were comparable variations in petiole lengths during November (5.14 cm), July (5.50 cm) and March (6.01 cm). The significant interaction was occurred between months and varieties of kapoori and sanchi cultivars. Parallel observations were noted by Reddy (1996) with petiole length of 4.6 to 6.6 cm

Table 4: Changes among the betelvine (*Piper betle* L.) cultivars with respect to petiole length (cm)

2012-13									
Varieties	*KAPOORI*				*SANCHI*				*Mean*
Months	*Kapoori chinacheppali*	*Kapoori dodhipatla*	*Kapoori pe-dacheppali*	*Swarna kapoori*	*Gangarampur sanchi*	*Halisahar sanchi*	*Simuali sanchi*	*Kalipatti*	
Jul-12	5.82	5.28	5.30	6.15	4.63	6.63	3.71	6.45	**5.50**
Sep-12	6.40	6.07	5.75	6.26	4.48	6.22	4.17	6.51	**5.73**
Nov-12	4.64	4.10	4.34	5.07	5.20	6.36	4.09	7.30	**5.14**
Jan-13	5.79	5.76	5.63	5.34	4.85	6.45	4.65	6.07	**5.57**
Mar-13	6.52	6.06	6.14	5.93	4.96	6.66	5.04	6.77	**6.01**
May-13	5.45	5.96	5.88	5.26	4.50	6.39	4.57	5.28	**5.41**
Mean	**5.77**	**5.54**	**5.51**	**5.67**	**4.77**	**6.45**	**4.37**	**6.40**	
		Factors		C.D.	SE(d)	SE(m)			
		Variety		0.41	0.21	0.15			
		Month		0.35	0.18	0.13			
		Interaction		0.99	0.50	0.36			
2013-14									
Jul-13	7.01	5.80	6.39	7.12	4.21	6.20	4.39	6.35	**5.93**
Sep-13	7.87	5.56	5.97	8.29	5.38	7.70	5.26	7.06	**6.64**
Nov-13	7.22	7.64	5.97	6.17	4.84	7.12	5.22	6.96	**6.39**
Jan-14	7.04	7.35	6.35	6.80	4.74	7.62	5.53	7.14	**6.57**
Mar-14	7.47	7.42	7.36	7.43	5.54	6.76	5.68	7.98	**6.95**
May-14	6.60	6.44	6.05	6.46	5.18	7.52	4.71	7.20	**6.27**
Mean	**7.20**	**6.70**	**6.35**	**7.04**	**4.98**	**7.15**	**5.13**	7.12	
		Factors		C.D.	SE(d)	SE(m)			
		Variety		0.41	0.21	0.15			
		Month		0.36	0.18	0.13			
		Interaction		1.01	0.51	0.36			
Pooled									
July	6.41	5.54	5.84	6.63	4.42	6.41	4.05	6.40	**5.71**
September	7.13	5.81	5.86	7.27	4.93	6.96	4.71	6.79	**6.18**
November	5.93	5.87	5.16	5.62	5.02	6.74	4.66	7.13	5.77
January	6.42	6.56	5.99	6.07	4.79	7.03	5.09	6.60	**6.07**
March	6.99	6.74	6.75	6.68	5.25	6.71	5.36	7.37	**6.48**
May	6.03	6.20	5.96	5.86	4.84	6.95	4.64	6.24	**5.84**
Mean	**6.49**	**6.12**	**5.93**	**6.36**	4.88	6.80	4.75	6.76	
		Factors		C.D.	SE(d)	SE(m)			
		Variety		0.30	0.15	0.11			
		Month		0.26	0.13	0.09			
		Interaction		0.74	0.37	0.26			

in different betelvine cultivars. In view of 2013-14, the petiole lengths in kapoori chinacheppali, swarna kapoori, halisahar sanchi and kalipatti were statistically at par with each other but found comparable with petiole lengths of kapoori dodhipatla, kapoori pedacheppali, gangarampur sanchi and simurali sanchi. Kapoori chinacheppali showed longest petiole (7.20 cm) followed by halisahar sanchi (7.15 cm) and kalipatti (7.12 cm). Among the kapoori types, significantly shorter petioles were observed in kapoori pedacheppali as compare to swarna kapoori and kapoori chinacheppali. Among sanchi types, gangarampur sanchi showed significantly shorter petioles as compare to that of other sanchi cultivars. Petiole length was significantly higher during March (6.95 cm) as compare to during January (6.57 cm), November (6.39 cm) and May (6.27 cm) while lowest found during July (5.93 cm). The interaction between months and varieties was significant with the range of petiole length 4.21-8.29 cm in all the varieties throughout the year. Rahaman et al. (1997) measured the petiole length of 4.0 and 4.2 cm in kapoori and sanchi respectively. In the same way Das et al. (2005) found matching results about petiole length of 5.26 cm in simurali bangla cultivars of betelvine. Pooled data demonstrated that halisahar sanchi showed maximum (6.80 cm) while simurali sanchi showed minimum (4.75 cm) petiole length among all the experimental varieties. Among kapoori cultivars, kapoori pedachppali had short petioles as compare to swarna kapoori and kapoori chinacheppali. Among sanchi types, petiole lengths gangarampur sanchi and simurali sanchi found at par with each other. Similar pattern was obtained in halisahar sanchi and kalipatti with respect to petiole length.

Petiole length during July and November was found at par with each other which was comparable with the petiole lengths during September, January and March. The petiole length was ranged from 4.05 cm in simurali sanchi during July to 7.37 cm in kalipatti during March throughout the whole study period in all the varieties with significant interaction between months and varieties, Table 4. Present results are more or less comparable with the results of John (1996) and Das *et al.* (1995).

QUALITATIVE CHARACTERISTICS OF BETELVINE

Leaf characteristics

Leaf lamina colour, leaf laminar shape, leaf base shape, leaf base angle, attachment and lobation were observed in order to qualitative characterization of betelvine accessions and presented in Table 5. All the kapoori type cultivars possessed light green while sanchi type cultivars possessed dark green colour of leaf lamina. It may be due to variation in the chlorophyll content of kapoori and sanchi leaves. Reddy (1996) found the range of leaf colour from light green to dark green, some genotypes were pungent and some were non pungent, some cultivars possessed flowering while some were non flowering plants. All the experimental varieties showed ovate shape of leaf lamina. Leaf base shapes of kapoori cultivars were cordate; gangarampur sanchi had rounded, kalipatti had lobate while halisahar sanchi and simurali sanchi had cordate leaf base shape. Leaf base angle was obtuse in all the kapoori and sanchi accessions. The alternate attachment and unlobed leaf condition was found in all the experimental varieties. Padmanabhan et al. (1995) observed different colours like yellowish green, green, deep green and light green in addition to leaf shape like more elliptical, cordate, cordate and elliptical in SB 35, vellaikodi, pachaikodi and kapoori varieties of betelvine respectively. Arulmozhiyan et al., 2005 recorded that the leaf shape was cordate and leaf colour was deep green in desawari and kapoori varieties of betelvine.

Table 6 presents the characterization study of betelvine with respect to leaf organization,

Table 5: Description of kapoori and sanchi types of betelvine (*Piper betle* L.) with respect to leaf characteristics

Varieties	*Leaf lamina colour*	*Leaf laminar shape*	*Leaf base shape*	*Leaf base angle*	*Leaf attachment*	*Lobation*
Kapoori Type Kapoori Chinacheppali	Light green	Ovate	Cordate	Obtuse	Alternate	Unlobed
Kapoori Dodhipatla	Light green	Ovate	Cordate	Obtuse	Alternate	Unlobed
Kapoori Pedacheppali	Light green	Ovate	Cordate	Obtuse	Alternate	Unlobed
Swarna Kapoori	Light green	Ovate	Cordate	Obtuse	Alternate	Unlobed
Sanchi Type Gangarampur Sanchi	Dark green	Ovate	Rounded	Obtuse	Alternate	Unlobed
Halisahar Sanchi	Dark green	Ovate	Cordate	Obtuse	Alternate	Unlobed
Simurali Sanchi	Dark green	Ovate	Cordate	Obtuse	Alternate	Unlobed
Kalipatti	Dark green	Ovate	Lobate	Obtuse	Alternate	Unlobed

Table 6: Description of kapoori and sanchi types of betelvine (*Piper betle* L.) with respect to leaf characteristics

Varieties	*Leaf organization*	*Leaf veining*	*Laminar symmetry*	*Leaf apex shape*	*Leaf apex angle (^{0})*
Kapoori Type Kapoori Chinacheppali	Simple	Acrodromous	Symmetrical	Acuminate	Acute (58.56)
Kapoori Dodhipatla	Simple	Acrodromous	Symmetrical	Acuminate	Acute (60.20)
Kapoori Pedacheppali	Simple	Acrodromous	Symmetrical	Acuminate	Acute (57.08)
Swarna Kapoori	Simple	Acrodromous	Symmetrical	Acuminate	Acute (56.56)
Sanchi Type Gangarampur Sanchi	Simple	Acrodromous	Symmetrical	Acuminate	Acute (60.32)
Halisahar Sanchi	Simple	Acrodromous	Symmetrical	Acuminate	Acute (66.72)
Simurali Sanchi	Simple	Acrodromous	Symmetrical	Acuminate	Acute (55.52)
Kalipatti	Simple	Acrodromous	Symmetrical	Acuminate	Acute (66.12)

Table 7: Description of kapoori and sanchi types of betelvine (*Piper betle* L.) with respect to plant characteristics

Varieties	*Stem colour*	*Stripe colour*	*Petiolar attachment*	*Root initiation node*	*Sex*
Kapoori Type Kapoori Chinacheppali	Light reddish green	Light brown	Marginal	3rd	Male
Kapoori Dodhipatla	Light reddish green	Light brown	Marginal	3rd	Male
Kapoori Pedacheppali	Light reddish green	Light brown	Marginal	3rd	Male
Swarna Kapoori	Green	Light brown	Marginal	3rd	Male
Sanchi Type Gangarampur Sanchi	Light green	Light brown	Marginal	3rd	Female
Halisahar Sanchi	Green	Light brown	Marginal	3rd	Female
Simurali Sanchi	Dark green	Light brown	Marginal	3rd	Female
Kalipatti	Light green	Light brown	Marginal	3rd	Female

leaf veining, laminar symmetry, leaf apex shape and leaf apex angle. Leaf organization was found simple and leaf veining was found acrodromous while leaf lamina was symmetrical in all the kapoori and sanchi cultivars. The field observations showed that the leaf apex shape and leaf apex angle found to be acuminate and acute, respectively in all

the varieties. Devi et al. (1992) characterized the betelvine cultivars into 4 distinct groups, namely bangla, meetha, sanchi and kapoori, in which each group had similar morphological and physiological properties, however, varied between cultivars within the same group.

Plant characteristics

The description of plant showed that the stem colour was light reddish green in three varieties of betelvine namely, kapoori chinacheppali, kapoori dodhipatla and kapoori pedacheppali but the stem colour of swarna kapoori and halisahar sanchi was green. The light green colour of stem was observed in gangarampur sanchi and kalipatti while the stem colour of simurali sanchi was dark green. Stripe colour was found to be light brown in all the kapoori and sanchi varieties. The petiolar attachment was marginal while root initiation node was third in all the experimental varieties. Kapoori varieties were male and sanchi varieties were female with some distinctive characteristics (Balasubrahmanyam and Rawat, 1992), Table 7.

CONCLUSION

Variation was existed among 8 betelvine cultivars in terms of growth and yield attributes. Kalipatti possessed highest (8.49 cm) internodal length while kapoori pedacheppali had the lowest value (6.35 cm). Leaf length ranged from 12.77 cm to 15.56 cm. There were significant interaction between time and varieties with respect to leaf width. Significant variations were found among the varieties of betelvine with respect to petiole length throughout the year. There were similarities and differences in qualitative characteristics of plant among the different kapoori and sanchi cultivars.

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KAPOORI CHINACHEPPALI

KAPOORI DODHIPATLA

KAPOORI PEDACHEPPALI

SWARNA KAPOORI

GANGARAMPUR SANCHI

HALISAHAR SANCHI

SIMURALI SANCHI

KALIPATTI

The pictures of different betelvine cultivars collected from Kalyani, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, W. B.