



Evaluation of betelvine (*Piper betle* L.) cultivars in the gangetic alluvial plains of West Bengal, India

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Abstract

Evaluation of 14 cultivars of betelvine (*Piper betle*) in the gangetic alluvial plains of West Bengal indicated that there was wide variation among them for growth, yield and quality parameters. Cultivar Simurali Sanchi showed superior performance with respect to increment in vine length (145.37 cm during June to August), fresh (364.38 g) and dry weight (52.29 g) of 100 leaves (depetiolated) and total chlorophyll content in leaves (2.45 mg g⁻¹ tissue). Leaf production was also maximum (58.56 vine⁻¹ year⁻¹) in cv. Simurali Deshi.

Keywords: betelvine, leaf yield, *Piper betle*, quality

Introduction

Betelvine (*Piper betle* L.) cultivation is highly labour intensive and is mostly suited for small holdings. However, once established, it becomes a perennial source of employment and cash flow for day-to-day requirement of farmers. In West Bengal, various local cultivars are used for cultivation whose performance in various regions is not known. Das *et al.* (1995) evaluated eight cultivars of Bengal and found cv. Ghanagette producing the highest number of leaves vine⁻¹ (88) with maximum fresh (380.75 g) and dry weight (44.60 g) of 100 leaves. Reddy (1996) observed that the fresh weight of 100 leaves was 300.5 g in Ramtek Bangla and 246.5 g in Godi Bangla. After evaluation of seven cultivars of betelvine, Sheet (2002) observed that cv. Chandrakona was superior with respect to

most of the characters compared to other cultivars. The present study was undertaken to find out the most suitable cultivar with higher leaf yield and better quality in the gangetic alluvial plains of West Bengal, India.

Materials and methods

The investigation was carried out during 2005–06 and 2006–07 at Horticultural Research Station, Mondouri, Nadia in the gangetic alluvial plains of West Bengal. The experimental site was situated approximately at 23°N latitude and 80° E longitude with an altitude of 9.75 m above MSL. Average rainfall was about 56.5 mm month⁻¹. The average temperature varied from 9.48° C to 36.52° C and relative humidity ranged from 41.30% to 98.90% during the period of experimentation. The soil was sandy clay loam in texture with good water holding

capacity and moderate soil fertility status with a pH of 6.8. Fourteen betelvine cultivars namely, Bagerhat, Boinchi Godi, CARI-2, CARI-6, Chamundai Bhabna, Ghanagette, Jabalpur, Kadwa, Kalipatti, Sanchi, Simurali Bhabna, Simurali Deshi, Simurali Jhal and Simurali Sanchi were evaluated with three replications in a randomized block design (CARI-2 and CARI-6 are not cultivars but germplasm collected from Andamans). The experiment was conducted in an established boraj (an artificially covered structure with bamboo, jute stick and ulu grass). Cuttings of same age group (20 cm long) were coiled and buried in the soil leaving one node at one end exposed to the air for initiation of vegetative growth. Row to row distance was maintained at 45 cm and vines were spaced at 15 cm. A uniform manuring schedule was followed with a dose of 200 kg N, 100 kg P₂O₅, 100 kg K₂O ha⁻¹ applied in splits through mustard oil cake, single super phosphate and muriate of potash respectively. Irrigation and other cultural operations were carried out as per recommended package of practice (Maiti *et al.* 1995; Dey *et al.* 2003). Data on growth, leaf yield and quality parameters was recorded from 20 vines selected randomly. Vine growth was measured at 15 days interval and total length for each three month period namely, September–November, December–February, March–May and June–August was considered to compare the growth pattern during different seasons. Growth during a specific period was calculated by deducting the previous length obtained upto beginning of the month from total length obtained upto last date of the specific period. Before lowering of vine (bhaj), the length of vine was measured. Other growth characters like internodal length was measured each month and mean data over the year was considered for analysis. Leaf yield was obtained by counting the number of leaves harvested throughout the year. Leaves were harvested at nine days interval leaving six leaves from the top. Leaf parameters like petiole length, length, breadth and area of the leaf at 8th node from the top was measured in each month and average data is presented. Fresh weight of leaves was taken from freshly harvested 100

leaves without petiole. For taking dry weight of leaves, the same leaves were dried in a drier at 45° C for 48 h and weighed. Qualitative characters like chlorophyll (a, b and total) was estimated by the method suggested by Arnon (1959) and β carotene in leaf was estimated by the method of Broadman & Anderson (1967). Data was analysed statistically by the method suggested by Gomez & Gomez (1984). Significance of different sources of variation was tested by Fishers and Sendecor's 'F' test at 0.5% probability level and least significant differences at 0.05 level of significance among the treatments was worked out (Fisher & Yates 1979).

Results and discussion

Vine length

The data on vine length showed significant variation among different cultivars (Table 1). During September–November the vine length was significantly higher (107.05 cm) in Simurali Sanchi followed by Simurali Deshi (94.35 cm). During December–February, vine length was very less mainly due to low temperature during the period. 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 is probably due to changes in temperature and atmospheric humidity during various seasons and genetic variation among the cultivars. During the period of investigation, high humidity (84.70%–98.90%), moderate temperature (25.94° to 34.15°C) and high rainfall (953.79 mm) prevailed during June–August which influenced the growth of the vines.

Since betel leaves are produced from each node of the vine, longer vines with shorter internode would be ideal for higher leaf production. Moreover, faster the growth of the vine, more

Table 1. Vine length of different cultivars of betelvine

Cultivar	Vine length (cm)											
	Sept–Nov			Dec–Feb			March–May			Jun–Aug		
	1 st Yr.	2 nd Yr.	Pooled	1 st Yr.	2 nd Yr.	Pooled	1 st Yr.	2 nd Yr.	Pooled	1 st Yr.	2 nd Yr.	Pooled
Bagerhat	43.47	46.99	45.23	22.20	23.57	22.88	37.93	40.73	39.33	59.53	65.42	62.48
Boinchigodi	46.23	48.59	47.42	23.20	24.25	23.73	40.69	42.59	41.64	63.60	46.68	55.14
CARI-2	84.97	89.00	86.98	41.60	45.07	43.33	74.07	78.83	76.45	116.67	120.80	118.73
CARI-6	87.63	88.23	87.93	43.47	43.47	43.47	76.73	77.47	77.10	121.13	121.40	121.27
Bhabna Chamundai	59.40	61.62	60.51	30.40	30.78	30.59	51.90	54.13	53.02	82.87	85.10	83.98
Ghanagette	70.07	72.67	71.37	34.86	34.33	34.60	61.52	62.50	62.01	96.83	99.10	97.97
Jabalpur	29.43	31.00	30.22	14.66	13.50	14.08	25.72	28.63	27.18	40.61	43.57	42.09
Kadwa	42.20	41.73	41.97	21.10	20.13	20.62	37.07	38.07	37.57	58.37	57.47	57.92
Kalipatti	66.87	70.50	68.68	34.67	35.67	35.17	57.83	61.30	59.57	94.73	97.13	95.93
Sanchi	82.73	89.13	85.93	41.57	47.53	44.55	71.87	69.13	70.50	114.73	111.00	112.87
Simurali Bhabna	90.33	85.87	88.00	44.69	47.13	45.91	78.13	83.97	81.05	123.27	132.07	127.67
Simurali Deshi	95.37	93.33	94.35	48.27	47.77	48.01	82.80	87.00	84.90	129.20	133.33	131.27
Simurali Jhal	53.53	51.67	52.60	26.32	23.73	25.03	46.00	49.33	47.67	73.43	81.00	77.22
Simurali Sanchi	104.83	109.33	107.05	51.67	45.13	48.40	91.80	92.67	92.23	143.07	147.67	145.37
Mean	68.36	69.98	69.16	34.19	34.43	34.31	59.58	61.88	60.73	94.15	95.84	94.99
SEm±	1.02	1.32	1.23	1.07	1.00	1.02	0.89	1.00	0.92	0.37	5.37	2.72
CD (P=0.05)	2.97	3.84	3.60	3.12	2.91	2.97	2.59	2.91	2.69	1.06	15.61	7.90

number of leaves would be obtained within a shorter time.

Internodal length

Internodal length varied significantly and was shortest in Jabalpur (3.38 cm) (Table 2). Longer vine with shorter internode is a desirable character in betelvine as it can produce more number of leaves due to increase in number of nodes.

Petiole length

Cultivar Chamundai Bhabna recorded significantly longest petiole (10.60 cm) (Table 2). Rahaman *et al.* (1997) reported a variation in petiole length between 5.90 cm and 17.50 cm in 27 genotypes of betelvine. Reddy (1996) also reported that petiole length of betel leaves varied significantly among cultivars (6.6–5.2 cm).

Leaf length

The cultivars showed significant variation with respect to leaf length (Table 2) and 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). Rahaman *et al.* (1997) also observed variation in leaf length between 6.2 cm to 15.3 cm among 27 genotypes of betelvine.

Leaf breadth

Significant variation in leaf breadth was observed among the cultivars (Table 2). The widest leaf (13.25 cm) was recorded in Chamundai Bhabna which was on par with Ghanagette (13.22 cm), Simurali Jhal (13.12 cm) and Simurali Bhabna (12.87 cm). Variation in leaf breadth between 4.2 cm and 11.6 cm was also reported by Rahaman *et al.* (1997) from a study with 27 genotypes of betelvine. Sheet (2002) reported maximum leaf width (12.43 cm) in cv. Chandrakona among seven cultivars of betelvine.

Leaf area

Significant variation in leaf area among the cultivars was recorded and highest leaf area (167.82 cm²) was recorded in Ghanagette, which was at par with Simurali Jhal (166.45

cm²) and Chamundai Bhabna (164.37 cm²) (Table 2). Rahaman *et al.* (1997) also reported significant variation in leaf area from 22 cm² to 147.20 cm² among 27 genotypes of betelvine. Among seven cultivars, Sheet (2002) observed highest leaf area in cv. Chandrakona (123.56 cm²).

Weight of 100 leaves

Fresh weight of 100 leaves varied significantly among the cultivars (Table 3). Significantly higher fresh leaf weight (364.38g) was observed in Simurali Sanchi. Significant variation in dry weight of 100 leaves observed among the cultivars (Table 3) followed the same trend as fresh weight of leaves.

Leaf yield

Significant variation was observed with respect to number of leaves vine⁻¹ among different cultivars and Simurali Deshi produced maximum number of leaves (58.56 vine⁻¹), which was statistically superior over all other cultivars (Table 3), Choudhary (2006) observed that Simurali Sanchi produced the highest (46.73 vine⁻¹) number of leaves followed by Ghanagette (41.70 vine⁻¹) and Simurali Jhal (37.63 vine⁻¹) among five cultivars. With regard to projected yield, the cultivar Simurali Deshi also recorded significantly higher leaf number (60.32 lakh ha⁻¹). Sheet (2002) recorded highest number of leaves (62.66 lakh ha⁻¹) in cv. Chandrakona.

Chlorophyll content

Chlorophyll 'a' content in leaves varied significantly in various cultivars and maximum chlorophyll 'a' content (1.61 mg g⁻¹ tissue) was found in cv. Sanchi (Table 4). Since all the cultivars were grown in the same agro climatic condition with partial shade, the differences observed among the cultivars may be due to their genetic make up. A significant variation was also observed among cultivars with regard to chlorophyll 'b' content and maximum chlorophyll 'b' content (1.00 mg g⁻¹ tissue) was recorded in Simurali Sanchi (Table 4). The total chlorophyll content of the leaves also varied significantly among the cultivars and was highest in Simurali Sanchi (2.45 mg).

Table 2. Internodal length and leaf parameters of different cultivars of betelvine

Cultivar	Internodal length (cm)		Petiole length (cm)		Leaf length (cm)		Leaf breadth (cm)		Leaf area (cm ²)						
	1 st Yr.	2 nd Yr.	1 st Yr.	2 nd Yr.	1 st Yr.	2 nd Yr.	1 st Yr.	2 nd Yr.	1 st Yr.	2 nd Yr.					
Bagerhat	4.33	4.60	4.47	6.63	7.20	6.92	11.33	11.82	9.60	106.50	111.33	108.92			
Boinchigodi	6.33	6.67	6.50	6.37	6.90	6.82	11.67	12.05	10.30	110.20	114.40	112.30			
CARI-2	7.97	8.23	8.10	7.30	7.63	7.47	15.40	15.75	10.07	10.17	127.27	135.13	131.20		
CARI-6	7.27	7.27	7.27	6.83	7.43	7.13	15.00	15.33	10.73	10.88	116.60	118.20	117.40		
Bhabna Chamundai	6.67	6.50	6.58	10.83	10.37	10.60	15.93	16.20	12.77	13.25	166.23	162.50	164.37		
Ghanagette	5.03	5.23	5.13	9.00	8.93	8.97	16.57	16.90	13.10	13.22	166.54	169.10	167.82		
Jabalpur	3.33	3.43	3.38	8.23	8.93	8.58	10.83	11.50	11.17	9.57	79.77	79.80	79.78		
Kadwa	5.50	5.43	5.47	8.67	8.83	8.75	12.60	13.03	12.82	10.57	10.67	108.30	110.87	109.58	
Kalipatti	6.83	7.03	6.93	6.90	7.13	7.02	13.67	13.87	13.77	10.63	10.93	122.73	127.07	124.90	
Sanchi	7.03	7.05	7.04	6.17	7.07	6.62	14.23	15.27	14.75	10.33	10.57	97.20	100.13	98.67	
Bhabna Simurali	6.43	6.53	6.48	7.33	7.50	7.42	14.47	14.70	14.58	12.77	12.97	127.46	130.17	128.82	
Deshi Simurali	6.23	6.07	6.15	6.83	7.20	7.02	14.10	14.97	14.53	10.80	11.50	125.13	128.83	126.98	
Simurali Jhal	4.33	4.17	4.25	7.30	7.40	7.35	16.37	16.50	16.43	13.07	13.16	165.37	167.53	166.45	
Sanchi Simurali	7.17	7.50	7.33	7.83	8.17	8.00	16.69	16.73	16.71	11.50	11.34	130.83	136.53	133.68	
Mean	6.03	6.12	6.08	7.59	7.91	7.76	14.33	14.60	14.47	11.13	11.37	125.00	127.97	126.49	
SEm±	0.13	0.09	0.10	0.28	0.33	0.29	0.34	1.27	0.70	0.35	0.29	0.28	1.56	1.99	1.23
LSD (P=0.05)	0.36	0.26	0.28	0.80	0.95	0.85	1.00	3.68	2.03	1.01	0.83	0.81	4.52	5.79	3.57

Table 3. Weight of 100 leaves and leaf yield of different cultivars of betelvine

Cultivar	Fresh weight of 100 leaves (g) (Without petiole)			Dry weight of 100 leaves (g) (Without petiole)			Leaf yield vine ⁻¹ (No.)			Leaf yield ha ⁻¹ (Lakh)		
	1 st Yr.	2 nd Yr.	Pooled	1 st Yr.	2 nd Yr.	Pooled	1 st Yr.	2 nd Yr.	Pooled	1 st Yr.	2 nd Yr.	Pooled
Bagerhat	254.50	204.33	229.42	34.83	36.73	35.78	37.10	39.07	38.08	38.21	40.24	39.22
Boinchigodi	269.97	262.81	216.39	37.53	41.82	39.68	26.17	27.47	26.82	26.96	28.29	27.62
CARI-2	264.30	283.56	273.93	46.13	53.55	49.85	39.87	41.07	40.47	41.07	42.30	41.68
CARI-6	275.50	284.23	279.87	38.40	42.67	40.54	43.87	44.87	44.13	45.19	46.22	45.45
Chamundai Bhabna	334.27	318.56	326.42	50.03	47.11	48.57	32.40	32.07	32.23	33.37	33.03	33.20
Ghanagette	340.13	349.31	349.72	47.00	49.20	48.10	51.47	53.23	52.35	53.01	54.83	53.80
Jabalpur	160.80	175.19	168.00	26.40	33.34	29.87	30.43	32.20	31.31	31.34	33.17	32.25
Kadwa	256.63	247.74	252.19	42.00	43.04	42.52	29.07	29.87	29.47	29.94	30.77	30.35
Kalipatti	312.45	315.02	313.74	43.13	45.05	44.10	36.10	38.80	37.45	37.18	39.96	38.57
Sanchi	222.50	232.37	227.44	31.67	32.20	31.94	43.67	45.17	44.41	44.98	46.53	45.74
Simurali Bhabna	248.43	267.21	257.82	32.27	33.08	32.68	54.50	52.10	53.30	56.14	53.66	54.90
Simurali Deshi	261.17	276.73	268.95	29.43	30.67	30.05	57.72	59.40	58.56	59.45	61.18	60.32
Simurali Jhal	308.85	308.43	308.65	50.07	52.23	51.15	46.17	45.13	45.65	47.56	46.48	47.02
Simurali Sanchi	360.50	368.26	364.38	50.23	54.35	52.29	55.80	57.67	56.73	57.47	59.40	58.43
Mean	276.43	278.13	274.07	39.94	42.50	41.22	41.74	42.72	42.21	42.99	44.00	43.47
SEm±	22.15	5.37	17.92	0.53	0.76	0.46	0.36	0.65	0.46	0.37	0.68	0.52
LSD (P=0.05)	64.42	15.61	52.10	1.53	2.21	1.32	1.04	1.88	1.32	1.07	1.97	1.49

Table 4. Qualitative parameters of leaves of different cultivars of betelvine at harvest

Cultivar	Chlorophyll a (mg g ⁻¹ tissue)		Chlorophyll b (mg g ⁻¹ tissue)		Total Chlorophyll (mg g ⁻¹ tissue)		Ascorbic acid (mg 100 g ⁻¹)		β Carotene (mg 100 g ⁻¹)						
	1 st Yr.	2 nd Yr.	1 st Yr.	2 nd Yr.	1 st Yr.	2 nd Yr.	1 st Yr.	2 nd Yr.	1 st Yr.	2 nd Yr.					
Bagerhat	0.68	0.67	0.68	0.25	0.23	0.24	0.93	0.90	0.92	1.68	1.78	1.73	7.30	7.25	7.28
Boinchigodi	1.05	1.01	1.03	0.64	0.64	0.64	1.69	1.64	1.67	1.71	1.71	1.71	7.10	7.18	7.14
CARI-2	1.07	1.11	1.09	0.70	0.72	0.71	2.11	1.47	1.79	3.19	3.19	3.19	7.00	7.07	7.03
CARI-6	1.42	1.42	1.42	0.41	0.42	0.42	1.84	1.83	1.84	2.34	2.35	2.35	6.50	6.56	6.53
Bhabna Chamundai	1.21	1.21	1.21	0.24	0.20	0.22	1.44	1.41	1.43	2.30	2.31	2.30	6.88	6.90	6.89
Ghanagette	1.39	1.40	1.40	0.82	0.84	0.83	2.21	2.24	2.23	1.89	1.87	1.88	5.61	5.65	5.63
Jabalpur	0.97	0.98	0.97	0.80	0.83	0.82	1.77	1.81	1.79	2.69	2.68	2.68	5.07	5.13	5.10
Kadwa	0.84	0.82	0.83	0.17	0.19	0.18	1.01	1.00	1.01	2.63	2.59	2.61	6.76	6.69	6.73
Kalipatti	1.25	1.23	1.24	0.95	0.93	0.94	2.20	2.16	2.18	3.05	3.07	3.06	5.27	5.24	5.26
Sanchi	1.60	1.61	1.61	0.68	0.67	0.68	2.28	2.28	2.28	1.83	1.82	1.83	6.51	6.58	6.55
Bhabna Simurali	1.46	1.47	1.47	0.81	0.82	0.81	2.27	2.29	2.28	3.20	3.21	3.20	7.01	6.95	6.98
Deshi Simurali	1.30	1.32	1.31	0.68	0.68	0.68	1.98	2.00	1.99	2.67	2.66	2.67	7.24	7.24	7.24
Simurali Jhal	1.28	1.28	1.28	0.84	0.85	0.84	2.12	2.12	2.12	1.74	1.74	1.74	7.31	7.33	7.32
Sanchi Simurali	1.45	1.45	1.45	1.00	1.00	1.00	2.45	2.45	2.45	2.08	2.12	2.00	7.05	7.06	7.05
Mean	1.21	1.21	1.21	0.64	0.64	0.64	1.87	1.82	1.85	2.35	2.36	2.35	6.61	6.63	6.62
SEm±	0.08	0.00	0.04	0.00	0.00	0.00	0.00	0.17	0.09	0.19	0.03	0.10	0.09	0.01	0.04
LSD (P=0.05)	0.25	0.01	0.12	0.01	0.02	0.01	0.02	0.51	0.26	0.57	0.08	0.29	0.26	0.03	0.13

Significant variation (0.93-2.49 mg g⁻¹) in chlorophyll content of leaves in different cultivars of betelvine was also reported by Balasubrahmanyam *et al.* (1990) and Guha (2006). Due to higher chlorophyll content in Simurali Sanchi, the leaves appear dark green which is preferred by customers and fetches higher price in comparison to other cultivars.

Ascorbic acid content

Since betel leaves are chewed directly as a masticatory, palatability is an important criteria and ascorbic acid may impart taste to it. A significant difference was recorded among cultivars for ascorbic acid content, which was maximum in Simurali Bhabna (3.20 mg 100 g⁻¹) (Table 4). Guha (2006) reported that ascorbic acid content in fresh betel leaves varied from 0.005%–0.01%.

β -carotene content

β -carotene is associated with the quality of the betel leaves. A significant variation with regard to β -carotene content was observed among various cultivars and highest β -carotene content in fresh leaves (7.32 mg 100 g⁻¹) was recorded in Simurali Jhal which was at par with Bagerhat (7.28 mg) (Table 4). The difference in quality parameters may be due to variation in inherent synthesizing ability of individual cultivars.

Based on the results of the present investigation, Simurali Deshi may be considered as the most suitable cultivar for cultivation in the gangetic alluvial plains of West Bengal.

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