



Performance Study of Betelvine (*Piper betle* Linn.) Cultivars under Varying Doses of Phytohormone-Triacontanol

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Betel vine (*Piper betle* Linn.) belongs to the family Piperaceae. The experiment was carried out with two factorial randomized block design combining 3 replications and 18 no. of treatments. Adopted plant spacing was 50 cm x10 cm and plot to plot distance was 60 cm. Treatment Details: Factor 1: Triacontanol – 0.1% (T₁), Triacontanol – 0.05% (T₂), Triacontanol – 0% (T₃), Factor 2: Cultivars: Utkal Sudam, Kali Bangla, Kotki, Simurali Bhabna, Simurali Gol Bhabna, Chalani local. Nutrients were applied as FYM (10 tonnes ha⁻¹) and N:P:K::200:100:100 Kg ha⁻¹year⁻¹. Regarding the interaction effect of cultivar with the effect of Triacontanol, the cultivar Kotki treated with Triacontanol @ 0.1% (T₁) recorded highest average vine elongation per month (32.83 cm). Whereas both the cultivar Kotki and Kali Bangla, when treated with Triacontanol @ 0.1% (T₁) recorded maximum number of leaves per vine per year (4.60). The highest content of total

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Chlorophyll (3.89 mg/g) and essential oil (0.82%) was obtained from the cultivar Simurali Gole Bhabna treated with Triacantanol @ 0.1% (T₁). The cultivar Utkal Sudam with Triacantanol @ 0.05% (T₂) was observed highest Phenol content (142.58 mg GAE /100g). Maximum shelf life (18 days) was obtained from the cultivar Kali Bangla and Kotki treated with Triacantanol 0.1% (T₁). From this experiment, highest benefit:cost ratio (3.03) was obtained from the cultivar Kali Bangla treated with Triacantanol @ 0.1%(T₁) and lowest benefit:cost ratio (1.75) was recorded in cultivar Chalani local without the use of Triacantanol i.e. in control plot.

Keywords: *Triacantanol; cultivars; betel vine; leaf yield.*

1. INTRODUCTION

Betel vine (*Piper betle* Linn.) is an evergreen, perennial, dioecious climbing herb and present itself as an important cash crop. Leaf is a rich source of eugenol, chavicol, methyl chavicol (used in perfumery and medicine) and in protein, minerals, vitamins and amino acids [1]. It is mainly cultivated in South-East Asian countries, viz., India, Bangladesh, Sri Lanka, Malaysia, Singapore, Thailand, Philippines, Taiwan and Papua New Guinea for its leaves, which are used as a masticatory. In India, it is grown on commercial scale as cash crop in the states such as Assam, West Bengal, Bihar, Uttar Pradesh, Meghalaya, Orissa, Karnataka, Kerala, Andhra Pradesh, Madhya Pradesh, Tamil Nadu, and Tripura. There are about 100 varieties of betel vine [2,3]. On an average about 66% of betel vine production is contributed by the state of West Bengal where it is cultivated on about 20,000 ha covering about 4-5 lakh *boroj* employing about the same number of agricultural families [4]. That apart, a small *boroj* of about three decimal area can generate employment opportunity for an agricultural worker throughout the year [5]. Subsequently, leaves worth about Rs 30-40 million are exported to the countries like Bahrain, Canada, Great Britain, Hong Kong, Italy, Kuwait, Nepal, Pakistan, Saudi Arab and many other European countries [6,7]. Contrary of production percentage, due to the huge utilization, the demand for quality planting material of betel vine is increasing day-to-day. However, current production of leaves is not enough for the fast-growing demand of local and international market. A survey over several years indicated between 125 to 150 local cultivars (landraces) of betel vines in India. Many of these varieties differ from each other in several properties. Variety with prefix Desi in their names invariably refer to the variety 'Bangla' in West Bengal, 'Kapoori' in Maharashtra and 'Desawari' in Madhya Pradesh [8]. Betel vine is cultivated in a 'boroj', with a specific microclimate. Various climatic factors like

temperature, relative humidity and canopy temperature play an important role on growth and yield of betel vine [9].

A natural plant growth regulator, Triacantanol found in epicuticular waxes which is used to enhance the crop production. Researchers have reported the Triacantanol mediated improvement in growth, yield, photosynthesis, protein synthesis, uptake of water and nutrients, nitrogen-fixation, enzymes activities and contents of free amino acids, reducing sugars, soluble protein, and active constituents of essential oil in various crops [10]. Verma et al., [11] also found the same results and suggested that the activity of this hormone varied with the different concentration. The foliar application of Triacantanol was also found to enhance the level of L-adenosine which elicits many physiological responses like plant growth [12,13].

Keeping the above facts in view, a field experiment was carried out at the research plot (*boroj*) under the Department of Plantation Crops & Processing, Faculty of Horticulture, Uttar Banga Krishi Vishwavidyalaya, Pundibari, Cooch Behar to study the performance of six cultivars under varying levels of a phytohormone i.e. triacantanol in respect of their growth and leaf yield.

2. MATERIALS AND METHODS

The experiment was carried out at the research plot (*boroj*) under the Department of Plantation Crops & Processing, Faculty of Horticulture, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal. The vines of six cultivars viz. Utkal Sudam, Kali Bangla, Kotki, Simurali Bhabna, Simurali Gole Bhabna and Chalani local was used as planting material. The experimental field was situated in *Terai* agro-climatic zones of West Bengal at 26.52°N latitude and 89.10°E longitude. It was laid out in two factor randomized block design with three replications and eighteen number of treatments. Single node

cuttings of six different cultivars were planted during 2018 followed single row system of planting with a row to row spacing of 50 cm, plant to plant spacing of 10 cm and plot to plot distance was 60 cm, accommodating sixty plants per plot of 3 m × 1.8 m size. FYM (10 t ha⁻¹) and Vermicompost (6 t ha⁻¹) was applied along with N:P:K:: 200:100:100 kg ha⁻¹. The data was recorded at three months interval in a year starting from June in the starting year of the experiment to May in the next year. Growth parameters like vine elongation, petiole length, length of internodes, leaf area and yield parameters like leaf yield vine⁻¹ and estimated leaf yield, fresh and dry weight of 100 betel leaves etc. was recorded. Triacantanol was applied by diluting in water. To make 0.1% Triacantanol, 5 ml of Triacantanol was mixed with 5 litre of water and was sprayed at monthly interval. Simultaneously to make 0.05% Triacantanol, 2.5 ml was added with 5 litre of water. The control plot were kept untreated i.e. no application of Triacantanol.

The observations were subjected to statistical analysis by using two factor randomized block design as described by Panse and Sukatme [14]. Treatment variations were tested for significance under different treatments performed using of critical difference at 5% level of significance ($p \leq 0.05$).

3. RESULTS AND DISCUSSION

3.1 Vine Elongation

Data presented in Table 1, represents the effect of triacantanol on vine elongation and internodal length of different varieties during the period of experiment. It was found that among the four quarters, the maximum vine elongation (35.05 cm) was observed in second quarter (Sept-Nov) with the application of treatment T₁ (0.1% triacantanol). Similarly, Pariari and Imam (2012a) also reported that during September–November the vine length was significantly higher (107.05 cm) in Simurali Sanchi. The minimum vine elongation (24.09 cm) was recorded in first quarter with treatment T₃ under control condition, which was statistically *at par* with same treatment application in third quarter (25.70 cm). It had also been observed that within the four quarters, among all the varieties the significant vine elongation was observed highest in cultivar Chalani local (36.37 cm) in the month of September–November in second quarter which was statistically *at par* with Kali Bangla (35.88 cm) in the first quarter. The minimum vine

elongation has been observed in variety Utkal Sudam (18.03 cm) during the month of June–August (1st quarter).

The significant variation of vine elongation was observed amongst the varieties in relation with the treatment combination during the different quarters (Table 1). Among all the varieties, variety Chalani local (39.08 cm) showed maximum vine elongation with the application of growth regulator triacantanol @ 0.05% during the second quarter which was statistically *at par* with the Kali Bangla (38.33 cm) and Kotki (38.13 cm) in the first and second quarter respectively. Similarly, Pariari and Imam (2012a) in their experiment also reported that vine length showed significant variation among different cultivars which may be due to the climatic changes. In another study, Mohanta and Pariari [15] also noted similar observation on vine elongation that differs at monthly interval with respect to temperature, rainfall, relative humidity. The minimum vine elongation was observed in variety Utkal Sudam (17.41 cm) in the first quarter with the application of treatment T₁ (0.1%).

Internodal Length:

Whereas in case of internodal length, it had been found that there was a significant variation in the internodal length in different treatments whereas maximum internodal length (6.77 cm) was found in the treatment T₁ (0.1% triacantanol) i.e., in the first quarter which is statistically *at par* with the treatment T₂ (6.68 cm) and T₃ (6.54 cm). It was also observed that there was a significant variation in internodal length among the varieties, such as Chalani local (7.27 cm) showed maximum internodal length in the month of September–November which was statistically *at par* with Kali Bangla (7.00 cm) and Kotki (7.05 cm) in the same months. The minimum internodal length was found in variety Utkal Sudam (4.26 cm) during the month of December–February (3rd quarter).

It has also been observed that maximum internodal length was found in the second quarter in comparison with the all four quarters. It is apparent from Table 1, that variety Kotki is showing maximum internodal length i.e., 7.49 cm during the third quarter under the control condition subsequently followed by Chalani local (7.61 cm and 7.36 cm) with the application of triacantanol 0.1 and 0.05 percent respectively which was statistically *at par* with Kali Bangla i.e., 7.24 cm. The minimum internodal length was

obtained during the first quarter in variety Utkal Sudam with 4.24 cm under control plot which was statistically *at par* with treatment T₁ i.e., 4.33 cm after the application of 0.1% triacontanol in the same variety Utkal Sudam. According to Pariari and Imam [16] the longer vine with shorter internode is a desirable character in betel vine which produced maximum number of leaves due to increased number of nodes.

3.2 Petiole Length

The longest petiole length was found in variety Utkal Sudam i.e., 9.31 cm during the second quarter. Pariari and Imam [16] also reported that cultivar Chamundali Bhabna recorded significantly longest petiole (10.60 cm). Whereas the shortest petiole length was obtained in the variety Utkal Sudam (5.53 cm) during the first quarter. In case of Tricontanol treatment, T₁ showed maximum petiole length in the third quarter i.e., during the months of December-February whereas, minimum effect was found during the first quarter in T₃ i.e., 6.20 cm.

Data recorded on the Table 2, represents the effect of different treatment on petiole and leaf area of the individual cultivars in different quarters. Significant variation on petiole length increment was recorded among the cultivars and the longest petiole length (9.91cm and 9.85 cm) was recorded in cultivar Utkal Sudam in both second and third quarter with respect to the application of treatment T₁ which is followed by Kotki (9.61 cm). Reddy [17] also reported that petiole length of betel leaves varied significantly among cultivars (6.6–5.2 cm).

3.3 Leaf Area Increment

The leaf area was measured variety wise accordingly in respective of four quarters whereas maximum leaf area was found in variety Simurali Gole Bhabna in both first and fourth quarter (120.30 cm² and 119.15 cm²) respectively. A field experiment conducted by Saikia et al. [18] at Assam Agricultural University reported that maximum leaf area of 116.41 cm² was found in cultivar Local Bangla. The minimum leaf area was found in variety Simurali Bhabna (109.20 cm²) during the second quarter which was *at par* with the cultivar Kali Bangla (117.30 cm²). Among three treatments, treatment T₁ (0.1% triacontanol) has recorded maximum effect on leaf area during the month of March-April (4th quarter) and minimum effect was recorded under control condition in the month of September-October (2nd quarter). Rahaman et al. [19]

reported significant variation in leaf area from 22 sq.cm to 147.20 sq.cm among 27 genotypes of betel vine.

In case of interaction effect, that maximum leaf area (133.39 cm²) was recorded in cultivar Simurali Gole bhabna in respect of treatment T₂ (0.05% triacontanol) which is statistically *at par* with Simurali bhabna (129.17 cm). The minimum leaf area was recorded in cultivar Kotki (98.2 cm) under the control plot in second quarter. Pariari and Imam [16] reported that the highest leaf area (167.82 sq.cm) was recorded in Ghanagette, which was *at par* with Simurali Jhal (166.45 sq.cm) and Chamundai Bhabna (164.37 sq.cm).

Fresh weight and dry weight of 100 leaves.

Table 3 represent significant variation of fresh weight of 100 leaves among different cultivars. The maximum fresh weight of 100 leaves was recorded in cv. Simurali Bhabna (444.45 g) during the month of March-April followed by cv. Kotki (406.89 g) which was *at par* with Kali Bangla (394.00 g). Significantly higher fresh leaf weight (364.38 g) was observed in Simurali Sanchi [16]. The minimum fresh weight (304.40 g) of leaves were recorded in Chalani Local. Table 3 also recorded the significant variation in dry weight of 100 leaves among the cultivars and the maximum dry weight (88.33 g) were recorded in Chalani local. It has also been observed that application of treatment T₁ (0.1% triacontanol) gives higher fresh weight (426.56 g) as well as maximum dry weight (183.33 g) during the March- April month.

Significant variation effect of triacontanol on fresh as well as dry weight of 100 leaves has been recorded between two seasons among the cultivars (Table 3). Significantly higher fresh leaves weight (472.67 g) was recorded in cultivar Utkal Sudam in the month of March-April (spring season) with respect to the application of treatment T₁ (0.1%) which was statistically *at par* with cv. Kotki (452 g) with the same treatment effect. Experiment conducted by Das et al. [20] on evaluation of eight cultivars from Bengal regarding maximum fresh weight and dry weight of 100 fresh leaves reported that cultivar Ghanagette recorded maximum fresh (380.75 g) and dry weight (44.60 g). The minimum significant variation of dry leaves weight (98.0 g) was recorded in cv. Chalani local during the months of October- November with respect to the application of T₁. The minimum fresh and dry weight (324.47 g and 109.97 g) were recorded

under the T₃ during the month of October-November.

3.4 Projected Leaf Yield (lakh/ha)

The projected yield was estimated by converting the monthly leaf yield data into hectare per year. It is apparent from Table 3 that application of treatment T₁ (Triaccontanol @ 0.1%) produced maximum leaf yield (5.90 lakh) and in respect of cultivar highest leaf number was observed in Kali Bangla (5.74 lakh) which was statistically *at par* with both cv. Simurali Bhabna and Kotki (5.56 lakh) respectively. Regarding projected yield,

Pariari and Imam [16] reported that the cultivar Simurali Deshi recorded significantly higher leaf number (60.32 lakh ha⁻¹). The lowest leaf number were recorded in Chalani local (5.28 lakh). As per the interaction effect cv. Kotki treated with Triaccontanol @0.1% (T₁) recorded the highest leaf yield (6.14 lakh) which was statistically *at par* with Kali Bangla (6.13 lakh) with same treatment doses. The cultivar Chalani local produces the lowest leaf yield (4.95 lakh) without application of Triaccontanol(T₃). Chatterjee (1999) also reported the similar finding that application of Triaccontanol increased leaf yield by 12-18%.

Table 1. Varietal performance and triaccontanol effect on vine elongation (cm) and internodal length (cm) of betelvine

Cultivars	Vine elongation (cm)				Internodal length (cm)			
	1 st	2 nd	3 th	4 th	1 st	2 nd	3 th	4 th
Utkal Sudam	18.03	30.36	27.56	27.39	4.60	5.03	4.26	5.35
Kali Bangla	35.88	33.45	24.79	27.28	5.99	7.00	6.26	6.38
Kotki	27.56	35.09	26.90	26.75	6.30	7.05	6.52	6.29
Simurali Bhabna	31.70	34.37	25.75	27.29	6.54	6.76	6.81	6.81
Simurali Gole Bhabna	27.26	32.67	24.81	27.11	6.52	6.86	6.47	6.74
Chalani local	22.19	36.37	26.76	27.27	6.30	7.27	6.21	6.66
S.Em. (±)	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
CD at 5%	0.021	0.02	0.021	0.019	0.021	0.02	0.021	0.019
Triaccontanol								
T ₁	29.93	35.05	26.81	27.86	6.15	6.77	6.27	6.47
T ₂	27.30	33.18	25.77	27.10	5.90	6.68	6.08	6.44
T ₃	24.09	32.92	25.70	26.59	6.08	6.54	5.91	6.21
S.Em. (±)	0.238	0.21	0.20	0.197	0.005	0.005	0.005	0.005
CD at 5%	0.687	0.63	0.58	0.567	0.015	0.014	0.015	0.013
Cultivar x Triaccontanol								
Utkal Sudam x T ₁	19.19	37.32	28.61	27.61	4.33	5.39	4.56	5.38
Kali Bangla x T ₁	38.33	31.51	24.53	28.32	6.45	7.24	6.41	6.88
Kotki x T ₁	34.61	38.13	27.61	30.17	6.39	6.74	6.54	7.04
Simurali Bhabna x T ₁	36.94	37.46	27.41	28.34	6.73	6.93	7.14	6.64
Simurali Gole Bhabna x T ₁	27.14	30.35	25.43	26.55	6.47	6.69	6.77	6.72
Chalani local x T ₁	23.38	35.54	27.29	26.16	6.55	7.61	6.21	6.17
Utkal Sudam x T ₂	17.41	28.46	26.39	26.70	5.24	5.07	3.94	5.64
Kali Bangla x T ₂	36.60	33.31	25.3	27.29	5.92	7.06	6.43	6.42
Kotki x T ₂	24.59	29.51	26.56	24.71	5.86	6.94	6.66	6.59
Simurali Bhabna x T ₂	30.11	32.27	25.40	27.02	6.23	6.61	6.70	6.75
Simurali Gole Bhabna x T ₂	30.70	36.48	25.61	26.58	5.94	7.05	6.54	6.55
Chalani local x T ₂	24.38	39.08	25.39	30.31	6.19	7.36	6.23	6.67
Utkal Sudam x T ₃	17.50	25.32	27.70	27.88	4.24	4.63	4.27	5.02
Kali Bangla x T ₃	32.72	35.52	24.54	26.23	5.59	6.72	5.93	5.85
Kotki x T ₃	23.49	37.63	26.52	25.39	6.65	7.49	6.36	5.25
Simurali Bhabna x T ₃	28.06	33.40	24.45	26.51	6.66	6.74	6.59	7.05
Simurali Gole Bhabna x T ₃	23.93	31.17	23.41	28.21	7.17	6.84	6.11	6.94
Chalani local x T ₃	18.81	34.50	27.60	25.34	6.16	6.85	6.19	7.14
S.Em.(±)	0.583	0.5	0.49	0.481	0.012	0.012	0.012	0.011
CD at 5%	1.683	1.54	1.43	1.39	0.036	0.034	0.036	0.033

1 – 1st quarter (June- Aug). 2 - 2nd quarter (Sept-Nov.). 3 -3rd quarter (Dec-Feb) and 4- 4th quarter (March-May).
5- T₁ (Triaccontanol 0.1%). 6- T₂ (Triaccontanol 0.05%) and 7-T₃ (Control i.e. 0%)

Table 2. Varietal performance and triacontanol effect on petiole length(cm) and leaf area (sq.cm) of betelvine

Cultivars	Petiole length(cm)				Leaf area (sq.cm)			
	1 st	2 nd	3 th	4 th	1 st	2 nd	3 th	4 th
Utkal Sudam	5.35	9.31	9.14	9.01	115.53	110.59	112.61	117.06
Kali Bangla	6.38	8.77	8.79	8.62	115.06	113.69	117.30	115.35
Kotki	6.29	8.61	8.98	8.99	111.20	110.00	108.45	111.38
Simurali Bhabna	6.81	8.71	9.19	8.77	119.14	109.28	115.16	114.60
Simurali Gole Bhabna	6.74	8.65	8.80	8.84	119.15	116.85	116.74	120.30
Chalani local	6.66	8.74	8.49	8.42	111.23	114.06	110.45	112.49
SEm(±)	0.007	0.007	0.042	0.008	0.352	0.35	0.387	0.319
CD at 5%	0.019	0.019	0.122	0.022	1.10	1.012	1.116	0.920
T1	6.47	8.98	9.20	8.99	117.90	116.25	114.82	118.58
T2	6.43	8.73	8.83	8.98	116.28	113.60	114.04	114.79
T3	6.20	8.69	8.66	8.35	111.48	107.38	111.50	112.24
SEm (±)	0.005	0.005	0.030	0.005	0.249	0.248	0.273	0.225
CD at 5%	0.013	0.014	0.086	0.016	0.719	0.715	0.789	0.650
Cultivar×Triacontanol								
Utkal Sudam x T ₁	5.38	9.85	9.91	9.43	118.74	120.05	115.47	122.46
Kali Bangla x T ₁	6.88	9.04	8.71	8.64	119.54	120.07	118.64	116.39
Kotki x T ₁	7.04	8.56	9.61	8.95	122.68	116.19	107.32	122.51
Simurali Bhabna x T ₁	6.64	8.87	9.30	9.26	115.45	112.46	118.47	115.20
Simurali Gole Bhabna x T ₁	6.72	8.74	9.23	9.15	120.55	113.28	120.66	119.33
Chalani local x T ₁	6.17	8.82	8.46	8.53	110.41	115.43	108.35	115.58
Utkal Sudam x T ₂	5.64	8.94	9.04	9.15	105.33	105.13	110.05	104.90
Kali Bangla x T ₂	6.43	8.43	8.85	8.61	113.36	110.49	111.50	115.22
Kotki x T ₂	6.59	8.71	8.49	9.40	110.64	115.67	111.14	110.40
Simurali Bhabna x T ₂	6.75	8.82	9.21	9.22	129.17	111.51	121.70	116.30
Simurali Gole Bhabna x T ₂	6.55	8.46	8.80	9.14	133.39	119.57	115.36	130.44
Chalani local x T ₂	6.67	9.04	8.57	8.40	105.80	119.28	114.46	111.49
Utkal Sudam x T ₃	5.02	9.16	8.47	8.47	122.49	106.50	112.32	123.82
Kali Bangla x T ₃	5.85	8.85	8.81	8.61	112.28	110.51	121.75	114.44
Kotki x T ₃	5.25	8.56	8.83	8.64	100.28	98.15	106.88	101.24
Simurali Bhabna x T ₃	7.05	8.45	9.06	7.83	112.79	103.87	105.30	112.33
Simurali Gole Bhabna x T ₃	6.93	8.75	8.36	8.24	103.52	117.70	114.21	111.15
Chalani local x T ₃	7.14	8.37	8.44	8.34	117.47	107.47	108.55	110.43
SEm(±)	0.011	0.012	0.073	0.013	0.61	0.607	0.67	111.15
CD at 5%	0.033	0.034	0.211	0.038	1.76	1.752	1.933	110.43

1 – 1st quarter (June- Aug). 2 - 2nd quarter (Sept-Nov.). 3 -3rd quarter (Dec-Feb) and 4- 4th quarter (March-May).
5- T₁ (Triacontanol 0.1%). 6- T₂ (Triacontanol 0.05%) and 7-T₃ (Control i.e. 0%)

3.5 Qualitative Parameters

Significant variation in qualitative parameters of leaf in different betelvine cultivars were also observed in this finding. The highest content of total Chlorophyll (3.89 mg/g) and essential oil content (0.82%) was obtained from the cultivar Simurali Gole Bhabna treated with Triacontanol @ 0.1% (T₁). On the other hand cultivar Utkal Sudam treated with Triacontanol @ 0.05% (T₂) was observed highest Phenol content (142.58 mg GAE /100g), and cultivar Kali Bangla treated with Triacontanol @ 0.1%(T₁) was observed lowest Phenol content (67.58 mg GAE /100g). Regarding shelf life of betel leaves, maximum (18 days) was obtained

from the cultivar Kali Bangla and Kotki treated with Triacontanol 0.1% (T₁).

3.6 Economic Return of Betel Vine

From the present studies (Table 4), it was found that the benefit cost ratio among all the cultivars showing significant variation in respective of leaf yield. The cultivar Kali Bangla has recorded the highest B:C ratio i.e., 3.03, 2.94 and 2.83 respectively under the influence of all the treatments T₁, T₂ and T₃ with respect to the highest selling prices/1000 leaves followed by Utkal Sudam (2.39). The lowest B:C ratio was recorded in Chalani local (1.75).

Table 3. Varietal performance and triacontanol effect on fresh weight and dry weight of betel leaves and projected leaf yield in hectare of betelvine

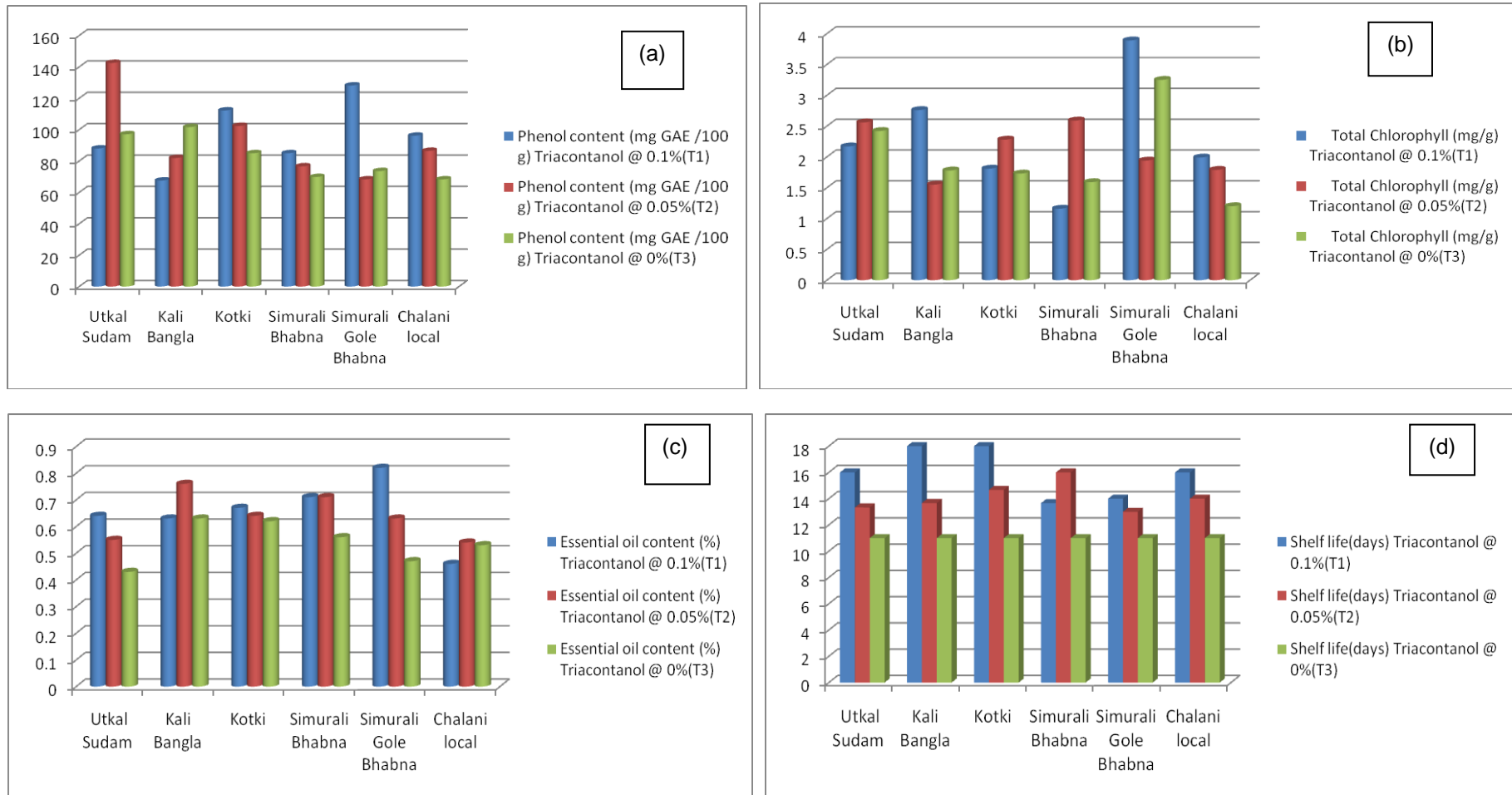
Cultivar	October-November		March-April		Projected leaf yield (lakh/ha)
	Fresh wt. (g)	Dry wt. (g)	Fresh wt. (g)	Dry wt. (g)	
Utkal Sudam	376.51	137.53	383.78	177.56	5.46
Kali Bangla	338.45	142.38	394.00	182.00	5.74
Kotki	368.93	120.40	406.89	182.89	5.56
Simurali Bhabna	378.11	144.84	444.45	189.33	5.56
Simurali Gole Bhabna	331.02	130.93	390.67	171.11	5.54
Chalani local	304.40	88.33	363.56	170.22	5.28
SEm(±)	0.122	0.140	1.823	1.084	0.012
C.D.	0.353	0.405	5.263	3.128	0.034
T ₁	382.77	137.30	426.56	183.33	5.90
T ₂	341.68	134.94	386.11	180.22	5.53
T ₃	324.27	109.97	379.00	173.00	5.14
SEm(±)	0.086	0.099	1.289	0.766	0.008
CD at 5%	0.250	0.286	3.721	2.212	0.024
Cultivar×Triacontanol					
Utkal Sudam x T ₁	395.40	158.80	472.67	190.00	5.75
Kali Bangla x T ₁	377.00	177.20	422.67	186.67	6.13
Kotki x T ₁	395.20	115.20	452.00	189.33	6.14
Simurali Bhabna x T ₁	372.60	113.00	451.33	190.00	5.86
Simurali Gole Bhabna x T ₁	385.20	168.60	391.33	174.00	5.97
Chalani local x T ₁	371.20	91.00	369.33	170.00	5.54
Utkal Sudam x T ₂	347.13	148.60	309.33	173.33	5.59
Kali Bangla x T ₂	303.13	123.00	370.67	189.33	5.75
Kotki x T ₂	425.00	155.20	404.00	190.00	5.43
Simurali Bhabna x T ₂	376.93	163.07	432.00	188.00	5.45
Simurali Gole Bhabna x T ₂	331.07	131.20	430.00	170.00	5.62
Chalani local x T ₂	266.80	88.60	370.67	170.67	5.35
Utkal Sudam x T ₃	387.00	105.20	369.33	169.33	5.05
Kali Bangla x T ₃	335.20	126.93	388.67	170.00	5.34
Kotki x T ₃	286.60	90.80	364.67	169.33	5.12
Simurali Bhabna x T ₃	384.80	158.47	450.00	190.00	5.37
Simurali Gole Bhabna x T ₃	276.80	93.00	350.67	169.33	5.01

Cultivar	October-November	October-November	March-April	March-April	Projected leaf yield (lakh/ha)
	Fresh wt. (g)	Dry wt. (g)	Fresh wt. (g)	Dry wt. (g)	
Chalani local x T ₃	275.20	85.40	350.67	170.00	4.95
SEm(±)	0.212	0.243	3.158	1.877	0.020
CD at 5%	0.611	0.701	9.116	5.418	0.059

T₁ (Triacontanol 0.1%), 6- T₂ (Triacontanol 0.05%) and 7-T₃ (Control i.e. 0%)

Table 4. Economic analysis of the experiment

Name of cultivars	Fixed cost (Rs.)	Leaf yield (Lakh ha ⁻¹)	Selling prices/1000 leaves	Gross return (Rs.)	Net return (Rs.)	B:C ratio
Utkal Sudam x T ₁	33992	5.75	150	86250	49789	2.37
Kali Bangla x T ₁	33992	6.13	180	110340	73879	3.03
Kotki x T ₁	33992	6.14	120	73680	37219	2.02
Simurali Bhabna x T ₁	33992	5.86	120	70320	33859	1.93
Simurali Gole Bhabna x T ₁	33992	5.97	120	71640	35179	1.96
Chalani local x T ₁	33992	5.54	120	66480	30019	1.82
Utkal Sudam x T ₂	33992	5.59	150	83850	48623	2.39
Kali Bangla x T ₂	33992	5.75	180	103500	68273	2.94
Kotki x T ₂	33992	5.43	120	65160	29933	1.85
Simurali Bhabna x T ₂	33992	5.45	120	65400	30173	1.86
Simurali Gole Bhabna x T ₂	33992	5.62	120	67440	32213	1.91
Chalani local x T ₂	33992	5.35	120	64200	28973	1.83
Utkal Sudam x T ₃	33992	5.05	150	75750	41758	2.23
Kali Bangla x T ₃	33992	5.34	180	96120	62128	2.83
Kotki x T ₃	33992	5.12	120	61440	27448	1.81
Simurali Bhabna x T ₃	33992	5.37	120	64440	30448	1.90
Simurali Gole Bhabna x T ₃	33992	5.01	120	60120	26128	1.77
Chalani local x T ₃	33992	4.95	120	59400	25408	1.75



**Fig. 1. (a). Phenol content (mg GAE /100 g) in betelvine leaves of different cultivars under varying levels of Triacontanol
 (b). Chlorophyll content (mg/g) in betelvine leaves of different cultivars under varying levels of Triacontanol
 (c) Essential oil content (%) in betelvine leaves of different cultivars under varying levels of Triacontanol
 (d) Shelf life (days) of betelvine leaves of different cultivars under varying levels of Triacontanol**

4. CONCLUSION

The present experiment was done to evaluate the performance of six betelvine cultivars under varying levels of Triacantanol i.e. T₁ (Triacantanol 0.1%), T₂ (Triacantanol 0.05%) and T₃ (No application of Triacantanol i.e. Control). It was found that the application of Triacantanol @ 0.1% (T₁) on the cv. Kotki recorded the highest leaf yield (6.14 lakh) which was statistically *at par* with Kali Bangla (6.13 lakh) with same treatment doses. But from the economic point of view, the cultivar Kali Bangla recorded the highest B:C ratio i.e., 3.03 under (T₁) and being more economical among the other treatments. Hence, the cultivar Kali Bangla and Triacantanol @ 0.1% may be adopted for cultivation under *Terai* region of West Bengal.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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