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EVALUATION OF BER CULTIVARS FOR GROWTH, YIELD AND YIELD ATTRIBUTING TRAITS UNDER NORTHERN DRY ZONE OF KARNATAKA INDIA

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ABSTRACT

Ber (*Ziziphus mauritiana* Lamk.) is an important dryland fruit crop grows as an evergreen shrub or tree mainly cultivated in arid and semi-arid regions of the country. Many varieties of ber are being cultivated in different parts of the country based on their adaptability to the particular region. Present investigation entitled 'Evaluation of ber cultivars for growth, yield and yield attributing traits under Northern dry zone of Karnataka' was conducted during the year 2023-24 at Horticulture Research and Extension Centre, Tidagundi, Vijayapura, under the University of Horticultural Sciences, Bagalkot. The experiment was laid out in a RBD design with eight treatments which are replicated thrice. Among different varieties evaluated, Chhuhara recorded the maximum plant height (3.98 m), leaf area (57.71 cm²) and specific leaf area (149.61 cm²/g) at 120 DAP (days after pruning), along with the highest TSS (20.33 °Brix), lowest acidity (0.27 %) and highest TSS to acid ratio (76.36). Umran exhibited the maximum fruit weight (17.01 g), pulp weight (15.63 g), pulp to stone ratio (14.28), pulp recovery (93.42 %), highest yield (45.55 kg/plant and 12.11 t/ha). Kadaka recorded the largest fruit (43.65 mm) and highest vitamin C content (97.61 mg/100g). The cultivar Mehrun showed the highest leaf chlorophyll content (28.82 SPAD), shortest duration from flowering to harvest (102.45 days) and pruning to harvest (184.14 days).
***Keywords*:** Ber, growth, physiological, stone, yield.

Introduction

Ber (*Ziziphus mauritiana* Lamk.) has been referred to as the crop of the 21st century and also called as Indian jujube, summer deciduous fruit, Chinese date. Its origin is believed to be from India to Southwestern China (Vavilov, 1951). The genus *Ziziphus*, classified under the order Rhamnales and the family Rhamnaceae (commonly known as the buckthorn family). It has been historically referred to as the "poor man's fruit" due to its nutritional value and affordability and is also known as the "king of arid fruits" for its ability to thrive in challenging environments. The type of fruit produced by these species is botanically classified as a drupe. The fruits are non-climacteric in nature.

The quality of ber fruits is significantly influenced by factors such as temperature, sunlight, water and nutrients, all of which contribute to notable physico-chemical changes throughout the growth process. Understanding these changes is critical for optimizing

cultivation practices and determining the ideal harvest time. Since ripening has a direct effect on fruit quality and shelf life, it is essential to monitor different growth stages to improve both yield and quality. This study aims to identify superior ber cultivars that are suitable for commercial cultivation in the Northern dry zone of Karnataka, with respect to growth, yield and yield attributing traits. Additionally, DUS (Distinctness, Uniformity and Stability) characteristics are being analysed to detect variations among cultivars.

Material and Methods

The present investigation was carried out during 2023-24 at the Horticulture Research and Extension Centre (HREC), Tidagundi, Vijayapura. The site was geographically situated at 16°49′ North latitude and 75°43′ East longitude, with an elevation of 513 meters above sea level. The soil, medium black in color, had a shallow depth and a pH ranging from 7.5 to 8.5. Throughout the experimental period, temperatures averaged between 15.38°C and 38.10°C, while relative humidity fluctuated from 31.00 to 91.03 per cent. The average annual rainfall is 590 mm.

The 15-year-old ber plants were selected for experimentation which were planted at 6 m x 6 m. A total of 120 plants were chosen using a randomized block design and were maintained under uniform agronomic practices as per the recommended package of practices. The selected plants for the experiment were pruned uniformly during the second week of May 2023 as part of the annual pruning. The experimental material consisted of eight treatments, namely Umran, Kadaka, Chhuhara, Illaichi, Gola, Mehrun, Dandan and Sanaur-2, with three replications.

Location	:HREC, Tidagundi (Vijayapura)
Experimental design	: RBD (Randomized Block Design)
No. of treatments	: 08
No. of replication	: 03
No. of plants per replication	: 05
Total number of plants	: 120

Plant height

The height of each plant was determined using a bamboo stick, measuring from the ground level to the highest growing point of the main stem. The average height of the plant was calculated by measuring the length of the bamboo stick covering the tallest shoot at 120 DAP. The height was expressed in meter (m).

Plant spread (N-S and E-W)

The spread of the plant canopy was determined using a measuring tape in two directions: North to South and East to West. Measurements were taken from the widest spread of shoots or branches towards both directions at 120 DAP. The average plant spread in both directions was calculated and expressed in meter (m).

Growth habit

The growth habit of each plant was observed through visual inspection and categorized as erect, semi-erect and spreading as per plant shape given in the guidelines for DUS testing of PPV and FRA (Anonymous, 2016).

Leaf shape

Twenty mature leaves per replication were collected (four leaves from each plant) and visual observations for leaf shape were recorded. Based on the leaf shape guidelines given in the DUS testing of PPV and FRA, the leaves were classified as ovate, obovate, oval and cordate (Anonymous, 2016).

Leaf base

To assess the shape of the leaf base, twenty mature leaves from each replication were gathered. They underwent a visual inspection and based on the guidelines established for DUS testing of PPV & FRA (Anonymous, 2016), they were categorized as acute, cordate, oval or oblique.

Leaf apex

To examine the shape of the leaf apex, 20 leaves per replication were plucked. It was observed by visual inspection and observed as acute and obtuse according to the guidelines for DUS testing of PPV & FRA (Anonymous, 2016).

Leaf curling

The leaves utilized for evaluating leaf shape were also utilized for examining leaf curving, which was determined through visual inspection with naked eyes. It was noted whether the leaf curving was present or absent based on the guidelines for DUS testing of PPV & FRA (Anonymous, 2016).

Leaf length

Ten mature leaves per replication were picked and assessed by measuring their length using a scale aligned parallel to the midrib. The distance from the apex to the base of each leaf was recorded as its length during 120 DAP, with the average length expressed in centimetres (cm).

Leaf width (cm)

Ten fully grown leaves used for leaf length were also used for measuring width of leaf. Leaf width was assessed using a measuring scale by measuring the

widest leaf blade perpendicular to the midrib and the average measurement was provided in centimetres (cm) at 120 DAP.

Thorn shape

To observe the thorn shape, twenty branches per replication or four branches per plant, were selected and marked. The thorn shape was visually evaluated according to the thorn shape guidelines for DUS testing of PPV and FRA, with observations recorded as either curved or alternating curved (Anonymous, 2016).

Shoot surface

To evaluate the surface texture, ten shoots per replication or two shoots from each plant were selected. The shoot surface was felt by hand to identify whether it was smooth or tomentose. Based on the guidelines for DUS testing of PPV & FRA (Anonymous, 2016).

Leaf area index

The mean leaf area index was determined using the following formula.

$$\text{Leaf area index} = \frac{\text{Leaf area per plant (cm}^2\text{)}}{\text{Land area occupied by plant (plant canopy) (cm}^2\text{)}}$$

Chlorophyll content (SPAD values)

Chlorophyll contents were assessed by randomly selecting five fully developed leaves from each direction of the plant. The chlorophyll meter unit was set to spade to measure chlorophyll levels, utilizing a SPAD-502 chlorophyll meter (Konica Minolta, Japan) at 120 days after pruning.

Fruit yield (kg/plant)

The fruit yield per plant was determined by weighing the harvested fruits using a weighing machine after each harvest. It expressed in kilograms per plant (kg/plant).

Fruit yield (t/ha)

The total plant population per hectare was determined and this value was then multiplied by the fruit yield per plant. The resulting quantity was subsequently converted into tons per hectare (t/ha).

Result and Discussion

Growth parameters

The results depicting the variation in growth parameters of ber was recorded at 120th day after pruning is outlined in Table 1.

The maximum plant height (3.93 m) was recorded in the Chhuhara cultivar, which was closely followed by Umran (3.80 m). In contrast, the minimum plant height (3.21 m) was observed in the Kadaka cultivar. The maximum height of Chhuhara can likely be attributed to its semi-erect growth habit, which enabled the efficient utilization of photosynthates and nutrients to support faster primary growth (Ruy *et al*., 2007). The cultivar Sanaur-2 displayed the maximum plant canopy from North to South (5.23 m) and from East to West (5.40 m). Conversely, the Umran cultivar exhibited the minimum plant canopy from North to South (3.96 m) and from East to West (3.90 m). This difference in canopy size could be due to the prolific sprouting from the pruned stumps and the increased exposure to sunlight in both directions, contributing to the variations in canopy spread observed across the ber cultivars. Similar variations in plant canopy among different cultivars have been reported by Lal *et al*. (2004) and Choudhary *et al*. (2017) in their studies on ber.

Morphological parameters of different ber cultivars

The data on morphological parameters of various ber cultivars was meticulously observed as per guidelines for DUS testing of PPV and FRA and which was outlined in Table 1 (Anon, 2016).

The semi-erect growth habit was observed in the Umran, Illaichi and Chhuhara cultivars while, spreading growth habit was noted in the Kadaka, Mehrun, Dandan and Sanaur-2 cultivars. These variations in growth habits are likely influenced by specific varietal or germplasm characteristics, as consistently observed across various agro-climatic conditions (Singh *et al*., 2018). The cultivars Umran, Kadaka, Illaichi, Gola and Sanaur-2 observed obovate leaf shape, while Mehrun and Dandan had oval leave and Kadaka showed a cordate shape. Umran, Chhuhara, and Mehrun exhibited a cordate leaf base, whereas Kadaka and Gola had an acute leaf base; Illaichi and Dandan had oblique and round leaf bases, respectively. The acute leaf apex was observed in Mehrun and Sanaur-2, while Umran, Kadaka, Chhuhara, Illaichi, Gola and Dandan had an obtuse leaf apex. This might be due to substantial diversity in leaf shapes and existing genetic variations across different cultivars. Similar data were also shown by Muhammad *et al*. (2013), Godi and Joshi (2016).

Leaf curling was observed in Umran, Chhuhara and Mehrun, while other cultivars like Kadaka, Illaichi, Gola, Dandan and Sanaur-2 showed absence of leaf curling. These variations in leaf traits among ber cultivars may result from genetic factors and adaptations to diverse climates, as noted by Singh *et al*. (2019). Only Illaichi and Mehrun exhibited a curved

thorn shape, while the other cultivars showed an alternate curved thorn shape. Kadaka, Mehrun and Sanaur-2 had smooth shoot surfaces, while Umran, Chhuhara, Illaichi, Gola and Dandan had tomentose shoots. These structural differences may be linked to genetic factors like aging and moisture fluctuations, consistent with the findings of Krishna *et al*. (2016).

Table 1 : Growth and morphological parameters of different ber cultivars after pruning

Treatment	Plant height (m)	Plant spread (m)		Growth habit	Leaf shape	Leaf base	Leaf apex	Leaf curling	Thorn shape	Shoot surface
		N-S	E-W							
T_1 - Umran	3.80	3.96	3.90	Semi-erect	Obovate	Cordate	Obtuse	Present	Alternate curve	Tomentose
T_2 - Kadaka	3.21	4.48	4.43	Spreading	Obovate	Acute	Obtuse	Absent	Alternate curve	Smooth
T_3 - Chhuhara	3.93	4.41	4.33	Semi-erect	Cordate	Cordate	Obtuse	Present	Alternate curve	Tomentose
T_4 - Illaichi	3.72	4.77	4.99	Semi-erect	Obovate	Oblique	Obtuse	Absent	All curved	Tomentose
T_5 - Gola	3.62	4.09	4.03	Spreading	Obovate	Acute	Obtuse	Present	Alternate curve	Tomentose
T_6 - Mehrun	3.61	4.29	4.33	Spreading	Oval	Cordate	Acute	Absent	All curved	Smooth
T_7 - Dandan	3.52	4.83	4.71	Spreading	Oval	Round	Obtuse	Absent	Alternate curve	Tomentose
T_8 - Sanuar-2	3.70	5.23	5.40	Spreading	Obovate	Cordate	Acute	Absent	Alternate curve	Smooth
S.Em ±	**0.06**	**0.08**	**0.23**	**--**	**--**	**--**	**--**	**--**	**--**	**--**
CD at 5%	**0.18**	**0.25**	**0.71**	**--**	**--**	**--**	**--**	**--**	**--**	**--**

Physiological parameters

The data on physiological parameters of various ber cultivars was mentioned in Table 2. The maximum leaf area was observed in Chhuhara (57.71 cm²), followed by Umran (46.26 cm²) and Kadaka (44.73 cm²), with the minimum leaf area in Sanaur-2 (37.10 cm²) and Gola (37.54 cm²). Maximum leaf area enhances light interception, supporting plant growth. Umran (6.46) and Chhuhara (6.16) had the highest leaf area index (LAI), followed by Kadaka (4.24), Gola (3.67), Mehrun (3.60) and Illaichi (3.47), while Sanaur-2 showed the lowest LAI (1.50). LAI is crucial for photosynthesis, plant health and yield influenced by both genetic traits and environmental factors. The data indicates that the highest specific leaf area (SLA) was recorded in Chhuhara (149.61 cm²/g), followed by Umran (141.25 cm²/g), while Sanaur-2 had the lowest SLA (110.14 cm²/g). Conversely, Sanaur-2 recorded the highest specific leaf weight (SLW) (9.08 mg/cm²), followed by Illaichi (8.53 mg/cm²) and Dandan (8.41 mg/cm²), with Chhuhara having the lowest SLW (6.69 mg/cm²). These variations in SLA and specific leaf weight are likely due to genetic differences and each cultivar's response to environmental factors. Higher SLA indicates larger, thinner leaves, promoting photosynthesis, while specific leaf weight is influenced by factors like light availability and also thicker and narrow leaves. According to the data, the Mehrun had the highest leaf chlorophyll content (28.82), closely followed by Illaichi (26.63), Sanaur-2 (26.45), and Dandan (24.07). The lowest chlorophyll levels were observed in Umran (22.72), Chhuhara (22.76), and Gola (23.04). These variations are likely due to genetic differences and leaf morphology, including thickness, shape, siz, and surface area which can affect chlorophyll distribution and SPAD measurements. Similar observations were done by Ezhilarasi and Tamilmani (2009).

Fruit and stone parameters

Different cultivars of ber plants exhibit considerable variation with respect to fruit and stone parameters, as shown in Table 3.

The findings revealed that the cultivar Kadaka had the highest fruit length (43.65 mm), followed by Umran (37.16 mm) and Sanaur-2 (36.08 mm), while Illaichi had the lowest (20.82 mm) fruit length. Sanaur-2 showed the maximum fruit width (27.79 mm), which was statistically similar to Gola (26.65 mm) and Umran (26.34 mm), with Mehrun having the minimum (17.70 mm). These variations in fruit size may result from differences in nutrient absorption and genetic factors, aligning with findings by Amin *et al*. (2018) and Sahu *et al*. (2019). Umran had the maximum fruit weight (17.01 g), which is on par with Kadaka (16.34 g), while Mehrun (4.90 g) and Illaichi (6.19 g) had the lowest fruit weight. The differences in fruit weight are linked to fruit shape diversity, consistent with studies by Anjum *et al*. (2018) and Sharif *et al*. (2019). The data indicated that cultivar Kadaka had the maximum stone length (28.29 mm), followed by Sanaur-2 (22.69 mm) and Umran (21.39 mm), while Illaichi had the shortest (9.24 mm). Sanaur-2 (8.93 mm) and Dandan (8.86 mm) had the highest stone width, followed by Kadaka (7.43 mm), Chhuhara (7.21 mm) and Mehrun (7.11 mm), with Illaichi recorded the smallest width (2.89 mm). Variations in stone length and width are primarily due to varietal traits but can also be

influenced by factors like climate and fruit growth patterns (Saran, 2005). Illaichi had the lowest stone weight (0.47 g) which was on par with Mehrun (0.60 g), while Kadaka (1.26 g), Sanaur-2 (1.24 g) and Umran (1.10 g) showed the highest stone weight.

Table 2 : Physiological parameters of different ber cultivars after pruning

Treatment	Leaf length (cm)	Leaf width (cm)	Leaf area (cm^2)	Leaf area index	Specific leaf area (cm^2/g)	Specific leaf weight (mg/cm^2)	Chlorophyll (SPAD values)
T_1 - Umran	9.59	6.67	46.26	6.46	141.25	7.08	22.72
T_2 - Kadaka	9.21	6.12	44.73	4.24	132.25	7.56	23.82
T_3 - Chhuhara	11.09	6.77	57.71	6.16	149.61	6.69	22.76
T_4 - Illaichi	9.22	6.37	42.96	3.47	117.27	8.53	26.63
T_5 - Gola	9.27	5.49	37.54	3.67	125.13	7.99	23.07
T_6 - Mehrun	8.08	6.75	38.73	3.60	122.87	8.14	28.82
T_7 - Dandan	8.49	6.11	38.6	3.01	118.84	8.42	24.07
T_8 - Sanuar-2	7.95	5.80	37.10	1.50	110.14	9.08	26.45
S.Em ±	**0.31**	**0.21**	**1.73**	**0.55**	**1.56**	**0.10**	**0.91**
CD at 5%	**0.95**	**0.64**	**5.23**	**1.66**	**4.72**	**0.31**	**2.75**

Table 3 : Fruit and stone parameters of different ber cultivars after pruning

Treatment	Fruit length (mm)	Fruit width (mm)	Fruit weight (g)	Stone length (mm)	Stone width (mm)	Stone weight (g)	Fruit shape	Fruit shape – apex	Stone shape	Stone shape – apex
T_1 - Umran	37.16	26.34	17.01	21.39	6.56	1.10	Oblong	Round	Oblong	Acute
T_2 - Kadaka	43.65	25.66	16.34	28.29	7.43	1.26	Ovate	Pointed	Club	Acute
T_3 - Chhuhara	26.51	19.94	6.49	17.62	7.21	0.74	Oval	Round	Oval	Obtuse
T_4 - Illaichi	20.82	21.27	6.19	9.24	2.89	0.47	Oblate	Flat	Oval	Obtuse
T_5 - Gola	28.41	26.65	8.41	17.63	6.58	0.63	Round	Round	Oval	Acute
T_6 - Mehrun	24.33	17.70	4.90	17.10	7.11	0.60	Oblong	Flat	Spindle	Obtuse
T_7 - Dandan	27.85	24.19	9.45	16.71	8.86	0.79	Round	Flat	Oval	Obtuse
T_8 - Sanuar-2	36.08	27.79	14.71	22.69	8.93	1.24	Ovate	Pointed	Oblong	Acute
S.Em ±	**0.82**	**0.59**	**0.71**	**0.61**	**0.34**	**0.05**	--	--	--	--
CD at 5%	**2.48**	**1.80**	**2.14**	**1.84**	**1.02**	**0.16**	--	--	--	--

Morphological characteristics of fruit and stone from different ber cultivars

The morphological characteristics of fruit and stone from different ber cultivars were observed according to the DUS testing guidelines for PPV and FRA, as shown in Table 3. (Anon., 2016).

Umran and Mehrun had oblong fruit shapes, Kadaka and Sanaur-2 were ovate, Gola and Dandan were round, while Chhuhara and Illaichi were oval and oblate, respectively. The fruit apex varied, with rounded shapes in Umran, Chhuhara and Gola; pointed in Kadaka and Sanaur-2; flat shape in Illaichi, Mehrun and Dandan. The observed diversity could be attributed to significant genetic variability among the cultivars and could also be influenced by variations in the duration of fruit growth periods (Gosh and Mathew, 2005; Meena *et al*., 2019). Stone shapes varied, with oblong stones in Umran and Sanaur-2, oval in Chhuhara, Illaichi, Gola and Dandan, a club shape in Kadaka and a spindle shape in Mehrun. From that it noticed that Umran, Kadaka, Gola and Sanaur-2 had acute stone apex, while Chhuhara, Illaichi, Mehrun and Dandan had obtuse type. The variation in stone among ber cultivars reflects both genetic diversity and environmental influences on phenotypic traits (Saran *et al*., 2006 and Flora, 2014). Umran and Illaichi showed ridged and warted surfaces, whereas the other cultivars had plain surfaces. The differences in fruit surface characteristics among cultivars are likely due to significant genetic diversity in their fruiting habits. These findings align with the observations made by Lin *et al*. (2011) and Krishna *et al*. (2016).

Yield and yield attributes parameters

All the cultivars showed significant differences with respect to yield and yield attributes as illustrated in Table 4.

The highest pulp weight was recorded in the cultivars Umran (15.63 g) and Kadaka (14.99 g) followed by Sanaur-2 (12.56 g), while the lowest in

Mehrun (3.89 g). Variations in pulp weight among cultivars are attributed to differences in fruit weight and shape, which correlate strongly with pulp weight, as noted by Meena *et al*. (2019) and Kumar *et al*. (2022). The maximum pulp to stone ratio was observed in Umran (14.28), which was on par with Illaichi (12.57), Gola (12.39) and Kadaka (12.01). Conversely, Mehrun (6.50) and Chhuhara (7.63) exhibited the lowest ratio these fluctuations occur in pulp to stone ratio due to variations in fruit and stone size and genetic differences among cultivars, aligning with findings by Gupta (2018) and Abdel-Sattar *et al*. (2021). The highest pulp percentage was found in Umran (93.42 %), it was on par with Gola (92.47 %) and Illaichi (92.33 %), while Mehrun (87.59 %) and Chhuhara (88.52 %) had the lowest pulp percentages, consistent with observations by Singh and Pathak (2015) and Gupta (2018).

Among the cultivars of ber, the shortest duration from flowering to harvesting (102.45 days) was recorded in the Mehrun cultivar, closely followed by Chhuhara (111.58 days) whereas, the longest duration (155.07 days) from flowering to harvesting was observed in Umran, with Kadaka following closely at 150.11 days. the shortest duration from pruning to harvesting (184.14 days) was observed in the Mehrun cultivar, which was followed to the cultivar Chhuhara (197.18 days) however, the longest duration (231.90 days) was recorded in the Umran cultivar, followed by Gola (226.89 days) and Sanaur-2 (223.41 days). The early flowering and rapid fruit maturation observed in the Mehrun cultivar are likely supported by its elevated chlorophyll content, which enhances photosynthetic efficiency and optimizes nutrient translocation, promoting robust fruit set. In contrast, the longer durations seen in Umran may be attributed to its lower chlorophyll content, leading to slower rates of photosynthesis and nutrient movement, thereby delaying fruit maturation (Sharma and Kore, 1990).

Table 4: Yield and yield attributes parameters of different ber cultivars after pruning

Treatment	Pulp weight (g)	Pulp to stone ratio	Pulp recovery (%)	Number of days taken from flowering to harvest	Number of days taken from pruning to harvest	Average fruit yield	
						kg/Plant	t/ha
T_1 - Umran	15.63	14.28	93.42	155.07	231.90	45.55	12.11
T_2 - Kadaka	14.99	12.01	92.19	150.11	219.87	41.15	10.44
T_3 - Chhuhara	5.68	7.63	88.52	111.58	197.18	30.41	7.84
T_4 - Illaichi	5.85	12.57	92.33	113.22	203.13	26.11	6.91
T_5 - Gola	7.85	12.39	92.47	142.9	226.89	31.45	8.15
T_6 - Mehrun	3.89	6.50	87.59	102.45	184.14	22.51	5.74
T_7 - Dandan	8.02	10.10	91.58	124.29	215.19	31.08	8.21
T_8 - Sanuar-2	12.56	10.14	91.38	133.62	223.41	29.19	7.33
S.Em ±	**0.63**	**0.81**	**0.76**	**1.05**	**1.15**	**0.45**	**0.29**
CD at 5%	**1.92**	**2.45**	**2.30**	**3.19**	**3.49**	**1.36**	**0.87**

The table indicates that the Umran cultivar has the highest yield per plant and per hectare (45.55 kg/plant and 12.11 t/ha, respectively), it was followed by cultivar Kadaka (41.12 kg/plant and 10.44 t/ha, respectively). Although the lowest yield per plant and per hectare (22.51 kg/plant and 5.74 t/ha, respectively) was recorded in the Mehrun and closely followed by the Illaichi (26.11 kg/plant and 6.91 t/ha). The higher yields per plant and hectare in cultivars like Umran and Kadaka can be attributed to their genetic traits favoring increased fruit yield, including larger fruit size, higher fruit set rates, and efficient nutrient utilization. These cultivars likely possess physiological characteristics that enhance growth and fruit development under specific environmental conditions. Additionally, their performance may be due to favorable canopy architecture for prolific fruiting, characterized by abundant new branches and a high fruit setting percentage. Similar variability in ber fruit yield has been documented by Gupta (1977), Lal *et al*. (2004), and Tarai and Ghosh (2010).

Conclusion

A wide range of variability was observed among the eight varieties examined in relation to various characteristics, including tree, leaf, flower, fruit and stone traits. The cultivar Umran found the best performance in terms of fruit weight, superior pulp characteristics (such as pulp weight, pulp to stone ratio and pulp recovery percentage) and highest yield per plant and per hectare. The cultivar Chhuhara is distinguished by its exceptional biochemical properties, including high total soluble solids (TSS), an

optimal TSS to acid ratio, low acidity and larger leaf area. These characteristics make it well-suited for research aimed at improving quality traits and for incorporation into crop improvement programs as a superior parent cultivar.

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