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EVALUATION OF BER CULTIVARS FOR QUALITY AND PEST AND DISEASE INCIDENCE UNDER NORTHERN DRY ZONE OF KARNATAKA INDIA

Niteen S. G. Gollagi[1], S. N. Patil[1], Kulapati Hipparagi[1], Bhuvaneshwari G.[1], Siddanna Thoke[2]* and Basavaraj Padashetti[1]

[1]Department of Fruit Science, College of Horticulture, UHS, Bagalkot- 587104, Karnataka, India
[2]Horticulture Research and Extension Centre Tidagundi, Vijayapura- 586119, Karnataka India
*Corresponding author E-mail: siddupom@gmail.com
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ABSTRACT

A field experiment was conducted during the year of 2023-24 at Horticulture Research and Extension Centre (HREC), Tidagundi, Vijayapura, under the University of Horticultural Sciences, Bagalkot. The experiment was laid out in a RBD design with three replications and eight treatments. Chhuhara recorded the highest TSS (20.33 °Brix), lowest acidity (0.27%) and highest TSS to acid ratio (76.36). Kadaka displayed the highest vitamin C content (97.61 mg/100g). Sanuar-2 (70.63 N) and Umran (67.69 N) exhibited the highest fruit firmness among the cultivars of ber. In contrast, the cultivar Mehrun displayed the lowest fruit firmness (35.64 N). The highest L^* values were observed in Gola (44.61) and Kadaka (43.66), indicating these cultivars have the lightest color of fruit. The maximum a^* value was found in Illaichi (17.03), indicating a higher red coloration, while Umran (-3.56) recorded the lowest value of a^* reflecting a greener hue. Gola showed the highest b^* value (41.46), indicating a stronger yellow hue, while Mehrun had the lowest value of b^* (0.50), suggesting a less pronounced yellow coloration. The cultivar Illaichi had the lowest fruit borer and fruit flies' infestation (6.80 % and 7.47 %, respectively) followed by Mehrun (9.84 % and 10.33 %, respectively). The lowest disease intensity was recorded in Sanaur-2 (4.39 %) and Chhuhara (4.52 %).

Keywords: Ber, cultivar, quality, pest and disease.

Introduction

Ber (*Ziziphus mauritiana* Lamk.) has been referred to as Indian jujube, summer deciduous fruit, Chinese date. Its origin is believed to span from India to South-western 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 fruits of the ber plant are rich in vitamin C, B-complex and vitamin A, along with minerals such as calcium, potassium, bromine and lanthanum. The pulp of ber is particularly prized for its high vitamin C content, which ranges from 70 to 165 mg per 100 g, along with around 70 IU of vitamin A and β-carotene levels between 75 and 80 mg per 100 g (Meena *et al.*, 2019).

The quality of non-climacteric 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. Since ripening has a direct effect on fruit quality and shelf life, it is essential to monitor different growth stages to improve quality. In India, ber plants contend with approximately 130 insect pest species, with notable threats posed by pests such as fruit borer (*Meridarchis scyrodes* Meyr) and fruit fly (*Carpomyia vesuviana* Costa), which are known to cause substantial yield losses. The diminishing genetic

variability in ber plants has heightened their vulnerability to diseases, pest attacks and adverse climatic shifts (Gill and Bal, 2006). It is imperative to conduct thorough screening of different ber varieties to assess their susceptibility to these pests and quantify infection rates. Additionally, disease (Powdery mildew) poses a significant threat to ber plants, impacting both growth and fruit quality. Regular monitoring of disease incidence is crucial for implementing timely control measures and preventing further spread. This study aims to identify superior ber cultivars that are suitable for commercial cultivation in the Northern dry zone of Karnataka, with respect quality traits and incidence of major pest and diseases.

Material and Methods

The present investigation was carried out during 2023-24 at Horticulture Research and Extension Centre (HREC), Tidagundi, Vijayapura, under the University of Horticultural Sciences, Bagalkot. 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 area received an average annual rainfall of 298.5 mm.

To conduct the field experiment, 15-year-old ber plants were selected and the spacing between the plants was maintained 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 June 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. Observations were recorded during the experiment on various quality traits and also screening of pest and diseases.

Observations recorded

Ascorbic acid

The concentration of ascorbic acid in the ber fruit was evaluated by analysing five fruits per replication in each treatment using the dye solution (dichlorophenolindophenol) binding technique. The results were quantified and expressed as milligrams per 100 grams of sample (mg/100g of sample) (Anon., 1980).

$$\text{Ascorbic acid}\,(\text{mg}/100\text{g}) = \frac{0.5\,\text{mg}}{\text{V1 ml}} \times \frac{\text{V2 ml}}{15\,\text{ml}} \times \frac{100\,\text{ml}}{\text{weight of sample}\,(500\,\text{mg})} \times 100$$

Fruit texture (N)

Fruit texture was determined using a penetrometer, which measures the force required to penetrate the fruit, providing an objective assessment of firmness. This method ensures consistent and precise evaluation of textural properties across different ber cultivars, aiding in the selection of high-quality varieties.

Instrumental colour values (*L**, *a**, *b**)

Colour values namely *L**, *a** and *b** of ber fruits were determined by using a Colour Flex EZ colorimeter (Model: CFEZ 1919, Hunter associate's laboratory. Inc., Reston) which fitted with 45 mm diameter aperture. The instruments calibrated using two tiles *i.e.* black and white. The values of *L**, *a** and *b** were recorded, where positive *a** and *b** and *L** values indicated the presence of red, yellow and lightness colours, respectively, while negative values indicated the presence of green, blue and darkness colours, respectively.

Titratable acidity (%)

The pulp acidity content of five randomly selected ber fruits was taken per replication in each treatment. The determination of titratable acidity in the ber fruit is done by the standard titration method procedure as suggested by Ranganna (1979). Acidity was determined by the following formula.

$$\text{Titratable acidity}\,(\%) = \frac{\text{Titratable value} \times \text{Normality of NaOH} \times \text{Volume made up} \times \text{m. equivalent weight of acid}}{\text{Volume of aliquot} \times \text{Volume of sample taken}} \times 100$$

TSS (°Brix)

Five randomly selected mature and healthy fruits were taken per replication in each treatment. From each fruit, one gram of pulp was crushed to extract the juice. The total soluble solid (TSS) content of fresh matured fruits was calculated using a hand refractometer with a scale of 0 to 32 °Brix (ERMA made). A drop of juice was placed on the clean and dry prism of the refractometer and readings were taken. The values were expressed in degree brix (°B).

TSS to acid ratio

The TSS and acid ratio was calculated mathematically by dividing the value of TSS to titratable acidity and the resulting data was expressed as the TSS/acid ratio.

Fruit borer and fruit flies infestation

Fruit borer and fruit flies per plant infestation were conducted through visual observations based on external damage symptoms such as bore holes on fruit for the fruit borer and deformed fruit shape for fruit flies. The per cent fruit borer and fruit fly damage on the each ber plant was calculated by counting the total number of fruits and number of damaged fruits in four branches of a plant considering all the directions. Observations were conducted weekly after the initiation of fruit and averages for the percentage of infested fruits were computed for each cultivar.

Per cent fruit infestation was computed by the following formula,

$$\text{Fruit infestation} = \frac{\text{Number of fruits damaged}}{\text{Total number of fruits in four branches of plant}} \times 100$$

Incidence of powdery mildew

The incidence of powdery mildew was checked by collecting the thirty fruits randomly in all direction (ten fruits in each replication) in the first week of the January 2024 and per cent disease intensity (PDI) was calculated as per 0-5 disease rating scale given by the McKinney (1923).

$$\text{Per cent disease intensity} = \frac{\text{Sum of individual ratings}}{\text{Total no. of observations} \times \text{Maximum disease rating}} \times 100$$

Disease rating scale for assessing host reaction against powdery mildew of ber is as follows,

Numerical scale	Description
0	0 % - No infection on fruit
1	1-10 % - Fruit area covered with pathogen
2	11-25 % - Fruit area covered with pathogen
3	26-50 % - Fruit area covered with pathogen
4	51-75 % - Fruit area covered with pathogen
5	76-100 %- Fruit area covered with pathogen

Categorization of ber varieties based on per cent disease intensity are as follows:

PDI	Host reaction
0	Immune
1-5	Resistant
6-20	Moderately susceptible
21-50	Susceptible
51-100	Highly susceptible

Result and Discussion

Quality parameters

The data illustrated in Table 1 concerning the quality parameters of ber fruits exhibited significant diversity among various ber cultivars. The highest total soluble solids (TSS) content was observed in Chhuhara (20.33 °Brix), followed by the Mehrun cultivar (19.10 °Brix) whereas, the lowest TSS content was recorded in Umran (14.33 °Brix). The variation in TSS among different cultivars may be attributed to the inherent genetic diversity and unique chemical compositions of the fruits. Dhingra *et al.* (1973) found similar result. Significant differences were recorded in titratable acidity, the lowest acidity observed in Chhuhara (0.27 %) and Dandan (0.30 %) while, Kadaka exhibited the highest titratable acidity (0.43 %), which was statistically comparable to Illaichi (0.40 %). Variations in acidity levels can be attributed to varietal differences and genetic variations within the cultivars. In Chhuhara and Dandan, genetic characteristics that regulate acid synthesis and interactions with the environment influence lower acidity levels.

Table 1 : Quality parameters of different ber cultivars after pruning

Treatment	TSS (^{0}Brix)	Titratable acidity (%)	TSS: acid ratio	Ascorbic acid (mg/100g)	Fruit firmness (N)	Colour intensity		
						*L**	*a**	*b**
T_1 - Umran	14.33	0.39	36.88	94.26	67.69	31.94	-3.56	26.83
T_2 - Kadaka	16.96	0.43	39.80	97.61	44.80	43.66	1.01	38.77
T_3 - Chhuhara	20.33	0.27	76.36	88.76	52.97	9.69	12.89	13.14
T_4 - Illaichi	16.67	0.40	42.19	95.63	60.82	21.95	17.03	28.96
T_5 - Gola	15.73	0.34	46.83	91.85	61.15	44.61	3.16	41.46
T_6 - Mehrun	19.10	0.35	54.06	88.43	35.64	0.29	1.30	0.50
T_7 - Dandan	16.20	0.30	53.47	90.62	51.67	0.69	3.21	1.18
T_8 - Sanuar-2	18.47	0.33	55.84	92.51	70.63	37.31	2.43	40.64
S.Em ±	**0.40**	**0.01**	**1.06**	**2.14**	**3.79**	**0.74**	**1.06**	**0.15**
CD at 5%	**1.20**	**0.03**	**3.21**	**6.50**	**11.51**	**2.24**	**3.21**	**0.46**

These findings align with research conducted by Godi and Joshi (2016) and Choudhary *et al.* (2017) in ber cultivation. The highest TSS to acid ratio (76.36) was recorded in Chhuhara, followed by Sanaur-2 (55.84), Mehrun (54.06) and Dandan (53.47). In contrast, Umran (36.88) and Kadaka (39.80) exhibited the lowest TSS to acid ratio, reflecting intrinsic variations in TSS and acidity levels, with Chhuhara consistently showing higher TSS values and lower acidity, while Umran consistently showed lower TSS and higher acidity. Ghosh and Mathew (2005) reported TSS to acid ratios ranging from 32.9 to 56.9. The Kadaka cultivar recorded the highest ascorbic acid (97.61 mg/100g), statistically comparable to Illaichi (95.63 mg/100g). Conversely, the lowest ascorbic acid content was observed in Mehrun (88.43 mg/100g), which was statistically similar to Chhuhara (88.76 mg/100g) and Dandan (90.62 mg/100g). Godi and Joshi (2016) reported ascorbic acid levels ranging from 91.55 to 92.95 mg/100 g. The highest fruit firmness was recorded in Sanaur-2 (70.63 N) and Umran (67.69 N) and it was on par with Gola (61.15 N) and Illaichi (60.82 N). In contrast, Mehrun (35.64 N) and Kadaka (44.80 N) showed the lowest firmness. The superior firmness in Sanaur-2 and Umran is likely due to thicker skin and sturdier cell structures, influenced by genetic traits and polyphenolic compounds.

Among the cultivars, Gola (44.61) and Kadaka (43.66) exhibited the highest lightness (L^*) values, followed by Sanaur-2 (37.31). In contrast, Mehrun (0.29) and Dandan (0.69) recorded the lowest L^* values. This variation in lightness (L^*) can be attributed to genetic differences, skin thickness, surface texture and pigment concentration. The highest a^* value was observed in the cultivar Illaichi (17.03), closely followed by Chhuhara (12.89), while Umran exhibited the lowest value (-3.56), indicating a significantly lower red-green chromaticity compared to the other cultivars. The elevated a^* values in Illaichi may indicate higher anthocyanin content and advanced ripening, contributing to its deeper red color. The cultivar Gola recorded the highest b^* value (41.46), closely followed by Sanaur-2 (40.64), while the lowest b^* value was noted in Mehrun (0.50), indicating significantly lower yellow-blue chromaticity compared to the other ber cultivars. This variation in b^* value can be attributed to differences in carotenoid concentrations

Screening of major pest and diseases

The cultivar Sanaur-2 showed the highest fruit borer infestation (41.07 %), followed by Umran (36.50 %), while Illaichi had the lowest fruit borer infestation (6.80 %), followed by Mehrun (9.84 %). However, the highest fruit flies infestation was found in the Sanaur-2 (30.54 %) and Gola (28.67 %) cultivars followed by Umran (25.12 %). Conversely, the lowest infestations were recorded in Illaichi (7.47 %) and Mehrun (10.33 %). According to Shevale and Padule (1992), the commonly preferred Umran variety exhibited vulnerability to fruit borer infestation. The current findings corroborate with Hosagoudar *et al.* (1999). Additionally, Ravikumar (2004) noted that Illaichi fruits showed the lowest fruit borer infestation (8.35 %). Arora *et al.* (2001) similarly found that the cultivar Illaichi exhibited the minimum fruit fly infestation.

Table 2 : Fruit borer, fruit flies' infestation, per cent disease intensity and host reaction of powdery mildew (PM) of different ber cultivars

Treatment	Fruit borer Infestation (%)	Fruit flies Infestation (%)	Per cent disease intensity	Host reaction of PM
T_1 - Umran	36.50 (37.17)*	25.12 (30.08)*	34.55 (36.00)*	Susceptible
T_2 - Kadaka	27.71 (31.73)*	20.73 (27.08)*	17.96 (25.07)*	Moderately susceptible
T_3 - Chhuhara	12.14 (20.38)*	15.39 (23.09)*	4.52 (12.26)*	Resistant
T_4 - Illaichi	6.80 (15.11)*	7.47 (15.84)*	23.84 (29.22)*	Susceptible
T_5 - Gola	24.50 (29.66)*	28.67 (32.37)*	26.91 (31.25)*	Moderately susceptible
T_6 - Mehrun	9.84 (18.27)*	10.33 (18.74)*	11.65 (19.95)*	Moderately susceptible
T_7 - Dandan	19.50 (26.19)*	22.95 (28.62)*	13.83 (21.83)*	Moderately susceptible
T_8 - Sanuar-2	41.07 (39.85)*	30.54 (33.55)*	4.39 (12.03)*	Resistant
S.Em ±	**0.70**	**0.50**	**0.51**	--
CD at 5%	**2.12**	**1.51**	**1.56**	--

Table 2 shows that there were notable differences in the varietal disparities with respect to per cent disease intensity of powdery mildew (PM), across the several cultivars of ber. The highest disease intensity was found in Umran (34.55 %), followed by Gola (26.91 %). Conversely, the lowest disease intensity was recorded in Sanaur-2 (4.39 %) and Chhuhara (4.52 %). Among the eight cultivars screened, two cultivars

Chhuhara and Sanaur-2 showed resistance to PM, while three cultivars (Umran and Illaichi) were susceptible to PM, while the remaining four cultivars were moderately susceptible. None of the plants were found to be immune to PM. Choudhary *et al.* (2017) observed powdery mildew disease intensities ranging from 2.60 per cent to 37.5 per cent, whereas Jamadar and Desai (1996) found a wider range, from 17 per cent to 71 per cent These findings are consistent with those reported by Rai *et al.* (2022).

Conclusion

A wide range of variability was observed among the eight varieties examined in relation to various characteristic. The cultivar Chhuhara is distinguished by its exceptional biochemical properties, including high total soluble solids (TSS), an optimal TSS to acid ratio, low acidity. 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. While Kadaka cultivar show the high vitamin C. The cultivar Illaichi had the lowest fruit borer and fruit flies infestation (6.80 % and 7.47 %), followed by Mehrun (9.84 % and 10.33 % respectively). The lowest disease intensity was recorded in Sanaur-2 (4.39 %) and Chhuhara (4.52 %).

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