

Germplasm Survey, Collection and Evaluation of *ber* (*Ziziphus mauritiana* Lamk) under Bundelkhand Region of Uttar Pradesh

Pradeep Kumar, A.K. Srivastava*, Om Prakash, Nidhika Thakur and Pradeep Singh

Department of Fruit Science

Banda University of Agriculture and technology Banda 210001, (U.P.) India

*Corresponding Author E-mail: srivastavahort@yahoo.com

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ABSTRACT

Ber is grown under rain-fed condition in arid and semi-arid regions of India and has been identified as highly draught and heat tolerant fruit crop. Bundelkhand region is rich in biodiversity for *ber* (*Ziziphus mauritiana* Lamk) and the agro-climatic condition of Bundelkhand has great potential for its commercial cultivation. Keeping these points in view, twenty-four genotypes of *ber* fruits were collected from diverse areas of Bundelkhand region of Uttar Pradesh and analyzed for various physico-chemical and morphological attributes. The results of the study revealed wide range of variability in morphological, quantitative, and qualitative and biochemical attributes. The variability for quantitative parameters for *ber* was observed for fruit length (1.6 cm to 4.4 cm), fruit width (1.3 cm to 3.5 cm), fruit weight (6 g to 30.5 g), specific gravity (0.59 to 1.05 g/cc), stone length (1.4 cm to 2.57 cm), stone width (0.80 cm to 1.5 cm), and stone weight (3.3 g to 9.1 g). The bio-chemical parameters also showed wide range of variation i.e. TSS (14.3 °Brix to 20.5 °Brix), acidity (0.19% to 0.60 %), total sugar (4.43 % to 9.53 %), protein (1.3 to 4.49 %), ascorbic acid (69.67 mg/100g to 135.37 mg/100g) and TSS/acidity ratio (28.71 to 85.42 ratio). Therefore, on the basis of morphological, quantitative and bio-chemical quality attributes, genotypes FS/Ber-2, FS/Ber-4, FS/Ber-5, FS/Ber-10 and FS/Ber-15 were screened as promising genotypes in terms of fruit shape, size, colour and fruit quality attributes. These promising genotypes can be recommended for commercial multiplication, growing at farmer's field and conservation in the field gene bank for further evaluation and crop improvement.

Keywords: *Ber* (*Ziziphus mauritiana* L.), Variability, Diversity, Total sugar, TSS, and Fruits size.

INTRODUCTION

Ber or Indian jujube (*Ziziphus mauritiana* Lamk.) which belongs to family Rhamnaceae is one of the most ancient and common fruits

of Indian subcontinent and South Western China. The genus *Ziziphus* consists of 50 species of which 18-20 are indigenous to India.

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The *Ziziphus mauritiana* Lamk in India and *Z. Jujuba* Mill. In China its fruits are cultivated on commercial scale and it is now widely naturalized in tropical region from Africa to Afghanistan and also through Malaysia, Australia and in some pacific regions (Watt, 1983).

Indian ber (*Ziziphus mauritiana* Lamk) trees are small to moderate, spreading with vine like branches. It is the hardiest fruit trees with wider adoptability to adverse soil and climate condition is an evergreen shrub or small tree up to 15 m high, with trunk 40 cm or more in diameter; spreading crown; stipule spines and many drooping branching. The fruit is of variable shape and size. It can be oval, obovate or round and can be 1-2.5 inch (2.5-6.5 cm) long. The flesh is white and crisp.

The major ber growing states in India are Assam, Haryana, and Punjab, UP, Rajasthan, Gujarat, Madhya Pradesh, Bihar, Maharashtra, Andhra Pradesh, West Bengal, and Tamil Nadu. But it is an ideal fruit for cultivation in the arid and semi-arid zone of northern India (Bal et al., 1982). In Uttar Pradesh, it is mainly grown in Raibareli, Fatehpur, Jhansi, Lalitpur, Hameerpur, Banda, Chitrakut, Mahoba, and Jalaun districts due to favorable environment condition. Genetic variability of ber and Chinese jujube is high in India and china respectively. Several other countries to which *Ziziphus* has now spread also have secondary diversity. Several horticultural varieties are in cultivation in both India and China. These varieties developed as a result of selection in different eco regions from progeny emanating from cross pollination between different *Ziziphus* species. An attempt has been made to collect diverse genotypes in ber, to select promising types and to find out diversity in Bundelkhand region of Uttar Pradesh.

MATERIALS AND METHOD

The present investigation was carried out at the Department of Fruit Science, college of Horticulture, Banda University of Agriculture & Technology, Banda (UP) during 2019-20. Twenty four genotypes were collected from

different ber growing areas of Bundelkhand region in Uttar Pradesh. Fruit and leaf samples were collected from different gemplasm collection site, passport data recorded and collector number assigned to each collection. Fruits of ber were randomly selected from all the direction of farmer field, kept into bags and tagged by the number and subjected to physico-chemical analysis in laboratory. Samples were physically and bio-chemically analyzed in the PG laboratory, College of Horticulture, BUAT Banda. Morphological characters of fruit and leaf were described on the basis of Minimal Descriptors of Agri-Horticultural Crops as prepared by Mahajan et al. (2002).

Physical parameters like fruit weight measure by electronic weighting machine and fruits length, fruits width, stone length. Stone width, stone weight was calculated with the help of digital Vernier Callipers. The total soluble solids were recorded with the help of Erma hand refractrometer (0-32⁰Brix). A drop of juice was placed on the prism facing the light source and value was recorded. Ascorbic acid was determined by using 2, 6-Dichlorophenol- indophenols visual titration method (Johnson, 1948). The acidity in fruit extract was estimated by titrating 5 ml aliquot against 0.1 N NaOH using phenolphthalein indicators. Appearance of light pink colour was marked as the end point. The total acidity was worked out in terms of citric acid and expressed in percentage. Stone and seed characters were also recorded for the study. Sugars content were estimated using Fehling's solutions (Lane & Eynon, 1923) and the method as described by (Rangana, 2010). Protein content was estimated by the method of Lowry et al. (1951) using Folin Ciocalreau's Phenol reagent.

The two years' data obtained during experimentation was statistically analyzed as per method given by Panse and Sukhatme (1985) and results were evaluated at 5% level of significance. The correlation coefficients among the different bio-chemical parameters were calculated as per method described by Fisher (1954).

RESULTS AND DISCUSSION

The data pertaining to morphological quantitative and qualitative attributes of ber exhibited significant variation with respect to fruits length, fruit width, fruit weight etc (Table 1, 2, 3.). The fruit length varied between 4.4 cm to 1.6 cm. Among the all genotypes FS/ber No. 15 produced longest fruit and closely followed by FS/Ber. The fruit width varied between 3.5 cm to 1.3 cm. Among genotypes FS/Ber 24 showed maximum fruit width. The difference of the fruits size may be due to different genetically character, photosynthetic activity and soil productivity or environmental factors. The similar fruits length variability in ber was reported by Vashishtha (1983), Nehra (1984) and Muhammad et al. (2013) in different ber types. The fruit weight varied between 30.5 g to 6 g. Among the genotypes, FS/Ber -15 (30.5 g) recorded maximum fruit weight whereas minimum fruit weight was noticed in FS/Ber -10 (6 g). Kumar et al. (1987) also recorded fruit weight ranged from 18.38 to 24.91 g in cv. Umran. Reddy *et al.* (1998) reported the fruit weight of 20 g in cv. Gola and 18 g cv. Kaithali. Variations in fruits weight observed in the present studies may be attributed due to genetic factors or micro climate of germplasm collected area or soil.

Variability was noted for leaf characters among different ber genotypes. Ovate leaf shape was recorded in the FS/Ber No. 1 and 9; ovate oblong shapes were recorded in FS/Ber No. 3, 8, 14, 19, 22 and 24; cordate leaf shape was observed in FS/Ber No. 4, 12, 17, and 23. Pareek (2001) also reported leaf physical and morphological character in several ber cultivar. The leaf colour varied from light green to dark green; leaf shape as oblong, oval- elliptic, round; leaf base as obtuse, broad, round, oblique, tearing, narrow, acute; leaf apex as round-obtuse, flat-obtuse, cupped acute and curved-acute. Similar results were also recorded by Vashishtha (1983), Nehra (1984) and Muhammad et al. (2013) in different ber types.

Wide variation recorded for shape of fruit apex, fruit base, mature fruit colour and

pulp colour. Broadly pointed fruit apex was observed with FS/Ber No. 1,9,15,19, and 24; broadly round fruit apex was noted with FS/Ber No. 10,13,23 and remaining all genotypes were beaked apex. Round fruit base was recorded in FS/Ber 1 and 3; remaining genotypes exhibited depressed shallow fruit base. Variability was also noted for fruit shape (such as round, ovate oblong, obovate, oblong oval, and oval, oblong, oblate). Mature fruit colour among the genotypes were as greenish yellow, golden yellow, light green colour, light red, and maximum genotypes showed light yellow coloured fruits. These observations are in conformity with the findings of Chadha et al. (1972), Nehra (1984), Singh and Singh (1973), Vashishtha (1984), Pareek (2001) and Bal (2006).

The variation in stone length, stone width, and stone weight of ber fruits were also recorded. The maximum stone length (2.57cm in FS/Ber No.5 and 19), stone width (1.5cm FS/Ber No.1), and stone weight (9.1g in FS/Ber No.15) were noted among 24 genotypes. Jan Brindza et al. (2011) also reported that the average weight of stone is in the range of 0.90-0.24 g, length from 14.35-0.58 mm and width 8.32-0.34 mm. Significant difference has been found in stone shape and colour. Abbas (2012) recorded highest stone size and stone weight in Foladi. Similar observation was also recorded Ram et al. (2008), Shukla et al. (2012), Singh and Misra (2012). The fruit stone characters are the yield contributing characters for improvement of pulp yield in ber. Hence, the genotype with high pulp stone should be selected for improvement programme. Similar associations have been reported by Thimmappaiah et al. (1985) and Kurni (1992) in guava, Attri et al. (1999) in mango and Patil in grapes. The variation in stone size and weight may be due to change in cultural practices and due to genetic makeup of the plant. These results conformity with the findings of finding of Bisla et al. (1998) and Pareek (2001).

The TSS value ranged from 14.3 to 20.5 among all the genotypes. The highest TSS was found in FS/Ber No.10 (20.50⁰ Brix) while

minimum in FS/Ber No.3 (14.3⁰ Brix). Similar variation and TSS range was observed by Dhingra et al. (1973), Singh et al. (1980), Chovatia et al. (1993), Jawanda et al. (1981), Bal (1992), Faroda (1996), Shobha et al. (2001) and Ram et al. (2008). Acidity ranged 0.16 to 0.60 mg per 100 g pulp. Ram et al. (2008) also studied the physico-chemical characters of fruits of the 12 cultivars viz, Banarasi Karaka, Karli, Shoot less, Mehrun, Peundi, Gola, Jaffaran, Chuhara, Khirni, Desi, Kaithali, and Illaichi. He reported TSS 10.00-19.33 per cent, acidity 0.01-0.43 per cent and ascorbic acid 45.67-93.22 mg/100 g in different cultivars of ber. Similar result also was found by Chovatia et al. (1992), Jawanda et al. (1981) and Singh and Mishra (2011). Sugar varied from 4.43 to 9.5 % being

maximum in FS/Ber No. 10 and minimum with FS/Ber No. 5. The findings are in agreement with the findings of Dhingra et al. (1973), Singh et al. (1980), Chovatia et al. (1992), Jawanda et al. (1981) and Bal (1992). Ascorbic acid ranged 69.67 mg/100g to 135 mg /100 g. these findings are quit in line with Singh et al. (1980). Significantly maximum TSS/Acid ratio recorded in FS/Ber No.2 (85.42) and minimum in FS/Ber No. 6 (33.71). Similar observations were reported by Obeed et al. (2008) and Singh and Mishra (2011). Protein ranged from 1.13 to 4.49% with average value of 2.53 %. Significantly maximum protein was recorded with FS/Ber 4 (4.49%). Variation in protein content might be due to genetic makeup of the fruits.

Table 1: Morphological fruit characters of different ber (*Ziziphus mauritiana* Lamk) genotypes

Genotype	Mature fruit colour	Fruit surface	Fruit shape	Fruit apex	Fruit base
FS/Ber-1	Greenish yellow colour	Smooth	Round	Broadly pointed	Round
FS/Ber-2	Golden yellow	Smooth	Ovate oblong	Round	Depressed shallow
FS/Ber-3	Golden Colour	Smooth	Obovate	Round	Round
FS/Ber-4	Light yellow colour	Smooth	Oblong oval	Round	Depressed shallow
FS/Ber-5	Light green to light yellow colour	Smooth	Oval	Beaked	Depressed shallow
FS/Ber-6	Pale green to gray colour	Smooth	Oblong	Round	Depressed shallow
FS/Ber-7	Light green to yellow spots	Smooth	Oblate	Round	Depressed shallow
FS/Ber-8	Light red	Smooth	Round	Round	Depressed shallow
FS/Ber-9	Light yellow	Smooth	Oblong oval	Broadly pointed	Depressed shallow
Fs/Ber-10	Light green	Smooth	Obovate	Broadly round	Depressed shallow
FS/Ber-11	Green with brown spots	Smooth	Ovate oblong	Round	Depressed shallow
FS/Ber-12	Light red	Smooth	Oval	Round	Depressed shallow
FS/Ber-13	Light Golden colour	Smooth	Oblong	Broadly round	Depressed shallow
FS/Ber-14	Light yellow	Smooth	Oblate	Round	Depressed shallow
FS/Ber-15	Pale yellow	Smooth	Oblong oval	Broadly pointed	Depressed shallow
FS/Ber-16	Light green colour	Smooth	Ovate oblong	Round	Depressed shallow
FS/Ber-17	Light yellow	Smooth	Obovate	Round	Depressed shallow
FS/Ber-18	Golden yellow colour	Smooth	Oblong	Round	Depressed shallow
FS/Ber-19	Light green	Smooth	Oval	Broadly pointed	Depressed shallow
FS/Ber-20	Brown	Smooth	Round	Round	Depressed shallow
FS/Ber-21	Pale green	Smooth	Oblate	Round	Depressed shallow
FS/Ber-22	Light yellow colour	Smooth	Ovate oblong	Round	Depressed shallow
FS/Ber-23	Light yellow	Smooth	Oblong	Broadly round	Depressed shallow
FS/Ber-24	Chocolaty colour	Smooth	Oblong oval	Round pointed	Depressed shallow

Table 2: Physical fruit characters of different ber (*Ziziphus mauritiana* Lamk) genotype

Genotype	Pulp Colour	Pulp texture	Average Fruit length (cm)	Average Fruit width (cm)	Average Fruit weight(g)	Specific Gravity (g/cc ³)
FS/Ber-1	Creamy	Medium	3.7	2.1	27.0	0.59
FS/Ber-2	Creamy	Medium	3.3	2	27.0	0.96
FS/Ber-3	Creamy	Soft	4.3	2.3	14.0	0.85
FS/Ber-4	Creamy	Medium	3.3	1.4	16.0	0.89
FS/Ber-5	Creamy	Medium	2.1	2	17.0	0.82
FS/Ber-6	Creamy	Medium	4.3	2.5	12.0	1.04
FS/Ber-7	Creamy	Medium	2.2	1.6	19.0	0.74
FS/Ber-8	Creamy	Medium	3.4	2.7	13.0	0.83
FS/Ber-9	Creamy	Medium	4.3	1.4	10.0	0.94
FS/Ber-10	Creamy	Medium	2.7	1.6	6.00	0.84
FS/Ber-11	Creamy	Medium	4.3	3.2	12.0	0.85
FS/Ber-12	Creamy	Medium	2.6	1.5	11.8	0.96
FS/Ber-13	Creamy	Medium	3.4	3.5	8.00	0.94
FS/Ber-14	Creamy	Medium	2.4	1.3	11.0	0.94
FS/Ber-15	Creamy	Medium	4.4	2.3	30.5	0.84
FS/Ber-16	Creamy	Medium	3.2	2.3	21.0	1.02
FS/Ber-17	Creamy	Medium	1.6	1.5	17.0	0.78
FS/Ber-18	Creamy	Medium	3.5	2.4	11.0	0.73
FS/Ber-19	Creamy	Medium	3.3	2.3	22.5	0.94
FS/Ber-20	Creamy	Medium	2.1	1.4	9.00	1.02
FS/Ber-21	Creamy	Medium	3.0	2.4	11.0	0.94
FS/Ber-22	Creamy	Medium	4.2	1.9	6.00	0.95
FS/Ber-23	Creamy	Medium	3.5	2.5	17.0	0.94
FS/Ber-24	Creamy	Medium	4.0	1.6	11.0	1.05
Mean			3.2	2.0	14.99	0.89
Range			1.6 - 4.4	1.3 - 3.5	6 – 30.5	.59-1.05
SEm±			0.06	0.06	0.39	0.03
CD at 1%			0.44	0.44	0.96	1.97

Table 3: Morphological stone characters of different ber (*Ziziphus mauritiana* Lamk) genotypes.

Genotype	Stone Apex	Stone base	Stone shape	Stone surface
FS/Ber-1	Acute	Oval	Obtuse	Warty
FS/Ber-2	Round	Elliptic	Acute	Furrowed
FS/Ber-3	Round	Obviate	Apiculate	Warty
FS/Ber-4	Acute	Obviate	Obtuse	Smooth
FS/Ber-5	Aciculate	Elliptic	Obtuse	Warty
FS/Ber-6	Acute	Oval	Acute	Warty
FS/Ber-7	Acute	Obviate	Obtuse	Warty
FS/Ber-8	Acute	Oblong	Obtuse	Warty
FS/Ber-9	Acute	Oblong	Apiculate	Warty
FS/Ber-10	Acute	Elliptic	Acute	Furrowed
FS/Ber-11	Acute	Obviate	Obtuse	Warty
FS/Ber-12	Acute	Round	Obtuse	Warty
FS/Ber-13	Acute	Ovate	Obtuse	Warty
FS/Ber-14	Acute	Elliptic mucronate	Acute	Warty
FS/Ber-15	Acute	Oblong	Acute	Warty
FS/Ber-16	Acute	Obviate	Obtuse	Warty
FS/Ber-17	Acute	Oval	Obtuse	Warty
FS/Ber-18	Acute	Obviate	Obtuse	Warty
FS/Ber-19	Acute	Obviate	Obtuse	Warty
FS/Ber-20	Acute	Obviate	Acute	Warty
FS/Ber-21	Acute	Oblong Oval	Obtuse	Warty
FS/Ber-22	Round	Oval	Obtuse	Warty
FS/Ber-23	Acute	Obviate	Acute	Warty
FS/Ber-24	Acute	Round	Obtuse	Warty

Table 4: Morphological for stone characters of different ber (*Ziziphus mauritiana* Lamk) genotypes.

Genotype	Stone length (cm)	Stone width (cm)	Stone weight (g)
FS/Ber-1	1.60	1.15	5.52
FS/Ber-2	1.80	1.07	5.70
FS/Ber-3	2.07	1.10	6.80
FS/Ber-4	2.33	1.17	8.17
FS/Ber-5	2.57	1.00	7.50
FS/Ber-6	1.57	0.90	4.20
FS/Ber-7	1.70	0.82	4.10
FS/Ber-8	1.40	0.80	3.30
FS/Ber-9	2.30	0.90	6.20
Fs/Ber-10	2.10	1.00	6.30
FS/Ber-11	1.60	0.87	4.10
FS/Ber-12	1.80	0.83	4.40
FS/Ber-13	1.67	0.80	4.00
FS/Ber-14	2.80	1.17	9.00
FS/Ber-15	2.53	1.20	9.10
FS/Ber-16	2.10	1.07	6.70
FS/Ber-17	1.40	0.97	4.00
FS/Ber-18	2.40	1.20	8.60
FS/Ber-19	2.57	0.93	7.40
FS/Ber-20	2.13	0.87	5.50
FS/Ber-21	2.37	1.00	7.00
FS/Ber-22	2.37	0.97	6.80
FS/Ber-23	2.00	0.90	5.40
FS/Ber-24	2.33	1.10	7.60
Mean	2.06	0.99	6.13
Rang	1.4-2.57	0.80-1.5	3.3-9.1
SEm±	0.05	0.05	0.43
CD at 1%	0.31	0.31	2.62

CONCLUSIONS

Therefore, from above studies it can be concluded that showed wide range genetic diversity in the existing population under Bundelkhand region of the Utter Pradesh. Variation noted for in quantitative, qualitative, morphological and biochemical traits. Among collected genotypes, the genotypes FS/Ber-2, FS/Ber-4, FS/Ber-5, FS/Ber-10 and FS/Ber-15 were screened as promising genotypes in terms of physic-chemical, morphological and fruiting traits. These promising genotypes can be recommended for commercial multiplication, growing at farmer's field and conservation in the field gene bank for further evaluation and release of cultivar in future.

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