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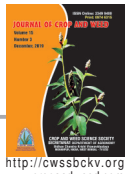

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Evaluation of ber (*Zizyphus mauritiana* Lamk.) genotypes under Kymore Plateau Satpura Hill regions of Madhya Pradesh

R. K. RAI, C.S. PANDEY, S. K. PANDEY AND *[1]R. PAL

College of Agriculture, JNKVV, Jabalpur, M.P, Pin-482004, India
[1]College of Horticulture and Forestry, Rani Lakshmi Bai Central Agricultural University, Jhansi, Utter Pradesh, Pin-284003, India

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ABSTRACT

This experiment was carried out to evaluate the performance of 20 genotypes of ber under Kymore Plateau and Satpura Hill regions of Madhya Pradesh during 2018-19. These genotypes were studied to observe the variability in respect to plant growth, fruiting, fruit quality and incidence of pest attack attributes. The tree height varied from 3.8m to 5.3m being the minimum in Jawaharber 4, where it was recorded maximum in Jawaharber 7. Among the 20 genotypes, growth habit was observed as 12 genotypes spreading and 8 genotypes was semi-spreading. Foliage color indicate 4 genotypes were found to have green, 6 genotypes light green and 10 genotypes were found to have dark green colour. The maximum fruit length (3.90 cm), fruit weight (24.63g) and fruit yield (76.5 kg plant^{-1}) was recorded in Jawahar ber 12. The genotype Jawaharber 20 recorded highest TSS content (21.40brix), total sugar (12.2%) and acidity was recorded minimum in Jawaharber 8 (0.41).The incidence of fruit fly was noticed on 3 genotypes, infestation of gray hairy caterpillar was noticed on 4 genotypes. Powdery mildew was not found on 4 genotypes and remaining 16 genotypes were found to be affected. Cladosporium fruit rot was noticed on 3 genotypes only. Based on various desired horticultural traits like desirable fruit morphological and physicochemical characteristics the genotype Jawaharber 12 was observed morphologically best genotype. Genotype Jawaharber 20 was observed to be best for physicochemical characteristics under Kymore Plateau and Satpura Hill conditions. By observing the overall performance, it is cocluded that the above genotypes can be utilized for further varietal improvement programme in ber.

***Keywords*:** *Zizyphus mauritiana*, morphological characters, biochemical characters.

The Indian ber (*Zizyphus mauritiana* Lamk.) is one of the most ancient and important underutilized fruit crops indigenous to India and belongs to family Rhamnaceae. Present time ber is very popular, and the fruits are in great demand during the season during November to February. It is called as a poor man's fruit, also designated as "King of Arid Fruit" owing to fact that it can be successfully grown in barren land, marginal or inferior soil with pH range as 9.0 in arid and semi-arid regions.

Ber is more suitable to tropical, subtropical and arid regions. Plants is spiny, semi vigorous in growth, branches are spreading to drooping, evergreen to deciduous nature, leaves are highly pubescent (tomentose, almost silvery) on the under surface, it flowers in autumn, fruit ripen in spring are round to oval, greenish yellow to reddish brown on ripening (Flora *et al.,* 2015).

Reviewing the capabilities there is endless scope for crop improvement by thoroughly screening some genotypes for their vegetative and reproductive growth and fruiting behavior to recommend superior varieties to the local farmers. Variation in crop morphology, yield attributes as well as physical and chemical properties of different ber varieties has been reported by several researchers (Pareek and Vashishtha, 1983). Saran *et al*. (2006) have evaluated different ber varieties and have suggested particular one for commercial grown in different agro climatic conditions. Looking the potential of ber fruits, the search of the most promising elite genotypes well suited under Madhya Pradesh conditions is the need of time. Considering these realities, the present investigation was carried out to find out variability of plant growth, fruit yield and quality attributes of different genotypes of ber to identify suitable genotypes for commercial cultivation.

MATERIALS AND METHODS

The present investigation was carried out at the Fruit Research Station, College of Agriculture, JNKVV, Jabalpur, Madhya Pradesh during 2018-19.

The experimental site was situated at 23.10^0 North latitude,79.50^0 East longitudes and at an altitude of 411.78 meters above the mean sea level. The site is typically semi arid with little rainfall during rainy season. The average precipitation (June to October) in this area about 1208 mm. The maximum and minimum temperature during summer months vary between 40°C and 27.3°C, respectively while during winter months it ranges between 24.5°C and 11.0°C.

The experimental material consisted of twenty genotypes, *viz*., Jawaharber 1 to 20. The experiment was car-

Email: ranjit_pal2@yahoo.com

ried out for two consecutive years during 2018 and 2019. This experiment was conducted in RBD with three replications. The observations were fruit yield attributes, physical and quality characteristics of fruits were recorded when the fruits were ready for harvest during maturity stage. For chemical analysis of the fruits, the methods were followed as described by A.O.A.C. (1990).

The pruning operation was done during second week of April. All other cultural practices like manuring and fertilization, irrigation, application of growth regulators, weeding, plant protection, etc. were carried out uniformly to all the plants. The data were analyzed statistically and test of significance were done by following the RBD methods as described by Panse and Sukhatme (1985).

RESULTS AND DISCUSSION

The data on tree height, growth habit, trunk girth, plant canopy and foliage colour of different ber genotypes depicted in Table 1 showed differences in respect to tree height of the plant. The tree height varied between 3.8m to 5.3m being the minimum in Jawaharber 4, where it was recorded maximum in Jawaharber 7. Among the genotypes, growth habit was observed as spreading and semi-spreading. The data revealed that maximum trunk girth was recorded in the genotype Jawaharber 9 (85 cm), followed by Jawaharber 3 (80 cm), Jawaharber 6 (77.5 cm), Jawaharber 1, 14 and 15 (75 cm). The lowest trunk girth was recorded in Jawaharber 11 (60 cm). The maximum North-South spread was recorded in genotype Jawaharber 15 (6.4m) whereas, the minimum in Jawaharber 13 (4.1 m). The data maximum East-West spread was recorded in genotype Jawaharber 15 (5.5 m) followed by Jawahar ber 7 (5.3m) whereas, the minimum spread of East-West was recorded in Jawaharber 11 (3.1 m).The data pertaining to foliage colour indicate that, out of 20 genotypes, 4 genotypes were found to have green foliage colour, 6 genotypes light green and 10 genotypes were found to have dark green colour.

Fruit physical characters like fruit length, width, weight, stone which are considered to be the most valuable parameters for attracting premium fruit price, varied significantly among the twenty genotypes of ber (Table 2). The data recorded that longest fruit length (3.90 cm), width (3.27 cm), weight (24.63 g) were obtained in Jawaharber 12, followed by Jawahar ber 16 (23.97 g), Jawaharber 11 (22.07 g). The genotype Jawaharber 7 (10.05 g) recorded the minimum fruit weight and Jawaharber 9 recorded lowest stone weight (0.62 g). Various genotypes of ber fruit showed significant variation in fruit production (Table 2). The data displayed that Jawahar ber 12 (76.5 kg/plant) produced highest yield, followed by Jawaharber 16 (64.5 kg/plant) while minimum yield was recorded in Jawahar ber 7 (54.0 kg/plant). The maximum yield in Jawahar ber 12 the present study was due to maximum vegetative growth, production of maximum fruit number and heavier fruits weight.

The maximum yield in 'Jogia' variety of ber due to production of highest number of fruits and heavier fruit weight as recorded by Pareek and Vashistha (1983), however, indicated 60 and 80 kg fruit per plant from 5years old 'Jogia' variety under irrigated conditions in Rajasthan. Contrary to this, Gupta (1977) reported maximum yield (210 kg fruit plant^{-1}) in 20 years old 'Umran' variety, under Hoshangabad region, Madhya Pradesh. Similar variation in yield attributed to age of the plants.

Table 3 clearly indicates the significant variation in the fruit pulp percentage which varied from 88.89 % to 97.19% in all the genotypes of ber. The maximum pulp was observed in Jawahar ber 12 (97.19%) followed by Jawahar ber 11 (96.82%) while minimum percentage was observed in Jawaharber 14 (88.89%). The maximum pulp and stone ratio (34.69) was observed in Jawaharber 12. These investigation resulted confirmed variations and similar findings of Flora and Joshi (2017) showed that pulp and stone ratio was maximum in Umran (23.10) under climatic condition of Rahuri, Maharashtra. Ram *et al*. (2008) reported pulp and stone ratio to be in the range of 5.03 to 36.98. Similar findings were given by Dhingra *et al*. (1973) and Shukla *et al.* (2012). The variation in the traits may be due to climatic conditions, and other biotic and abiotic factors, yet they provided a reliable basis for cultivar identification in local ber verities.

Ber fruits are also rich source of total soluble solids and sugars, and these values varied significantly in different genotypes (Table 3). The TSS and total sugar content of fruits ranged from 12.2^0 to 21.4^{0}Brix and 7.1% to 12.2% respectively in different genotypes. The highest TSS content was found in Jawaharber 20 (21.4^{0}brix) closely followed by Jawahar ber 18 (20.0^0 brix), Jawahar ber 19 (19.2^{0}brix), it was found least in Jawaharber 11 (12.2^0 brix). The maximum total sugar content was also recorded in Jawaharber 20 (12.2%), closely followed by Jawaharber 18 (11.0%), Jawaharber 8 (10.9%), and it was recorded least in Jawaharber 6 (7.1%). The highest reducing sugar content was found to be maximum in Jawaharber 2 (4.83%), closely followed by Jawahar ber 8 (4.28) and Jawaharber 20 (4.23), it was noted lowest in Jawaharber 17 (2.89). The genotype Jawaharber 20 also recorded highest non reducing sugar content (7.07%), closely followed by Jawaharber 18 (7.66%), Jawaharber (6.91%) and lowest was recorded

Table 1: Tree height, growth habit, trunk girth, plant canopy and foliage colour of different ber genotypes

Genotypes	Tree height (m)	Growth habit	Trunk girth (cm)	Plant canopy (m)		Foliage colour
				N-S	E-W	
Jawaharber 1	4.2	Spreading	75.0	5.2	4.6	Light green
Jawaharber 2	3.9	Spreading	72.5	5.6	4.3	Dark green
Jawaharber 3	5.0	Spreading	80.0	5.1	4.4	Dark green
Jawaharber 4	3.8	Spreading	72.5	4.8	4.5	Light green
Jawaharber 5	4.6	Semi Spreading	67.5	4.2	3.3	Green
Jawaharber 6	4.4	Spreading	77.5	5.4	4.9	Dark green
Jawaharber 7	5.3	Spreading	72.5	6.2	5.3	Dark green
Jawaharber 8	4.9	Semi Spreading	65.0	4.5	4.0	Dark green
Jawaharber 9	4.6	Spreading	85.0	5.4	4.9	Dark green
Jawaharber 10	4.8	Spreading	70.0	4.8	4.6	Light green
Jawaharber 11	4.0	Semi Spreading	60.0	4.3	3.1	Dark green
Jawaharber 12	4.6	Semi Spreading	67.5	4.4	3.7	Dark green
Jawaharber 13	4.2	Semi Spreading	70.0	4.1	4.2	Green
Jawaharber 14	4.6	Semi Spreading	75.0	4.4	4.3	Green
Jawaharber 15	4.8	Spreading	75.0	6.4	5.5	Green
Jawaharber 16	4.3	Semi Spreading	70.0	4.3	4.3	Dark green
Jawaharber 17	4.5	Semi Spreading	62.5	4.2	4.0	Light green
Jawaharber 18	4.4	Spreading	62.5	5.6	4.8	Dark green
Jawaharber 19	4.3	Spreading	62.5	5.5	5.0	Light green
Jawaharber 20	5.1	Spreading	65.0	6.3	5.1	Light green

Table 2: Fruit morphological and yield characters of ber genotypes at the time of maturity

Genotypes	Fruit length (cm)	Fruit width (cm)	Fruit weight (g)	Stone weight (g)	Yield (kg tree^{-1})
Jawaharber 1	2.77	2.48	16.33	1.47	60.0
Jawaharber 2	3.23	2.67	18.30	1.47	63.0
Jawaharber 3	3.23	2.87	20.27	1.80	63.3
Jawaharber 4	2.90	2.73	17.72	1.12	58.0
Jawaharber 5	3.13	2.88	19.47	1.50	62.0
Jawaharber 6	2.80	2.14	15.40	1.40	60.0
Jawaharber 7	1.77	1.70	10.05	0.78	54.0
Jawaharber 8	2.67	2.61	15.53	1.07	59.0
Jawaharber 9	2.57	2.43	14.83	0.62	62.0
Jawaharber 10	1.90	1.75	12.50	0.82	63.8
Jawaharber 11	3.60	2.54	20.77	0.66	64.0
Jawaharber 12	3.90	3.27	24.63	0.69	76.5
Jawaharber 13	2.70	2.58	17.07	0.80	63.0
Jawaharber 14	2.30	2.13	14.13	1.57	59.5
Jawaharber 15	2.63	2.29	16.67	0.76	61.5
Jawaharber 16	3.70	2.95	22.97	0.74	64.5
Jawaharber 17	2.90	2.55	18.73	0.88	59.0
Jawaharber 18	2.83	2.48	18.33	0.97	55.0
Jawaharber 19	2.57	2.35	13.33	0.75	58.5
Jawaharber 20	2.93	2.57	17.27	0.82	61.5
SEm(±)	**0.11**	**0.0075**	**0.71**	**0.09**	**1.27**
LSD(0.05)	**0.32**	**0.022**	**2.04**	**0.27**	**3.60**

Table 3: Fruit quality attributes characters of different ber genotypes

Genotypes	Fruit shape	Colour	Texture	Taste	Pulp (%)	Pulp: Stone ratio	TSS (^{0}Brix)	Total sugar (%)	Reducing sugar (%)	Non reducing sugar (%)	Acidity (%)
Jawaharber 1	Oval	Greenish yellow	Soft	Sweet	90.99	10.10	14.0	8.8	3.99	4.81	0.51
Jawahaber 2	Oblong	Greenish yellow	Soft	Very sweet	91.96	11.44	16.4	10.0	4.83	5.17	0.55
Jawahaber 3	Oblong	Greenish yellow	Soft	Very sweet	91.11	10.26	15.8	9.8	3.57	6.23	0.45
Jawahaber 4	Oval	Greenish yellow	Medium	Sweet	93.67	14.82	12.6	8.8	3.43	5.37	0.46
Jawahaber 5	Oval	Creamy	Crispy	Sweet	92.29	11.98	14.0	8.7	3.81	4.89	0.44
Jawahaber 6	Oval	Greenish yellow	Soft	Sweet	90.90	10.00	13.2	7.1	3.53	3.57	0.47
Jawahaber 7	Round	Chocolate colour	Crispy	Mild sweet	92.23	11.88	17.4	10.3	3.94	6.36	0.47
Jawahaber 8	Round	Chocolate colour	Crispy	Very sweet	93.11	13.51	18.4	10.9	4.28	6.62	0.41
Jawahaber 9	Oval	Light green	Soft	Sweet	95.81	22.91	14.6	9.2	3.86	5.34	0.43
Jawaharber 10	Oblong	Greenish yellow	Medium	Mild sweet	93.44	14.24	14.2	8.2	3.40	4.80	0.48
Jawaharber 11	Oval	Light green	Medium	Sweet	96.82	30.46	12.2	8.4	3.45	4.95	0.49
Jawaharber 12	Oblong	Greenish yellow	Soft	Sweet	97.19	34.69	15.4	9.0	3.30	5.70	0.47
Jawaharber 13	Oval	Greenish yellow	Soft	Mild sweet	95.31	20.33	15.6	9.3	4.17	5.13	0.61
Jawaharber 14	Oval	Greenish yellow	Medium	Sweet	88.89	8.00	14.8	8.3	3.60	4.70	0.62
Jawaharber 15	Oblong	Greenish yellow	Medium	Mild sweet	95.44	20.93	15.2	8.3	3.23	5.07	0.50
Jawaharber 16	Oval	Light green	Medium	Mild sweet	96.77	30.04	15.4	8.7	2.90	5.80	0.58
Jawaharber 17	Oval	Greenish yellow	Medium	Acidic	95.30	20.28	17.8	9.8	2.89	6.91	0.60
Jawaharber 18	Oblong	Greenish yellow	Crispy	Sweet	94.70	17.89	20.0	11.0	3.34	7.66	0.65
Jawaharber 19	Oblong	Greenish yellow	Medium	Sweet	94.37	16.77	19.2	10.2	3.53	6.67	0.56
Jawaharber 20	Oval	Light green	Medium	Mild sweet	95.25	20.06	21.4	12.2	4.23	7.97	0.45
SEm(±)	**-**	**-**	**-**	**-**		**0.85**	**0.76**	**0.14**	**0.1**	**0.14**	**0.02**
LSD (0.05)	**-**	**-**	**-**	**-**		**2.43**	**2.19**	**0.41**	**0.31**	**0.41**	**0.06**

Table 4: Reaction of existing ber genotypes against, insect-pest and diseases of different ber genotypes

Genotypes	Insect pest		Diseases	
	Fruit fly	Gray hairy caterpillar	Powdery mildew incidence	Cladosporium fruit rot
Jawaharber 1	Absent	Absent	Observed	Absent
Jawaharber 2	Present	Absent	Observed	Absent
Jawaharber 3	Absent	Present	Observed	Absent
Jawaharber 4	Absent	Absent	Observed	Present
Jawaharber 5	Absent	Absent	Observed	Absent
Jawaharber 6	Absent	Present	Not observed	Absent
Jawaharber 7	Absent	Absent	Not observed	Absent
Jawaharber 8	Absent	Absent	Observed	Absent
Jawaharber 9	Present	Absent	Observed	Absent
Jawaharber 10	Absent	Absent	Observed	Absent
Jawaharber 11	Absent	Absent	Observed	Present
Jawaharber 12	Absent	Absent	Not observed	Absent
Jawaharber 13	Absent	Absent	Observed	Absent
Jawaharber 14	Absent	Absent	Observed	Absent
Jawaharber 15	Absent	Present	Observed	Present
Jawaharber 16	Present	Absent	Observed	Absent
Jawaharber 17	Absent	Absent	Observed	Absent
Jawaharber 18	Absent	Present	Observed	Absent
Jawaharber 19	Absent	Absent	Not observed	Absent
Jawaharber 20	Absent	Absent	Observed	Absent

Jawaharber (3.57%). Fruit acidity is one of the most important quality characters and its ranged from 0.41% to 0.65% respectively in different genotypes. The maximum acidity was recorded in Jawaharber 18 (0.65%) and minimum was recorded in Jawaharber 8 (0.41%), closely followed by Jawaharber 9 (0.43), Jawaharber 5 (0.44) and Jawaharber 20 (0.45). These findings are quiet in line with Singh and Jindal (1980); Dhingra *et al*. (1973); Gupta (1977); Chovatia *et al*. (1992) and Faroda (1996).

The color and taste have been found to be markedly changed from initial stage of fruit growth to harvestable maturity. The fruit colour at harvestable maturity was observed, out of the 20 genotypes, Jawaharber 5 genotype was creamy colour, Jawaharber 7 and 8 were chocolate colour, Jawahar ber 9, 11, 16 and 20 genotypes were light green and remaining 13 genotypes were greenish yellow colour. Out of the 20 genotypes, 3 genotypes Jawaharber 2, 3 and 8 were very sweet in test, 6 genotypes were mild sweet, 10 genotypes were sweet and 1 genotype was acidic in test. These findings are also supported by Gupta (1977). Out of the 20 genotypes, 2 genotypes were round shaped and 7 genotypes were oblong and 11 genotypes were oval shaped. Texture out of the 20 genotypes, 4 genotypes were crispy in texture, 7 genotypes were soft, 9 genotypes were medium in texture.

The incidence of fruit fly was noticed on Jawahar ber 2,9,16 genotypes and remaining 17 genotypes were found to be not affected by fruit fly infestation. Gray hairy caterpillar was noticed on Jawaharber 3,6,15,18 genotypes and remaining 16 genotypes were found to be not affected by grey hairy caterpillar infestation. Powdery mildew was noticed but not observed on Jawaharber 6,7,12,19 and remaining 16 genotypes were found to be affected by powdery mildew infestation. Cladosporium fruit rot was noticed on Jawaharber 4, 11, 15 genotype remaining 17 genotypes were not affected by Cladosporium fruit rot infestation.

CONCLUSION

Wide range of variability existed amongst the twenty genotypes studied while evaluating for various characteristics. The genotypes Jawaharber 18,19 and 20 were found to be superior for their biochemical characters. The genotype Jawaharber 12 was found to be superior for fruit yield attributes. The result of present investigation will be helpful for selecting ber genotypes for growing on the basis of their superior growth, morphological and quality attributes. Similarly, the genotypes Jawahar ber 12 and 20 may be utilized for further research programmes on the basis of morphological and physicochemical characters.

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