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GENETIC VARIABILITY AND CORRELATION ANALYSIS IN BER (*Zizyphus mauritiana* Lamk.) GERMPLASM GROWN IN LUCKNOW

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ABSTRACT: A study was conducted in sodic soil conditions of Lucknow during 2005-2006 using 16 genotypes of *Zizyphus mauritiana* Lamk. in which 12 were commercial cultivars viz. Banarasi Karaka, Karali, Shootless, Mehrun, Peundi, Gola, Jaffran, Chhuhara, Khinni, Desi, Kaithli and Illaichi; and 4 selections-i.e. Ambedkar Ber 1, Ambedkar Ber-2, Ambedkar Ber-3 and Ambedkar Ber-4 to correlate 13 physico-chemical characters of fruits i.e. fruit length, fruit width, fruit weight, fruit volume, specific gravity, total soluble solid (TSS), acidity, ascorbic acid, stone length and stone width, stone weight, pulp: stone ratio and fruit pulp. The experiment was carried out in completely randomized design (CRD) with three replications. Correlation analysis study showed a high positive and statistically significant (P<0.01) correlation between fruit pulp and fruit weight (0.999). Fruit pulp also had positive and significant correlation with fruit volume (0.874) and fruit width (0.730). Fruit volume indicated negative correlation with specific gravity. Therefore, information on different physico-chemical characters of fruits and fruit pulp yield may be of great importance to a breeder in selecting a desirable genotype.

Keywords: *Ber, genetic variability, correlation analysis, physico-chemical characters.*

Indian jujube or ber (*Z. mauritiana* Lamk.), belongs to the family Rhamnaceae, consists of 45 genera and 550 species. The genus *Zizyphus* has approximately 40 species, including *Zizyphus mauritiana* Lamk.(Indian jujube). It is one of most ancient and common fruits in India (Rai and Gupta, 10). The ber fruits has a high sugar content and a high level of vitamins A & C, carotene, phosphorus and calcium. It is an excellent source of ascorbic acid and carotenoids. Ber can provide food security, due to sustained production of the fruit, irrespective of drought, as the tree is drought and saline tolerant and can grow on poor and degraded land. It is widely distributed in tropical and subtropical climates in the world (Mukhtar *et al*., 7). The fresh fruit has a mild sub-acid flavour and crisp firm flesh. It is used for preparation of murrabba, candy, pickles, preserve, canned ber and chutney (Singh, 14) and pulp is used for making jam (Neog *et al*., 8). *Jujube* is both a delicious fruit and an effective herbal remedy. The dried fruits are stomachic, styptic and tonic considered to purify the blood and aid digestion (Chopra *et al.*, 4). They are used internally in the treatment of chronic fatigue, loss of appetite, diarrhoea, anaemia, irritability and hysteria (Bown, 3). The study of physico-chemical characteristics of different ber cultivars are of great value in assessing its potentiality for fruit improvement programme through hybridization for which systematic and sustained research needs to be carried out of all the aspects of commercial cultivation including basic studies to meet the challenges of 21st century (Kumar, 5). Ber demonstrates a rich genetic diversity mostly resulting from natural cross-pollination and self-incompatibility (Bhargava *et al.,* 2). Thus, it is necessary to select desired genotypes for superior fruit characteristics and to develop standard cultivars from a wide variety of natural population.

MATERIALS AND METHODS

Present investigations were carried out during year 2005-2006 in the Department of Applied Plant Science (Horticulture), Babasaheb Bhimrao Ambedkar University, Lucknow. It is situated within the sub tropical tract of central U.P. at 26° 56' N altitude and 80° 52' E longitude at an

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Table 1: Genetic variability for physico-chemical characters of ber.

Characters	**Mean ± SD**	Range
Fruit length	3.968 ± 0.127	1.51-5.56
Fruit width	2.690 ± 0.113	1.01-3.56
Fruit weight	19.385 ± 1.156	0.98-28.65
Fruit volume	16.583 ± 1.469	1.00-25.00
Specific gravity	1.225 ± 0.071	0.53-2.89
T.S.S.(%)	14.000 ± 0.246	8.00-20.00
Acidity	5.667 ± 0.355	1.60-9.50
Ascorbic acid	6.243 ± 0.421	1.80-8.40
Stone length	2.480 ± 0.083	1.11-3.49
Stone width	0.657 ± 0.018	0.41-1.30
Stone weight	0.795 ± 0.049	0.06-3.42
Pulp:Stone ratio	23.660 ± 1.158	3.45-65.35
Fruit pulp	18.590 ± 1.118	0.79-25.17

elevation of 1100 meter above mean sea level. 12 commercial cultivars of ber Banarasi Karaka, Karali, Shootless, Mehrun, Peundi, Gola, Jaffran, Chhuhara, Khinni, Desi, Kaithli, Illaichi, and 4 selections Ambedkar Ber-1, Ambedkar Ber-2, Ambedkar Ber-3 and Ambedkar Ber-4 were selected for this experiment. Fruits were collected at fully ripe stage and experiment was carried out in Completely Randomized Design (CRD) with three replications. Observations were recorded on some physical characters viz. fruit length, fruit width, fruit volume, specific gravity, stone length and stone width, stone weight, pulp:stone ratio, fruit pulp and biochemical characters viz. total soluble solid (TSS%), acidity (%) and ascorbic acid by taking twelve healthy and uniformly ripe fruits randomly from each genotype. Data on length and width of fruit and stone were recorded using Vernier callipers, weight by using digital balance and volume by water displacement method. Total soluble solid of the fruit was recorded directly with the help of hand refractometer (ERMA, Japan 0-30 °Brix), whereas acidity and ascorbic acid were recorded using standard methods as described by (Ranganna, 11). The Simple Correlation Coefficients between all possible combinations of variables were worked out using OPSTAT windows by (Sheoran, 12).

RESULTS AND DISCUSSION

The analysis of variance revealed the significant difference among the genotypes for all the traits studied indicating that there is substantial genetic variability for these traits. The mean values and range for all the fruit traits (Table 1) showed considerable variation in morphological and physico-chemical characters of fruits. Fruit length ranged from 1.51-5.56 with mean value 3.968. Range for fruit width, fruit weight, fruit volume, specific gravity, total soluble solid (TSS %), acidity (%), ascorbic acid, stone length and stone width, stone weight, pulp:stone ratio and fruit pulp were 1.01-3.56, 0.98-28.65, 1.00-25.00, 0.53-2.89, 8.00-20.00, 1.60-9.50, 1.80-8.40, 1.11-3.49, 0.41- 1.30, 0.06-3.42, 3.45:1-65.35:1 and 0.79-25.17 with mean values 2.690, 19.385, 16.583, 1.225, 14.000, 5.667, 6.243, 2.480, 0.657, 0.795, 23.660, 18.590, respectively. Genotype Mehrun had highest fruit weight (21.82 g), fruit volume (21.79 cc), fruit pulp (21.21 g) and pulp:stone ratio (36.98).

The results of the correlation coefficient analysis (Table 2) revealed that a high, positive and significant correlation ($P<0.01$) was observed between fruit pulp and fruit weight (0.999), between fruit pulp and fruit volume (0.874) and between fruit pulp and fruit width (0.730). Fruit weight had positive and significant correlation with fruit volume (0.871) and fruit width (0.729) and fruit volume had negative and significant correlation with specific gravity (-0.804) at $P<0.01$. There was a statistically significant ($P<0.05$) and positive correlation between fruit volume and stone weight (0.618), fruit volume and fruit length (0.586) and fruit volume and fruit width (0.611). Fruit volume had negative and significant correlation with total soluble solids (-0.524) at $P<0.05$. Therefore, study of physico-chemical characteristics of different ber cultivars are of great value in assessing its potentiality for fruit improvement programme through hybridization for which systematic and sustained research needs to

Table 2: Genotypic means for 13 physico-chemical characters in 16 genotypes of ber.

Genotypes	Fruit length (cm)	Fruit width (cm)	Fruit weight (g)	Fruit volume (ml)	Specific gravity (g/cc)	T.S.S. (%)	Acidity (%)	Ascorbic acid (mg/100g)	Stone length (cm)	Stone width (cm)	Stone weight (g)	Pulp: Stone ratio	Fruit Pulp (g)
Banarasi Karaka	3.968	2.690	19.385	16.583	1.225	14.000	5.667	6.243	2.480	0.656	0.795	23.660	18.590
Karali	5.113	2.648	20.169	18.083	1.130	13.66	8.500	5.568	2.828	0.694	2.805	6.500	17.363
Shootless	3.613	2.523	10.420	8.708	1.315	10.50	2.633	3.668	2.116	0.608	0.549	18.618	9.872
Mehrun	4.613	2.932	21.821	21.792	1.005	13.000	2.633	3.667	2.299	0.681	0.607	36.978	21.210
Peundi	3.530	2.345	9.467	8.541	1.198	10.000	2.867	5.843	2.233	0.620	0.573	16.043	8.893
Gola	2.994	2.480	9.712	9.166	1.075	17.333	3.200	4.600	1.710	0.710	0.588	16.452	9.12
Jaffran	4.254	2.949	20.788	16.417	1.361	15.000	3.700	4.943	2.384	0.794	0.870	23.613	19.92
Chhuhara	3.108	2.289	10.058	9.042	1.171	15.667	2.800	4.943	2.063	0.764	0.635	15.385	9.42
Khinni	2.305	1.699	2.435	2.750	0.947	9.333	1.800	3.678	1.564	0.518	0.123	22.790	2.31
Desi	2.413	2.596	6.189	5.583	1.990	19.333	6.800	5.022	1.323	0.922	0.613	9.258	5.58
Kaithali	2.053	1.752	4.179	2.375	2.006	16.000	7.167	4.143	1.487	0.858	0.638	5.993	3.54
Illaichi	3.423	2.259	9.912	7.750	1.34	13.333	3.600	3.702	2.176	0.559	0.576	17.493	9.35
Ambedkar Ber 1	1.505	1.511	2.443	2.625	0.933	15.667	6.767	5.578	0.869	0.606	0.246	9.038	2.20
Ambedkar Ber 2	1.988	1.648	3.848	2.583	1.68	12.333	6.967	5.633	1.179	0.684	0.386	9.667	3.46
Ambedkar Ber 3	2.284	1.591	4.198	2.917	1.447	12.333	9.600	4.200	1.439	0.426	0.683	5.028	3.50
Ambedkar Ber 4	2.305	2.433	7.757	6.923	1.16	17.333	8.270	4.523	1.215	0.911	0.781	9.064	6.98

Table 3: Correlation coefficients for 13 physico-chemical characters of ber (*Zizyphus mauritiana* Lamk.).

Chatacters	Fruit length	Fruit width	Fruit weight	Fruit volume	Specific gravity	T.S.S. (%)	Acidity (%)	Ascorbic acid	Stone length	Stone width	Stone weight	Pulp:Stone ratio	Fruit Pulp
Fruit length	1.000	0.366	0.599*	0.586*	-0.417	-0.141	-0.365	-0.433	0.425	0.089	0.392	0.337	0.602*
Fruit width		1.000	0.729**	0.611*	-0.310	-0.391	-0.374	0.022	0.712**	0.247	0.540*	0.182	0.730**
Fruit weight			1.000	0.871**	-0.442	-0.381	-0.202	-0.380	0.740**	0.236	0.789**	0.284	0.999**
Fruit volume				1.000	-0.804**	-0.524*	-0.133	-0.212	0.444	-0.043	0.618*	0.393	0.874**
Sp. gravity					1.000	0.600*	0.157	-0.107	0.019	0.285	-0.235	-0.362	-0.446
T.S.S. (%)						1.000	0.00	-0.176	-0.078	0.180	-0.044	-0.475	-0.392
Acidity (%)							1.000	-0.135	-0.342	-0.179	-0.142	-0.065	-0.203
Ascorbic acid								1.000	-0.123	-0.082	-0.143	-0.443	-0.387
Stone length									1.000	0.329	0.806**	-0.168	0.730**
Stone width										1.000	0.451	-0.415	0.225
Stone weight											1.000	-0.354	0.772**
P:S ratio												1.000	0.309
Fruit Pulp													1.000

*Significant at 5% level; **Significant at 1% level.

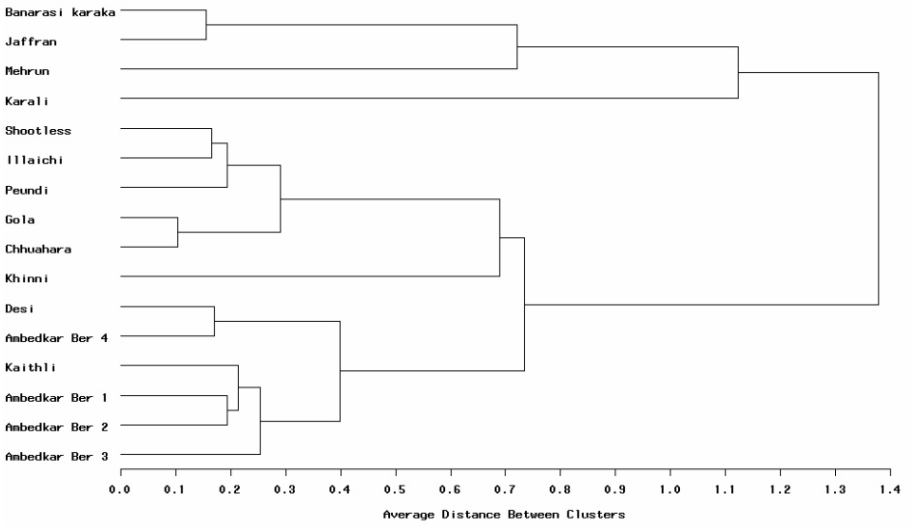

Fig. 1: Average distance between mean clusters of ber genotypes.

be carried out of all the aspects of commercial cultivation. Characters like fruit width, fruit weight and fruit volume are the yield contributing character for improvement of pulp yield in ber. Similar associations between traits studies have also been reported by Thimmappaiah *et al.* (13) and Kurmi (6) in guava, Attri *et al.* (1) in mango and Patil and Patil (9) in grape.

CONCLUSIONS

On the basis overall performance, four genotypes Mehrun, Jaffran, Karali and Banarasi Karaka were found more suitable in respect of fruit weight (21.82, 20.79, 20.17 and 19.39, respectively), T.S.S. (13.00, 15.00, 13.67 and 14.00 °Brix), ascorbic acid (3.67, 4.94, 5.57 and 6.24, respectively), pulp: stone ratio (36.98, 23.61, 6.50 and 23.66, respectively) and fruit pulp (21.21, 19.92, 17.36 and 18.59) for cultivation under sodic soil condition of Lucknow.

Fruit pulp yield can be increased by selecting genotypes having higher fruit width, fruit weight and fruit volume and for hybridization parents can be selected on basis of fruit width, fruit weight and fruit volume, which are counted as yield contributing characters for fruit pulp yield for attaining commercial cultivation of Ber.

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