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Identification of component traits as selection criteria to improve fruit yield in Indian jujube (*Zizyphus mauritiana* Lamk.)

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ABSTRACT

The study was conducted on 43 Indian jujube cultivars collected from Haryana, Rajasthan, Punjab and other parts of the country, planted at CCS Haryana Agricultural University, Hisar for estimating genetic parameters, correlation and path coefficient with respect to fruit yield and component traits. Heritability estimates were high for all the traits. GCV and PCV values were close to each other indicating least role of environment in the inheritance of different traits. High genetic gain for fruit yield per tree, fruit weight, pulp: stone ratio and leaf area demonstrated that these traits are under the control of additive gene action and phenotypic selection for their improvement will be effective. Significant positive association of fruit yield per tree was detected with fruit weight and fruit breadth. Path coefficient analysis showed maximum direct effect of stone weight upon fruit yield per tree followed by pulp: stone ratio and pulp percentage. It was concluded that during selection due weightage should be given to traits like fruit weight and pulp percentage for developing high yielding cultivars of Indian jujube for semi-arid regions.

Key words: Genetic advance, heritability, *Zizyphus mauritiana* Lamk., path analysis, fruit yield.

INTRODUCTION

Indian jujube (*Zizyphus mauritiana* Lamk.) commonly known as *ber,* member of Rhamnaceae family is indigenous to India. It occupies 40,530 ha with an annual production of 4,38,010 tonnes fruit in India (NHB, 9). However, out of more than 90 cultivars, only 11 are being commercially cultivated in different agro-climatic regions of India (Moton, 5). The development of a suitable region-specific high yielding cultivar is of paramount importance to the growing population for protective food as the *ber* is known as poor man's fruit. Earlier, Umran is reported the most stable cultivar for fruit yield and most other characters having more pulp: stone ratio and bold fruit (Navjot *et al*., 7). Fruit yield in *ber* as in other crops, is a complex character dependent upon many components. The components being less susceptible to environmental fluctuations than yield are more amenable to improvement. Therefore, it is important to identify these component traits. Path coefficient analysis provides an in depth picture about direct and indirect contribution of component traits towards yield. The present investigation was therefore conducted to estimate genetic parameters and to identify component traits contributing to fruit yield by correlation and path coefficient analysis in *ber*.

MATERIALS AND METHODS

The experimental material comprising 43 cultivars collected from Haryana, Punjab, Rajasthan and other parts of the country having uniform training and pruning budded on *Zizyphus rotundifolia* rootstock was planted at CCS, Haryana Agricultural University, Hisar at 8 m x 8 m spacing. The study was conducted during 2010 and 2011. The age of plants was 30-35 years. Four uniform plants per cultivar were selected and treated as four replications per treatment. Ten fruits per treatment were collected at full ripe stage for collecting all fruit and stone traits. For collecting the leaf data, 20 fully mature leaves per replication were collected all around the canopy. Leaf size index was calculated by ratio of leaf length to leaf breadth. Observations were recorded on fruit yield/ plant (kg), fruit and stone weight (g), fruit and stone length and breadth (cm), pulp (%), pulp: stone ratio, leaf area (cm^2) and leaf size index and data was pooled. Analysis of variance was carried out to test the significance of difference among genotypes. The genotypic and phenotypic coefficient of variation and heritability (in broad sense) were calculated as suggested by (Singh and Choudhary, 12), while genetic advance was estimated as per the procedure of Johnson *et al.* (3). The path coefficient analysis was carried out following Dewey and Lu (2).

RESULTS AND DISCUSSION

The mean sum of squares due to genotypes showed significant differences among the cultivars for all the traits (Table 1). The high estimates (>20%) of GCV recorded for fruit yield/ tree, fruit weight, fruit length, stone weight, stone length, pulp: stone ratio

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Table 1. Analysis of variance for various characters in *ber.*

Source of variation	Degree of freedom	Mean sum of squares										
		Fruit yield	Fruit weight	Fruit length	Fruit breadth	Pulp percentage	Stone weight	Stone length	Stone breadth	Pulp: stone ratio	Leaf area	Leaf size index
Replication	3	9.24	0.78	0.01	0.00	0.46	0.02	0.18	0.01	4.05	11.13	0.08
Genotype	42	748.93	61.07	2.48	0.38	8.96	0.20	1.04	0.08	153.91	226.99	0.32
Error	126	10.90	0.54	0.01	0.00	0.28	0.00	0.02	0.00	4.43	13.54	0.02

and leaf area indicated the presence of adequate genetic variation suggesting that these traits may be improved through selection. The heritability estimates were high for all the traits as GCV and PCV values were close to each other for different traits (Table 2). It demonstrated least role of environment in the expression of these traits. Nanohar *et al.* (6), Bisla and Daulta (1) and Navjot *et al.* (8) also reported moderate to high estimates of heritability along with high genetic gain for various characters in this crop. As fruit yield per tree, fruit weight, pulp: stone ratio and leaf area showed high genetic gain along with high estimates of heritability, it can be inferred that these traits are under the control of additive gene action and phenotypic selection for their improvement will be effective. Navjot *et al.* (8), Kaushik *et al.* (4) and Saran *et al.* (10) also reported the effectiveness of selection for these traits in their germplasm.

The genotypic correlation coefficients (below diagonal) were generally higher than their corresponding phenotypic values (Table 3). Significant positive association of fruit yield per tree was shown with fruit weight and fruit breadth, while negative association with leaf size index. Further, fruit weight was identified to be positively correlated with all the traits except leaf size index. The significant positive correlation of fruit length and breadth with stone length and breadth, respectively indicated that more the length/ breadth of stone, more will be the length/ breadth of fruit. Stone weight was also positively associated with its components, *i.e*. length as well as stone breadth. This demonstrated that although traits like stone length, stone breadth and stone weight improved fruit weight and thereby fruit yield per tree, yet these are not desirable characters from quality point of view as they reduce pulp percentage and pulp: stone ratio. this has been shown by the significant negative correlation between stone breadth and pulp percentage, stone breadth and pulp: stone ratio, stone weight and pulp percentage, stone weight and pulp: stone ratio. The significant positive association of fruit weight with leaf area indicated that more leaf area synthesized more photosynthates and fruit act as source of sink for these metabolites.

The results presented in (Table 4) showed that stone weight had maximum positive direct effect upon fruit yield per tree (1.401) followed by pulp: stone ratio (0.674) and pulp percentage (0.533). High direct effect of stone weight and pulp percentage was also reported by Saran *et al.* (11) and Navjot *et al.* (8), respectively.

Table 2. Estimation of genetic parameters for fruit yield components in *ber*.

Character	Genotypic coefficient of variability (%)	Phenotypic coefficient of variability (%)	Heritability (%)	Genetic advance	Genetic advance (%)	CV (%)
Fruit yield/ tree	22.13	22.77	94.42	27.19	44.29	5.38
Fruit weight	28.76	29.27	96.53	7.87	58.20	5.46
Fruit length	20.88	21.00	98.83	1.61	42.75	2.27
Fruit breadth	11.56	11.74	96.97	0.62	23.46	2.05
Pulp percentage	1.56	1.65	88.62	2.86	3.02	0.56
Stone weight	31.84	33.06	92.75	0.44	63.16	8.90
Stone length	22.07	23.04	91.79	0.99	43.57	6.60
Stone breadth	16.42	17.78	85.34	0.26	31.25	6.81
Pulp: stone ratio	31.14	32.94	89.40	11.91	60.66	10.72
Leaf area	24.83	27.83	79.76	13.44	45.68	12.51
Leaf size index	13.92	13.92	78.62	0.50	25.43	7.26

Table 3. Phenotypic (above diagonal) and genotypic (below diagonal) correlations among yields components in *ber.*

Character	Fruit yield/ tree	Fruit weight	Fruit length	Fruit breadth	Pulp percentage	Stone weight	Stone length	Stone breadth	Pulp: stone ratio	Leaf area	Leaf size index
Fruit yield/ tree	-	0.391*	0.045	0.466**	0.106	0.258	-0.029	0.299	0.138	-0.014	-0.341*
Fruit weight	0.414	-	0.607**	0.855**	0.354*	0.560**	0.504**	0.314*	0.320*	0.330*	-0.130
Fruit length	0.046	0.619	-	0.228	0.242	0.310*	0.911**	-0.155	0.255	0.286	0.158
Fruit breadth	0.485	0.882	0.220	-	0.188	0.589**	0.138	0.571**	0.147	0.249	-0.265
Pulp percentage	0.127	0.354	0.256	0.202	-	-0.557**	0.121	-0.510**	0.906**	0.319*	0.204
Stone weight	0.274	0.583	0.323	0.621	-0.537	-	0.318*	0.734**	-0.530**	0.020	-0.330*
Stone length	-0.025	0.533	0.958	0.145	0.125	0.349	-	-0.121	0.120	0.257	0.232
Stone breadth	0.332	0.355	-0.167	0.635	-0.578	0.821	-0.135	-	-0.513**	-0.116	-0.386*
Pulp: stone ratio	0.153	0.318	0.271	0.157	0.912	-0.515	0.121	-0.563	-	0.236	0.144
Leaf area	-0.013	0.395	0.316	0.270	0.413	0.023	0.334	-0.139	0.300	-	-0.086
Leaf size index	-0.397	-0.152	0.181	-0.295	0.236	-0.398	0.257	-0.460	0.162	-0.122	-

*P = 0.05; **P = 0.01

Table 4. Path coefficient analysis of fruit yield/ tree versus components characters in *ber.*

Character	Fruit weight	Fruit length	Fruit breadth	Pulp percentage	Stone weight	Stone length	Stone breadth	Pulp: stone ratio	Leaf area	Leaf size index	PCC* with fruit yield/ tree
Fruit weight	**-0.693**	0.033	0.095	0.189	0.784	-0.231	0.077	0.216	0.005	-0.083	0.391
Fruit length	-0.421	**0.054**	0.025	0.129	0.435	-0.417	-0.038	0.172	0.004	0.101	0.045
Fruit breadth	-0.593	0.012	**0.111**	0.100	0.826	-0.063	0.140	0.099	0.004	-0.169	0.466
Pulp percentage	-0.246	0.013	0.021	**0.533**	-0.781	-0.056	-0.125	0.611	0.005	0.131	0.106
Stone weight	-0.388	0.017	0.065	-0.297	**1.401**	-0.146	0.180	-0.357	0.003	-0.217	0.258
Stone length	-0.350	0.049	0.015	0.065	0.446	**-0.458**	-0.030	0.081	0.004	0.148	-0.029
Stone breadth	-0.218	-0.008	0.063	-0.272	1.029	0.555	**0.245**	-0.346	-0.002	-0.247	0.299
Pulp: stone ratio	-0.222	0.014	0.016	0.483	-0.743	-0.055	-0.126	**0.674**	0.004	0.092	0.138
Leaf area	-0.229	0.016	0.027	0.170	0.028	-0.118	-0.028	0.159	**0.015**	-0.055	-0.014
Leaf size index	0.090	0.008	-0.029	0.109	-0.476	-0.106	-0.095	0.097	-0.001	**0.061**	-0.341

*Phenotypic correlation coefficient, Bold figures are direct effects

Characters like fruit weight, fruit length, fruit breadth, stone length and stone breadth contributed to fruit yield per tree indirectly *via* stone weight. It revealed that stone acted as site for the synthesis of growth hormones for the growth and development of fruit resulting in increased fruit weight. Fruit weight also made indirect contribution to fruit yield/ tree *via* pulp percentage and pulp: stone ratio, revealing that fruit weight is the major contributor to fruit yield per tree. In addition to their direct effect, pulp percentage and pulp: stone ratio also contributed to fruit yield/ tree indirectly *via* each other. Indirect contribution of pulp: stone ratio *via* pulp percentage was also reported (Navjot *et al*., 8).

It is concluded that during selection due weightage should be given to traits like fruit weight (resultant of fruit length and breadth), and pulp percentage for the development of high yielding cultivars of Indian jujube for semi-arid regions.

REFERENCES

1. Bisla, S.S. and Daulta, B.S. 1986. Studies on variability, heritability and genetic advance for quality traits in ber (*Zizyphus mauritiana* Lamk.). *Haryana J. Hort. Sci.* **15**: 175-78.

2. Dewey, D.R. and Lu, K.H. 1959. A correlation and path coefficient analysis of components of

crested wheat grass seed production. *Agron. J.* **51**: 515-18.

3. Johnson, H.W., Robinson, H.F. and Comstock, R.F. 1955. Estimation of genetic and environmental variability in soybean. *Agron. J*. **47**: 314-18.

4. Kaushik, R.A., Sharma, S. and Panwar, R.D. 2004. Evaluation of ber (*Zizyphus mauritiana* Lamk.) germplasm under rainfed conditions. *Haryana J. Hort. Sci.* **33**: 160-62.

5. Morton, J.F. 2005. Indian jujube. *J. Exp. Bot.* **56**: 3082-92.

6. Nanohar, M.S., Sen, N.L. and Yadvendra, J.P. 1986. Phenotypic variation and its heritable components in some biometric characters in *ber* (*Zizyphus mauritiana* Lamk.). *Indian J. Hort.* **43**: 42-45.

7. Navjot, Brar, K.S., Mittal, V.P., Thakur, A. and Dalal, R.P. 2009. Genetic parameters, character association and path analysis for fruit yield and its components in *ber* (*Ziziphus mauritiana*). *Indian J. Agric. Sci.* **79**: 1000-02.

8. Navjot, Mittal, V.P., Brar, K.S., Thakur, A. and Dalal, R.P. 2010. Stability analysis for fruit yield and its components in ber (*Zizyphus mauritiana* Lamk.). *Indian J. Genet.* **70**: 304-6.

9. NHB. 2013. *Indian Horticulture Database-2013*. National Horticulture Board, Ministry of Agriculture, Govt. of India.

10. Saran, P.L., Godara, A.K. and Dalal, R.P. 2007. Biodiversity among Indian jujube (*Ziziphus mauritiana* Lamk.) genotype for powdery mildew and other traits. *Nat. Bot. Hort. Agrobot. Cluj.*: 15-21.

11. Saran, P.L., Godara, A.K., Lal G. and Yadav, I.S. 2007. Correlation and path coefficient analysis in *ber* genotypes for yield and yield contributing traits. *Indian J. Hort.* **64**: 459-60.

12. Singh, R.K. and Choudhary, B.D. 1979. *Biometrical Methods in Quantitative Genetics Analysis*, Kalyani Publishers, Ludhiana.

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