



Correlation Studies in Ber (*Ziziphus mauriatiana* Lamk.) in Eastern Region of Uttar Pradesh, India

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The present investigation was carried out in forty genotypes of ber at the Department of Fruit Science, College of Horticulture, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (UP) from 2021–22 to 2022–23. Phenotypic correlations were worked out among eighteen characters of Ber to know the nature of the association existing among the characters. The correlation among the quantitative characters was worked out. The length of the fruit was found to be significantly and positively correlated with fruit weight (0.617**), and the width of the fruit exhibited a significant positive correlation with fruit weight (0.853**). Leaf length showed significant positive correlations with length of fruit (0.443*) and a non-significant but positive correlation with weight of fruit and width of fruit. Leaf width showed significant positive correlations with fruit weight (0.794**), length of fruit (0.563**), and leaf length (0.487*). Stone weight has shown significant positive correlations with fruit weight (0.626**) and width of fruit (0.874**), and stone length has shown significant positive correlations with fruit weight (0.440*), leaf width (0.409*), and stone weight (0.584**). Stone width has shown significant positive correlations with leaf length (0.417*),

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leaf width (0.701**), and stone weight (0.487*). The height of the tree has shown significant positive correlations with length of fruit (0.576**), width of fruit (0.977**), stone length (0.803**), and stone width (0.628**). The stem girth also exhibited a significant positive correlation with fruit weight (0.966**), width of fruit (0.496*), leaf length (0.650**), stone weight (0.397*), and height of the tree (0.406*). Specific gravity has shown significant positive correlations with fruit weight (0.817**), leaf length (0.641**), leaf width (0.424*), stone weight (0.455*), stone length (0.417*), and stone width (0.734**).

TSS content was also found to be significantly and positively correlated with fruit weight (0.774**), leaf length (0.645**), leaf width (0.970**), stone weight (0.539**), stone length (0.425*), stone width (0.765**), stem girth (0.855**), and specific gravity (0.547**). Total acidity content in fruit was found to be significantly and positively correlated with fruit weight (0.725**), length of fruit (0.882**), width of fruit (0.948**), leaf length (0.809**), leaf width (0.989**), stone weight (0.772**), stone length (0.605**), stone width (0.892**), height of the tree (0.792**), and specific gravity (0.702**). TSS: acid ratio has shown significant positive correlations with fruit weight (0.981**), length of fruit (0.455*), width of fruit (0.963**), leaf length (0.929**), leaf width (0.854**), stone length (0.813**), stone width (0.727**), height of the tree (0.832**), stem girth (0.453*), and specific gravity (0.728**). Reducing sugar has shown significant positive correlations with fruit weight (0.680**), leaf width (0.821**), stone length (0.835**), stone width (0.503*), height of tree (0.747**), stem girth (0.812**), and TSS acidity ratio (0.410*). Non-reducing sugar has shown significant positive correlations with fruit weight (0.782**), length of fruit (0.999**), width of fruit (0.499*), leaf width (0.482*), stone weight (0.662**), stone length (0.399*), stone width (0.453*), specific gravity (0.488*), and TSS (0.787**). Total sugars have shown significant positive correlations with fruit weight (0.960**), length of fruit (0.412*), leaf length (0.539**), leaf width (0.710**), stone length (0.745**), stone width (0.897**), height of the tree (0.658**), stem girth (0.841**), and acidity (0.584**). Ascorbic acid has shown significant positive correlations between length of fruit (0.938**), leaf width (0.642**), stone length (0.664**), stone width (0.685**), height of tree (0.400**), and specific gravity (0.942**).

Keywords: Ber; correlation coefficient; variability; character association.

1. INTRODUCTION

The expression of a particular character is an aggregate of complex contribution of so many other characters. In tree improvement programme, a clear understanding of the nature and degree of association among different traits is of great importance because the choice of one character can favour the appearance or disappearance of the other. Correlation, an important statistical tool, helps in determining such associations among different factors under consideration.

“Ber (*Zizyphus mauritiana* Lam.) an indigenous important fruit crop for arid and semi-arid regions of India belong to the family Rhamnaceae. It is mainly grown in India and other countries in central Asia, China and Taiwan and is more associated with the Indian culture since ancient times” [1]. “It is cultivated widely for its resistance to grow in drought and other diversified soil and climatic conditions. It is a hardy tree that tolerates extreme temperature and thrives under dry conditions. Fruit quality is best under hot, sunny and dry conditions, but there should be a rainy season

to support growth and flowering, leaving enough soil moisture to carry the fruit to maturity” [2]. Along with the ability to withstand drought, ber can also tolerate adverse conditions, such as salinity and water logging. In view of the recent development in production technology of this crop, the cultivation of ber is becoming increasingly popular in many parts of country. It is an ideal fruit tree for tropical and subtropical regions of the country viz., Rajasthan, Haryana, Punjab, Uttar Pradesh, Gujarat, Madhya Pradesh, Bihar, Maharashtra, Andhra Pradesh and Tamil Nadu. Ber fruit have both sour and sweet tastes and are rich in nutritive value. It is rich in vitamin ‘B’ complex and vitamin ‘C’ [3]. “However, ber is richer than apple in protein, phosphorus, calcium, carotene and vitamin C and than oranges in phosphorus, iron, vitamin C, carbohydrates and exceeds them in calorific value” [4].

2. MATERIALS AND METHODS

The present investigation was carried out at Department of Fruit Science, college of Horticulture, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur (UP)

during 2021-2022 and 2022 - 2023. Fruit of forty genotypes were collected from eastern region (Balrampur, Bahraich, Sidarthnagar, Shrivasti, Gonda, Basti, Ayodhya, Sultanpur Banaras and Allahabad district) of Uttar Pradesh. "Twenty fruits of ber were randomly selected from all the direction of trees from each site collected then kept into bags and tagged by the number and subjected to physico-chemical analysis in laboratory. Physical parameters like stone weight was measure by electronic weighting machine, height of tree and stem girth were estimated with the help of measuring tape data on fruit shape, fruit apex, fruit base, mature fruit colour, immature fruit colour, tree shape, leaf shape, leaf apex, leaf margin, Stone shape, stone apex, stone base, leaf colour, thorn shape, pulp colour and , pulp texture were observed using standard and recommended techniques" [5]. Pooled data of both years was examined by using one and two way analysis mean values were differentiated using the CRD test. Pearson's correlation was significantly analyzed among various physicochemical attributes. The regression equation between the two factors was analyzed and the P-value of ≤ 0.05 was found statistically significant for all the given treatments .The two years data obtained during experimentation period was statistically analysed as per method given by Panse and Sukhatme [6] and results were evaluated at 5% level of significance

3. RESULTS AND DISCUSSION

"Phenotypic correlations were worked out among 18 characters of ber to know the nature of association existing among the characters" [5]. The findings about the relationship between fruit weight and other associated characteristics at the phenotypic level are shown here.

Length of fruit was found significantly and positively correlated with fruit weight (0.617**), the width of fruit analysis exhibited significant positive correlation with fruit weight (0.853**), Leaf length showed significant positive correlations with length of fruit (0.443*) and non-significant but positive correlation with weight of fruit and width of fruit, Leaf width was showed significant positive correlations with fruit weight (0.794**), length of fruit (0.563**) leaf length (0.487*), Verma et al. [7] Kevadiya et al. [8] Rathod et al. [9] Patel et al. [10] Singh et al. [11] Patel et al. [12] Tatari et al. [13]

Dolkar et al. [14] Wangchu et al. (2017) Kumar et al. [15] Kumar et al. [16] Siddique et al. [17] Panthor et al. [18] Dong et al. [19] Ahmad et al. [20].

Stone weight has showed significant positive correlations with fruit weight (0.626**) width of fruit (0.874**), Stone length has showed significant positive correlations with fruit weight (0.440*) leaf width (0.409*) Stone weight (0.584**), Stone width has showed significant positive correlations with leaf length (0.417*) leaf width (0.701**) stone weight (0.487*). Verma et al. [7] Kevadiya et al. [8] Rathod et al. [9] Patel et al. [10] Tatari et al. [13] Dolkar et al. [14] Wangchu et al. [24] Gaikwad et al. (2017) Arivazhagan et al. [21] Kumar et al. [15] Kumar et al. [16] Siddique et al. [17] Sheikh et al. [23] Panthor et al. [18] Dong et al. [19] Ahmad et al. [20].

Hight of tree has showed significant positive correlations with length of fruit (0.576**) width of fruit (0.977**) stone length (0.803**) stone width (0.628**).The stem girth also exhibited significant positive correlation with fruit weight (0.966**), width of fruit (0.496*) leaf length (0.650**) stone weight (0.397*) hight of tree (0.406*).Specific gravity has showed significant positive correlations with fruit weight (0.817**) leaf length (0.641**) leaf width (0.424*) stone weight (0.455*), stone length (0.417*) stone width (0.734**) Verma et al. [7] Kevadiya et al. [8] Rathod et al. [9] Patel et al. [10] Singh et al. [11] Patel et al. [12] Tatari et al. [13] Dolkar et al. [14] Wangchu et al. (2017) Gaikwad et al. [22] Kumar et al. [15] Siddique et al. [17] Sheikh et al. [23] Panthor et al. [18] Dong et al. [19].

TSS content was also found significantly and positively correlated with fruit weight (0.774**) leaf length (0.645**) leaf width (0.970**) stone weight (0.539**), stone length (0.425*) stone width (0.765**) stem girth (0.855**) specific gravity (0.547**).Total acidity content in fruit was found significantly and positively correlated with fruit weight (0.725**) length of fruit (0.882**) width of fruit (0.948**) leaf length (0.809**) leaf width (0.989**) stone weight (0.772**), stone length (0.605**) stone width (0.892**) hight of tree (0.792**) specific gravity (0.702**).TSS: acid ratio has showed significant positive correlations with fruit weight

Table 1. Correlation coefficients between various quality attributes of ber fruits

	Fruit weight(g)	Length of Fruit (cm.)	Width of Fruit (cm.)	Leaf Length (cm.)	Leaf Width (cm.)	Stone Weight (g)	Stone length (cm.)	Stone Width (cm.)	Hight of Tree (m.)	Stem girth (cm.)	Specific gravity	TSS (Brix)	Acidity (%)	TSS/ Acidity ratio	Reducing sugar (%)	Non reducing sugar (%)	Total Sugar (%)	Ascorbic Acid (mg/100g)
Fruit weight		0.617**	0.853**	0.092	0.794**	0.626**	0.440*	0.179	0.092	0.966**	0.817**	0.774**	0.725**	0.981**	0.680**	0.782**	0.960**	0.279
Length of Fruit			0.240	0.443*	0.563**	0.296	0.000	0.138	0.576**	0.160	0.075	0.167	0.882**	0.455*	0.173	0.999**	0.412*	0.938**
Width of Fruit (cm.)				0.264	0.233	0.874**	0.026	0.217	0.977**	0.496*	0.060	0.037	0.948**	0.963**	0.062	0.499*	0.094	0.173
Leaf Length (cm.)					0.487*	0.155	0.353	0.417*	0.378	0.650**	0.641**	0.645**	0.809**	0.929**	0.048	0.273	0.539**	0.062
Leaf Width (cm.)						0.352	0.409*	0.701**	0.286	0.072	0.424*	0.970**	0.989**	0.854**	0.821**	0.482*	0.710**	0.642**
Stone Weight (g)							0.584**	0.487*	0.286	0.397*	0.455*	0.539**	0.772**	0.122	0.217	0.662**	0.225	0.115
Stone length (cm.)								0.076	0.803**	0.042	0.417*	0.425*	0.605**	0.813**	0.835**	0.399*	0.745**	0.664**
Stone Width (cm.)									0.628**	0.079	0.734**	0.765**	0.892**	0.727**	0.503*	0.453*	0.897**	0.685**
Hight of Tree (m.)										0.406*	0.154	0.364	0.792**	0.832**	0.747**	0.230	0.352	0.400*
Stem girth (cm.)											0.261	0.855**	0.310	0.453*	0.812**	0.350	0.658**	0.161
Specific gravity												0.547**	0.702**	0.728**	0.222	0.488*	0.841**	0.942**
TSS (Brix)													0.051	0.000	0.048	0.787**	0.249	0.017
Acidity (%)														0.000	0.268	0.170	0.584**	0.254
TSS/ Acidity ratio															0.410*	0.221	0.387	0.009
Reducing sugar (%)																0.002	0.00	0.245
Non reducing sugar (%)																	0.00	0.064
Total Sugar (%)																		0.071

Significance 0.05- (0.396) * and Highly significance 0.01 (0.505) **

(0.981**) length of fruit(0.455*) width of fruit (0.963**) leaf length (0.929**) leaf width (0.854**) stone length (0.813**) stone width (0.727**) hight of tree (0.832**) stem girth (0.453*) specific gravity (0.728**). Verma et al. [7] Kevadiya et al. [8] Rathod et al. [9] Patel et al. [10] Singh et al. [11] Patel et al. [12] Tatari et al. [13] Dolkar et al.[14] Wangchu et al. [24] Gaikwad et al. [22] Arivazhagan et al. [21] Kumar et al. [15] Kumar et al. [16] Siddique et al. [17] Sheikh et al. [23] Panthor et al. [18] Dong et al. [19] Ahmad et. al. [20].

Reducing sugar has showed significant positive correlations with fruit weight (0.680**) leaf width (0.821**) stone length (0.835**) stone width (0.503*) hight of tree (0.747**) stem girth (0.812**) TSS acidity ratio (0.410*), Non-reducing sugar has showed significant positive correlations with fruit weight (0.782**) length of fruit(0.999**) width of fruit (0.499*) leaf width (0.482*) stone weight (0.662**) stone length (0.399*) stone width (0.453*) specific gravity (0.488*) tss (0.787**), Total sugars has showed significant positive correlations with fruit weight (0.960**) length of fruit (0.412*) leaf length (0.539**) leaf width (0.710**) stone length (0.745**) stone width (0.897**) hight of tree (0.658**) stem girth (0.841**) acidity (0.584**) and Ascorbic acid has showed significant positive correlations with length of fruit(0.938**) leaf width (0.642**) stone length (0.664**) stone width (0.685**) Hight of tree (0.400*) specific gravity (0.942**). Verma et al. [7] Kevadiya et al. [8] Rathod et al. [9] Patel et al. [10] Singh et al. [11] Patel et al. [12] Tatari et al. [13] Dolkar et al. [14] Wangchu et al. [24] Gaikwad et al. [22] Arivazhagan et al. [21] Kumar et al. [15] Kumar et al. [16] Siddique et al. [17] Sheikh et al. [23] Panthor et al. [18] Dong et. al. [19] Ahmad et. al. [20].

4. CONCLUSION

Length of fruit was found significantly and positively correlated with fruit weight. The width of fruit analysis exhibited significant positive correlation with fruit weight. Leaf length showed significant positive correlations with length of fruit and non-significant but positive correlation with weight of fruit and width of fruit. Leaf width was showed significant positive correlations with fruit weight, length of fruit and leaf length. Stone weight has showed significant positive correlations with fruit weight and width of fruit. Stone length has showed significant positive

correlations with fruit weight, leaf width and Stone weight. Stone width has showed significant positive correlations with leaf length, leaf width and stone weight. Hight of tree has showed significant positive correlations with length of fruit, width of fruit, stone length and stone width. The stem girth also exhibited significant positive correlation with fruit weight, width of fruit, leaf length, stone weight and hight of tree. Specific gravity has showed significant positive correlations with fruit weight, leaf length, leaf width, stone weight, stone length and stone width.

TSS content was also found significantly and positively correlated with fruit weight, leaf length, leaf width, stone weight, stone length, stone width, stem girth and specific gravity. Total acidity content in fruit was found significantly and positively correlated with fruit weight, length of fruit, width of fruit, leaf length, leaf width, stone weight, stone length, stone width, hight of tree and specific gravity. TSS: acid ratio has showed significant positive correlations with fruit weight, length of fruit, width of fruit, leaf length, leaf width, stone length, stone width, hight of tree, stem girth and specific gravity. Reducing sugar has showed significant positive correlations with fruit weight, leaf width, stone length, stone width, hight of tree, stem girth and TSS acidity ratio. Non-reducing sugar has showed significant positive correlations with fruit weight, length of fruit, width of fruit, leaf width, stone weight, stone length, stone width, specific gravity and TSS. Total sugars has showed significant positive correlations with fruit weight, length of fruit, leaf length, leaf width, stone length, stone width, hight of tree, stem girth and acidity. Ascorbic acid has showed significant positive correlations with length of fruit, leaf width, stone length, stone width, Hight of tree, specific gravity.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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