

## Correlation studies in Ber (*Ziziphus mauritiana* Lamk.) in Eastern region of Uttar Pradesh

### 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\*), 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.

### **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 (Baloda *et al.*, 2012). 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 (Awasthi and More, 2009). 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' (Pareek, 2013). 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 (*Nissi et al.*, 2016).

### **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, Shravasti, 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. 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  $\leq 0.05$  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 (1985) and results were evaluated at 5% level of significance

### **Results and Discussion**

Phenotypic correlations were worked out among 18 characters of ber to know the nature of association existing among the characters. 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.* (2002) Kevadiya *et al.* (2006) Rathod *et al.* (2007) Patel *et al.* (2015) Singh *et al.* (2015) Patel *et al.* (2016) Tatari *et al.* (2016) Dolkar *et al.* (2017) Wangchu *et al.* (2017) Kumar *et al.* (2020a) Kumar *et al.* (2021b) Siddique *et al.* (2022) Panthor *et al.* (2023) Dong *et al.* (2023) Ahmad *et al.* (2023)

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.* (2002) Kevadiya *et al.* (2006) Rathod *et al.* (2007) Patel *et al.* (2015) Tatari *et al.* (2016) Dolkar *et al.* (2017) Wangchu *et al.* (2017) Gaikwad *et al.* (2017) Arivazhagan *et al.* (2019) Kumar *et al.* (2021a) Kumar *et al.* (2021b) Siddique *et al.* (2022) Sheikh *et al.* (2023) Panthor *et al.* (2023) Dong *et al.* (2023) Ahmad *et al.* (2023)

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.* (2002) Kevadiya *et al.* (2006) Rathod *et al.* (2007) Patel *et al.* (2015) Singh *et al.* (2015) Patel *et al.* (2016) Tatari *et al.* (2016) Dolkar *et al.* (2017) Wangchu *et al.* (2017) Gaikwad *et al.* (2017) Kumar *et al.* (2021a) Siddique *et al.* (2022) Sheikh *et al.* (2023) Panthor *et al.* (2023) Dong *et al.* (2023)

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 (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.* (2002) Kevadiya *et al.* (2006) Rathod *et al.* (2007) Patel *et al.* (2015) Singh *et al.* (2015) Patel *et al.* (2016) Tatari *et al.* (2016) Dolkar *et al.* (2017) Wangchu *et al.* (2017) Gaikwad *et al.* (2017) Arivazhagan *et al.* (2019) Kumar *et al.* (2021a) Kumar *et al.* (2021b) Siddique *et al.* (2022) Sheikh *et al.* (2023) Panthor *et al.* (2023) Dong *et al.* (2023) Ahmad *et al.* (2023)

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.* (2002) Kevadiya *et al.* (2006) Rathod *et al.* (2007) Patel *et al.* (2015) Singh *et al.* (2015) Patel *et al.* (2016) Tatari *et al.* (2016) Dolkar *et al.* (2017) Wangchu *et al.* (2013) Gaikwad *et al.* (2017) Arivazhagan *et al.* (2019) Kumar *et al.* (2021a) Kumar *et al.* (2021b) Siddique *et al.* (2022) Sheikh *et al.* (2023) Panthor *et al.* (2023) Dong *et al.* (2023) Ahmad *et al.* (2023)

## 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.

#### **Reference:**

- Ahmad , R., Ali H. M., Lisek A., Mosa W. F. A., Ercisli S. and Anjum M. A. (2023).** Correlation among some phenological and biochemical traits in date palm (*Phoenix dactylifera* L.) germplasm. *Frontiers in Plant Science*. **35**, 1–16.
- Arivazhagan, E., Kandasamy, R., and Ramadoss, N. (2019) .** Variability and Correlation Analysis in Sapota (*Manilkara Zapota*) Under Coastal Ecosystem. *Plant Archives Vol. 19 No. 1, pp. 652-654.*
- Awasthi, O.P. and More, T.A (2009).** Genetic Diversity and Status of *Ziziphus* in India. *Acta Hortic.*; 840:33-40
- Baloda , S., Sehrawat S.K., Yadav B.S., Ahlawat V.P., and Singh (2012).** Resent status of ber production and future thrusts in india- a review. *Agri. Reviews*, 33 (3): 256- 264.
- Panthor, D and Hazarika, T, K: (2023).** Genetic diversity of Bael (*Aegle marmelos* (L.) Corr.) accessions from north-east India based on principal component and cluster analysis. *Genet Resour Crop Evol.* **71**:253–277.

- Dolkar, T., Sharma, M.K., Kumar A., Mir M.S., Hussain, S. (2017)** . Genetic variability and correlation studies in grapes (*Vitis vinifera* L.) in Leh District of Jammu and Kashmir. *Adv. Hort. Sci.* **31**(4): 241-247
- Dong Yi, Sun W., Yue Z., Gong B., Yang Xu, Wu K., and Xu Y. (2023)**. Phenotypic Diversity and Relationships of Fruit Traits in Persimmon (*Diospyros kaki* Thunb.). *Germplasm Resources Agriculture.* 13: 1804
- Gaikwad, K.A., Patil, S.R., Nagre, P.K., Potdukhe, N.R., Paithankar, D.H., Gahukar, S.J. and Umbarkar, P.S. 2017**. Correlation studies of different physic morphological characters in citrus rootstock genotypes with fruit yield under Vidarbha region. *International Journal of Chemical Studies.* **5**(4): 1421-1425
- Kevadiya, P. K. (2006)**. Variability, correlation and path analysis for yield and fruit characters in mango. M.Sc. (Agri.) thesis, *Anand Agricultural University, Anand.*
- Kumar P., Prakash Om, Srivastava A.K., Thakur N., Chugh V and Singh R. S., (2021a)**. Correlation Studies in Wood Apple (*Feronia limonia* L.) in Bundelkhand Region of Uttar Pradesh. *Ind. J. Pure App. Biosci.* **9**(1), 316-321
- Kumar, P., Srivastava A.K., Prakash Om, Thakur, N. and Singh P (2021b)**. Germplasm Survey, Collection and Evaluation of ber (*Ziziphus mauritiana* Lamk) under Bundelkhand Region of Uttar Pradesh. *Ind. J. Pure App. Biosci.* **9**(1), 259-266.
- Nissi F Godi, Vinayak R Joshi, Vinay S Supe (2016)**. Physical fruit characteristics assessment of selected Ber (*Zizyphus mauritiana* Lamk.) Genotypes. *Int J Appl Res;***2**(2):757-761.
- Panse VG, Sukhatme PV (1985)** . Statistical Methods for Agricultural workers, 2nd ed. New Delhi, ICAR. 1967, 99-116.
- Pareek, O.P. (2013)**. Fruit of the Future Ber. International centre for Underutilization crops, University of Southampton, Southampton UK.
- Patel, M.C., Patel, D.A., Patel, K.V., Soni, N.V., Satodiya, B.N. and Jadav R.G. (2016)**. Genetic variability and correlation studies for fruit yield and quality parameters in mango (L.) *Green Farming* **3**: 706-709.
- Patel, R.K., Maiti, C.S., Deka, C.B., Deshmukh, N.A., Verma, V.K. and Nath, A. (2015)**. Physical and biochemical change in guava during various stage of fruit growth and development. *Int.J. Agri. Environ. Biotech.* **8**(1):63-70.
- Rathod, B. P. (2007)**. Genetic variability, correlation, path coefficient and D analysis for morphological and biochemical parameters of mango fruit. M.Sc. (Agri.) thesis, Navsari

Agricultural University, Navsari.

**Sheikh, A. A., Kumar, R., Bakshi, P., Sharma, R., Reena, Kumar, V., Sharma, N., Raina, V and Sinha, B, K. (2023):** Genetic diversity analysis of loquat (*Eriobotrya japonica* Lind L.) Germplasm through morphological traits. *The Pharma Innovation Journal.*, **12**,5020-5026.

**Siddique I. M., Sharif N., Naseer M., Khan M. N, Noreen A. Asif M., Faiz H., Aslam K. And Mehreen N. (2022).** A morpo-biochemical perspective on sixteen promising sweet orange (*citrus sinensis* (l.) osbeck) cultivars *Plant Cell Biotechnology and Molecular Biology* 23(13&14):69-87.

**Singh S. K., Singh A., Nath V., Parthasarathy VA., Sthapit B., Rajan .,S and Vinoth., (2015).** Genetic Diversity in Seedling Populations of Mango. *Indian J. Plant Genet. Resour.* 28(1): 123-131.

**Tatari, M., Ghasemi, A. and Mousavi, A. (2016).** Genetic diversity in Jujube germplasm (*Ziziphus jujuba* Mill.) based on morphological and pomological traits in Isfahan province, Iran. *Crop Breeding Journal.* **4, 5 and 6** (2; 1 and 2): 79-85.

**Verma, S.K., Singh, R.K. and Arya, P.R. (2002).** Variability and correlation studies in strawberry germplasm for quotatives traits. *Indian J. Hort.* **59**(1):39-43.

**Wangchu LD. Singh, Mitra S.K., (2013).** Studies on the diversity and selection of superior types in jackfruit (*Artocarpus heterophyllus* Lam.). *Genet. Resour. Crop Evol.*; 60:1749-1762.

**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)
<b>Fruit weight</b>		0.617* *	0.853 **	0.092	0.794 **	0.626* *	0.440 *	0.179	0.092 2	0.966 **	0.817* *	0.774 **	0.725* *	0.981* *	0.680* *	0.782* *	0.960 **	0.279
<b>Length of Fruit</b>			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**
<b>Width of Fruit (cm.)</b>				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
<b>Leaf Length (cm.)</b>					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
<b>Leaf Width (cm.)</b>						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**
<b>Stone Weight (g.)</b>							0.584 **	0.487 *	0.286	0.397 *	0.455* *	0.539 **	0.772* *	0.122	0.217	0.662* *	0.225	0.115
<b>Stone length (cm.)</b>								0.076	0.803 **	0.042	0.417* *	0.425 *	0.605* *	0.813* *	0.835* *	0.399* *	0.745 **	0.664**
<b>Stone Width (cm.)</b>									0.628 **	0.079	0.734* *	0.765 **	0.892* *	0.727* *	0.503* *	0.453* *	0.897 **	0.685**
<b>Hight of Tree (m.)</b>										0.406 *	0.154	0.364	0.792* *	0.832* *	0.747* *	0.230	0.352	0.400*
<b>Stem girth (cm.)</b>											0.261	0.855 **	0.310	0.453* *	0.812* *	0.350	0.658 **	0.161
<b>Specific gravity</b>												0.547 **	0.702* *	0.728* *	0.222	0.488* *	0.841 **	0.942**
<b>TSS (Brix)</b>													0.051	0.000	0.048	0.787* *	0.249	0.017
<b>Acidity (%)</b>														0.000	0.268	0.170	0.584 **	0.254
<b>TSS/ Acidity ratio</b>															0.410* *	0.221	0.387	0.009
<b>Reducing sugar</b>																0.002	0.00	0.245
<b>Non reducing sugar (%)</b>																	0.00	0.064
<b>Total Sugar (%)</b>																		0.071

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