Original Research Article

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

Abstract

The present investigation was carried out in thirty genotype of ber at department of Fruit Science, college of Horticulture, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur (UP) during 2021-22 to 2022-23. Phenotypic correlations were worked out among eighteen characters of ber to know the nature of association existing among the characters. Correlation among the quantitative characters was worked out. 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*). 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*). 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**).

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**).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**).Ascorbic acid has showed significant positive correlations with lenght 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**).

Keywords: Ber, Correlation Coefficient, Variability, Character Asoociation.

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, U.P, Gujarat, M.P., 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 and carbohydrates and exceeds them in calorific value (*Nissi and Vinayak,* 2016).

Materials and Method

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 Utter 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 recomended techniques.

Results and Discussion

Phenotypic correlations were worked out among 40 characters of ber to know the nature of association existing among the characters. The results are presented and pertaining to correlation at phenotypic levels between fruit weight and other related characters are presented 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.* (2020) Kumar *et al.* (2021) Siddique *et al.* (2022) Panthor *at. al.* (2023) Dong *et. al.* (2023) Ahmad *et. al.* (2023)

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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 withfruit 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.* (2021) Siddique *et al.* (2022) Sheikh *at. al.* (2023) Panthor *at. 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.* (2021) Kumar *et al.* (2021) Siddique *et al.* (2022) Sheikh *at. al.* (2023) Panthor *at. 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 lenght 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.* (2021) Kumar *et al.* (2021) Siddique *et al.* (2022) Sheikh *at. al.* (2023) Panthor *at. 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 lenght of fruit, leaf width, stone length, stone width, Hight of tree, specific gravity.

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table 1 : Result of Corrilation analysis

	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 (g/cm3)	TSS (Brix)	Acidity (%)	TSS/ Acidity ratio	Reducing sugar (%)	Non reducing sugar (%)	Total Sugar (%)	Ascorbic Acid (mg/100g)
Fruit weight(g.)		0.743**	0.844**	0.109	0.818**	0.446*	0.519**	0.164	0.110	0.967**	0.856**	0.821**	0.466*	0.877**	0.623**	0.974**	0.628**	0.285
Length of Fruit (cm.)			0.149	0.324	0.846**	0.294	0.014	0.140	0.788**	0.185	0.095	0.138	0.606**	0.459*	0.334	0.679**	0.940**	0.767**
Width of Fruit (cm.)				0.318	0.473*	0.859**	0.015	0.171	0.291	0.526**	0.064	0.135	0.765**	0.827**	0.117	0.430*	0.048	0.336
Leaf Length (cm.)					0.341	0.140	0.301	0.524**	0.348	0.631**	0.589**	0.572**	0.683**	0.974**	0.036	0.340	0.404*	0.048
Leaf Width (cm.)						0.363	0.420*	0.575**	0.251	0.089	0.593**	0.947**	0.897**	0.753**	0.914**	0.649**	0.859**	0.653**
Stone Weight (g.)							0.600**	0.710**	0.442*	0.624**	0.586**	0.568**	0.513**	0.168	0.208	0.675**	0.291	0.104
Stone length (cm.)								0.141	0.649**	0.043	0.810**	0.255	0.755**	0.794**	0.808**	0.218	0.296	0.676**
Stone Width (cm.)									0.471*	0.103	0.664**	0.961**	0.599**	0.976**	0.878**	0.146	0.551**	0.716**
Hight of Tree (m.)										0.384	0.251	0.322	0.978**	0.920**	0.924**	0.478*	0.582**	0.300
Stem girth (cm.)											0.214	0.821**	0.261	0.420*	0.832**	0.322	0.521**	0.171
Specific gravity (g/cm3)												0.787**	0.951**	0.576**	0.282	0.533**	0.759**	0.992
TSS (Brix)													0.045	0.000	0.049	0.923**	0.177	0.018
Acidity (%)														0.000	0.231	0.270	0.251	0.550**
TSS/ Acidity ratio															0.338	0.188	0.284	0.014
Reducing sugar (%)																0.002	0.000	0.243
Non reducing sugar (%)																	0.000	0.077
Total Sugar (%)																		0.076

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

table 2 : Corrilation analysis 2022-2023

	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 (g/cm3)	TSS (Brix)	Acidity (%)	TSS/ Acidity ratio	Reducing sugar (%)	Non reducing sugar (%)	Total Sugar (%)	Ascorbic Acid (mg/100g)
Fruit weight(g.)		0.538**	0.876**	0.090	0.675**	0.834**	0.374	0.236	0.093	0.966**	0.729**	0.734**	0.485*	0.922**	0.744**	0.571**	0.708**	0.276
Length of Fruit (cm.)			0.541**	0.671**	0.023	0.327	0.000	0.126	0.494*	0.162	0.077	0.223	0.582**	0.491*	0.070	0.672**	0.117	0.884**
Width of Fruit (cm.)				0.337	0.241	0.898**	0.184	0.333	0.333	0.485*	0.073	0.008	0.549**	0.658**	0.041	0.681**	0.241	0.085
Leaf Length (cm.)					0.685**	0.180	0.576**	0.369	0.463*	0.674**	0.666**	0.750**	0.765**	0.764**	0.075	0.222	0.708**	0.091
Leaf Width (cm.)						0.893**	0.333	0.722**	0.873**	0.232	0.182	0.629**	0.568**	0.406*	0.440*	0.146	0.420*	0.866**
Stone Weight (g.)							0.672**	0.401*	0.177	0.223	0.405*	0.492*	0.140	0.114	0.245	0.679**	0.248	0.131
Stone length (cm.)								0.043	0.991**	0.081	0.141	0.771**	0.028	0.431*	0.346	0.939**	0.407*	0.665**
Stone Width (cm.)									0.828**	0.085	0.778**	0.537**	0.487*	0.534**	0.307	0.794**	0.407*	0.709**
Hight of Tree (m.)										0.474*	0.133	0.440*	0.397*	0.796**	0.506**	0.108	0.157	0.545**
Stem girth (cm.)											0.294	0.890**	0.782**	0.496*	0.797**	0.398*	0.803**	0.152
Specific gravity (g/cm3)												0.385	0.346	0.704**	0.180	0.486*	0.874**	0.961**
TSS (Brix)													0.548**	0.000	0.048	0.665**	0.369	0.015
Acidity (%)														0.000	0.878**	0.178	0.301	0.076
TSS/ Acidity ratio															0.528**	0.270	0.421	0.006
Reducing sugar (%)																0.001	0.000	0.251
Non reducing sugar (%)																	0.000	0.058
Total Sugar (%)																		0.078

	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.)	High t of Tree (m.)	Stem girth (cm.)	Specifi c gravity	TSS (Brix)	Acidity (%)	TSS/ Acidity ratio	Reduci ng sugar (%)	Non reducin g sugar (%)	Total Suga r (%)	Ascorbi c Acid (mg/100 g)

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

table 3 : Pooled Corrilation analysis

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) **