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Morphological and Phenological Variability of Ber Genotypes under Semi-Arid Conditions in Haryana, India

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ABSTRACT

The study on morphological variability in fruiting characteristics of ber genotypes was conducted at the experimental orchard of CCS Haryana Agricultural University Regional Research Station, Bawal. In this study sixteen genotypes were planted in a randomized block design were grown under uniform agronomic practices and evaluated for variability. Different genotypes showed considerable variation in morphological parameters. The shortest time taken from fruit setting to fruit maturity (118.7 days) was observed in Gola, which was statistically at par with Kaithali (121.3 days) and the maximum time taken from fruit setting to fruit maturity (152.0 days) was reported in Bawal Sel-1. The maturity period of Gola, Goma Kriti and Kakrola Gola was observed early, whereas Umran, Bawal Sel-1, Bawal Sel-2 and Katha Phal had late-maturing fruit. Remaining fruit of eight genotypes (Kaithali, Chhuhara, Thar Sevika, Thar Bhubraj, Narendra Ber Sel-1, Narendra Ber Sel-2, Rohtak Safeda, Mudia Murhara and Illaichi) were maturing in mid of season. The longest fruit (40.99 mm) was recorded in Narendra Ber Sel-1, followed by Chhuhara (38.86 mm), Mudia Murhara (38.03 mm) and Umran (37.22 mm), whereas the minimum fruit length (20.34 mm) was reported in Illaichi. The Narendra Ber Sel-1 had the maximum fruit diameter i.e., 38.90 mm, which was followed by Bawal Sel-2 (29.26 mm) and Bawal Sel-1 (28.85 mm). The minimum fruit diameter (17.57 mm) was recorded in Illaichi. Maximum fruit weight of 37.69 g was recorded in Narendra Ber Sel-1, followed by Umran (26.37 g) and Narendra Ber Sel-2 (26.05 g). In contrast, the lowest fruit weight of 6.05 g was observed in Illaichi. Maximum stone length (28.88 mm) and stone diameter (11.44 mm) were recorded in Chhuhara, while stone weight (1.47 g) was recorded maximum in Narendra Ber Sel-1 whereas minimum stone length (11.94 mm), stone diameter (5.01 mm) and stone weight (0.58 g) were recorded in Illaichi. Maximum pulp/stone ratio (26.64) was noted in Narendra Ber Sel-2, followed by Narendra Ber Sel-1 (24.64) and Kaithali (24.53).

Keywords: Genotypes, Indian jujube, pulp stone ratio, fruit size, fruit shape, stone size

Introduction

The Indian ber (*Ziziphus mauritiana* Lamk.) is one of the most ancient and important underutilized fruit crops indigenous to India. It belongs to the family Rhamnaceae and has a chromosome number 2n=48 (Srinivasan, 1952). Ber is believed to an originated in the Indian subcontinent and extended to Malaya, includes parts of south-western China (Vavilov, 1951; Hu et al., 2010). The genus *Ziziphus* encompasses about 170 species of spiny shrubs and small trees distributed across warm-temperate and subtropical regions worldwide (Islam and Simmons, 2006). It is commonly known as Indian jujube, Chinese date, Chinese fig, and 'poor man's fruit' as it is easily available among the poor (Kumari et al., 2016). It is also designated as the "King of Arid Fruits" owing to the facts that it can

be successfully grown in barren land or marginal soil in arid and semi-arid regions, it holds considerable economic value.

Nutritionally, the ripe fruit surpasses apples in protein, calcium, phosphorus, carotene and vitamin C content (Godi and Joshi, 2016), providing 20.9 kcal per 100 g pulp. Antioxidants and phenolic compounds such as p-coumaric acid, ferulic acid, caffeic acid and p-hydroxybenzoic acid are also found in its leaves, fruits and seeds (Koley et al., 2011; Krishna and Parashar, 2013; Okala et al., 2014 and Gupta, 2018).

In India, ber occupies an area of about 48000 hectares, with an annual production of nearly 512000 metric tons. Globally, India is the second largest producer of ber after, China (Anonymous, 2024). The breeding programmes of plants need suitable genetic variation. Evaluation of genetic variability is essential for efficient application in breeding. Genetic diversity is investigated using several methods, among which morphological characterization is the most powerful method for breeders to identify genotypes with desired traits (Jannatabadi et al., 2014; Khadivi-Khub et al., 2014).

This crop holds immense potential for improvement, offering ample opportunities to enhance its productivity and adaptability but it remained neglected for a long time. Screening diverse genotypes can facilitate the identification of superior traits, such as higher yield, improved quality, and increased resistance to abiotic and biotic stresses.

Previous studies consistently demonstrate substantial genotypic variability in fruit physical, morphological, and yield traits of *Ziziphus mauritiana* across diverse agro-climatic regions, with wide ranges reported for fruit weight, size, pulp-to-stone ratio, and yield (Abdel-Sattar et al., 2021; Das et al., 2022; Rai et al., 2022; Rajadurai et al., 2022; Nikmatullah et al., 2023; Vikalp et al., 2023). Notably, several cultivars and germplasm lines have been identified for respective growing conditions for selection and genetic improvement in ber.

Although several studies have documented variability in fruit physical traits and yield attributes of *Ziziphus mauritiana* across different agro-climatic regions, systematic evaluations integrating both morphological and phenological traits under the semi-arid conditions of Haryana remain limited. In view of the above, the present study was undertaken to assess the extent of morphological and phenological variability among ber genotypes under semi-arid conditions of Haryana with the aim to identify superior and early-maturing genotypes suitable for cultivation and future improvement programmes in semi-arid regions.

Materials and Methods

The investigation was carried out at the experimental orchard of CCS Haryana Agricultural University, Regional Research Station, Bawal. The location lies in the south-west part of Haryana at an elevation of 266 meters above sea level, with geographic coordinates of 28° 10' N latitude and 76° 50' E longitude. Summers in Bawal are unforgivingly hot, often soaring above 45°C, while winters dip below freezing. May and June are typically the hottest months, while December and January are the coldest. The region receives an average annual rainfall of 456 mm. Of this, around 80-85 per cent is received during the monsoon season, while the remaining rainfall occurs as light showers from December to February.

Plant Material: In total sixteen genotypes viz., Gola, Umran, Kaithali, Chhuhara, Goma Kirti, Thar Sevika, Thar Bhubharaj, Narendra Ber Selection-1, Narendra Ber Selection-2, BS-1, BS-2, Kakrola Gola, Rohtak Safeda, Katha Phal, Mudia Murhara, Illaichi, planted in a randomized block design, were used for the study. All genotypes were maintained under similar agronomic practices during the study period.

Phenological and Morphological Parameters: Time taken from fruit setting to fruit maturity (days) was calculated by adding up the number of days taken from the date of 50 per cent fruit set to the date of 50 per cent fruit maturity on the tagged branches. Maturity refers to the point at which the fruits attain maximum size and start ripening or turning yellowish with a brownish tinge on the outer skin. The genotypes were classified into three maturity groups based on the maturity period of the fruits: early, mid, and late maturing. The fruits of genotypes that matured before February were classified as early maturing. Fruits that matured between the third week of February and the third week of March were classified as mid-maturing, whereas fruits that matured after the second week of March until April were classified as late-maturing.

Fruit length was measured from the distal to proximal ends, while fruit diameter was measured at its widest point, which is usually the middle or equatorial region of the fruit, using a digital vernier caliper. The average values were calculated for all replications. The weight of twenty fruits from each quarter of the plant was measured with the help of a digital electronic weighing balance (AND EK-6100V) at the ripening stage and the average weight of fruit was calculated and expressed in grams (g). The length and diameter of the stones were measured with the help of digital vernier caliper. The length of the stone was measured as distance from apex to base, and the diameter of the stone was measured at its thickest region.

The extracted stones were also used to determine stone weight. The pulp, which was separated from the fruits during stone weight calculation, was weighed separately. The weight of the pulp was divided by the weight of the stone to estimate the pulp-to-stone ratio.

Statistical Analysis: The statistical analysis of data was done using the software R, MS excel and OPStat. The level of significance between genotypes was estimated with the help of critical difference.

Results and Discussion

Time taken from fruit setting to fruit maturity (days)

The genotypes showed considerable variation in time taken from fruit setting to fruit maturity (Table 1). Time taken from fruit set to fruit maturity ranged from 117.3 days to 151.7 days and 120.0 days to 152.3 days during 2022-23 and 2023-24, respectively. During both years, the minimum duration from fruit setting to fruit maturity (117.3 days and 120.0 days) was recorded in Gola, which was statistically at par with Kaithali (120.3 days and 122.3 days), while the maximum duration was observed in Bawal Sel-1 (151.7 days and 152.3 days).

Mean data analysis revealed that the minimum duration from fruit setting to fruit maturity (118.7 days) was observed in Gola, which was statistically at par with Kaithali (121.3 days), whereas the maximum was observed was in Bawal Sel-1(152.0 days). These results are in agreement with the findings of Tarai and Ghosh (2010), Sharif et al. (2013), Choudhary et al. (2017) and Hardeep et al. (2022) in ber. Kumari et al. (2016) reported that under rainfed conditions of Jammu, Gola took 180 days from fruit setting to fruit maturity and Ranjari Selection-2 took 205 days. Variation in the maturity period among cultivars across regions may be attributed to differences in agro-climatic conditions. Saran (2005) reported that environmental factors such as temperature, humidity and nutritional status along with genetic variability are key determinants responsible for variation in the time taken from fruit setting to fruit maturity among different germplasms.

Fruit length and diameter (mm)

The data presented in Table 2 indicate that fruit length varied from 21.21 mm to 40.03 mm and 19.47 mm to 41.95 mm among selected ber genotypes during the years 2022-23 and 2023-24, respectively. The maximum fruit length (40.03 mm) was recorded in Narendra Ber Sel-1, which was found statistically at par with Mudia Murhara (38.86 mm), while Illaichi (21.21 mm) had the shortest fruit during the year 2022-23. Similarly, during 2023-24, the maximum fruit length (41.95 mm) was recorded in Narendra Ber Sel-1, followed by Chhuhara (39.74 mm), Bawal Sel-1 (38.42 mm) and Umran (37.25 mm), while the minimum fruit length (19.47 mm) was observed in Illaichi. Mean data of both years revealed that the longest fruit (40.99 mm) was recorded in Narendra Ber Sel-1, followed by Chhuhara (38.86 mm), Mudia Murhara (38.03 mm) and Umran (37.22 mm), whereas the minimum fruit length (20.34 mm) was reported in Illaichi.

Fruit diameter among different genotypes varied from 18.03 mm to 38.73 mm and 17.13 mm to 39.07 mm during the years 2022-23 and 2023-24, respectively (Table 2). The maximum fruit diameter (38.73 mm and 39.07 mm) was recorded in Narendra Ber Sel-1, followed by Bawal Sel-1 (29.45 mm and 28.24 mm) and Narendra Ber Sel-2 (28.53 mm and 29.00 mm), whereas the minimum fruit diameter (18.03 mm and 17.13 mm) was recorded in Illaichi in both years. Mean data of both years revealed represented that Narendra Ber Sel-1 had maximum fruit diameter (38.90 mm), followed by Bawal Sel-2 (29.26 mm) and Bawal Sel-1 (28.85 mm), while the minimum fruit diameter (17.57 mm) was recorded in Illaichi.

Flora et al. (2015) also reported maximum fruit length in Narendra Ber Sel-1 (48 mm) under Rahuri conditions. Similarly, Singh et al. (2015) in eastern Uttar Pradesh, Kumar et al. (2017) in West Bengal conditions and Gupta (2018) in Punjab conditions also reported minimum fruit length in Illaichi. Overall, the maximum fruit diameter (38.90 mm) was observed in Narendra Ber Sel-1, followed by Bawal Sel-2 (29.26 mm) and Bawal Sel-1 (28.85 mm). The minimum fruit diameter (17.58 mm) was recorded in Illaichi. The variation in fruit length and diameter among different genotypes may primarily result from the inherent genetic traits of each genotype. However, these traits can also be influenced to some extent by environmental factors, such as climate, which may alter growth conditions (Saran, 2005). The variation in fruit size can be attributed to the accumulation of food materials within the fruit during its growth (Kumari et al., 2016). The length and width of the fruit were important traits for breeders, as these parameters directly influence the fruit's marketability and suitability for fresh consumption. Additionally, fruit size-related traits are important for logistical considerations such as packaging and shipping. Larger and more uniform fruits are easier to pack efficiently, reducing the risk of damage during transport and improving overall shipping efficiency. These characteristics are essential in the commercial production of fruits like ber, where uniformity in size can also enhance consumer appeal (Liu et al., 2009).

Fruit weight (g)

The data presented in Table 2 indicates that the fruit weight among different genotypes ranged from 6.11 g to 36.31 g during the year 2022-23 and 5.99 g to 39.06 g during 2023-24. During both years, the highest fruit weight (36.31 g and 39.06 g) was recorded in Narendra Ber Sel-1, followed by Narendra Ber Sel-2 (26.36 g and 25.73 g) and Umran (25.47 g and 27.27 g). Conversely, the lowest fruit weight (6.11 g and 5.99 g) was consistently observed in Illaichi during both years. The mean data across both years revealed that Narendra Ber Sel-1 exhibited the maximum fruit weight of 37.69 g, followed by Umran (26.37 g) and Narendra Ber Sel-2 (26.05 g). In contrast, the lowest fruit weight of 6.05 g was observed in Illaichi.

Tarai and Ghosh (2010) also reported the minimum fruit weight in Illaichi under West Bengal conditions. Similar variations in ber fruit characteristics were also recorded by Singh et al. (2015), Godi et al. (2016), Sharif et al. (2019), Singh et al. (2019), Yadav et al. (2020), Das et al. (2022), Rai et al. (2022), Rajadurai et al. (2022) and Singh and Deen (2022). Fruit weight is a crucial parameter in the evaluation and selection of promising cultivars, as it directly influences yield and quality. The variation in fruit weight may be attributed to a longer fruit retention period on the plant, which allows extended time for growth and ripening. Additionally, the increased uptake of nutrients and water, coupled with the efficient translocation of photosynthates from the source (leaves) to the sink (fruits), likely contributed to the enhanced development and weight gain of the fruits (Patel et al., 1977). These factors collectively enhance the accumulation of dry matter and other essential compounds in the fruits, promoting their growth and quality. Umbreen et al. (2018) reported that variation in fruit weight might be due to agro-climatic conditions of the growing region, the genetic makeup of the genotype, and the availability of nutrients to the plant. These factors collectively impact fruit development, particularly in terms of its length and width. Climatic conditions like temperature, humidity, and light directly affect physiological processes, while genetic traits determine the inherent potential for fruit size. Nutrient supply further enhances growth by providing essential elements needed for cell expansion and overall fruit development. Genotypes with larger fruit sizes and higher weights are ideal for breeding programs focused on fresh fruit production, as they offer the potential for higher yields and better market appeal.

Fruit maturity

Fruits of genotypes Gola, Goma Kriti and Kakrola Gola matured early, while late maturity was observed in Umran, Rohtak Safeda, Bawal Sel-1, Bawal Sel-2 and Katha Phal. Remaining eight genotypes (Chhuhara, Kaithali, Thar Sevika, Thar Bhubraj, Narendra Ber Sel-1, Narendra Ber Sel-2, Mudia Murhara and Illaichi) matured in mid-season. Similar observations with respect to fruit maturity in ber were reported by Saran et al. (2006), Godi et al. (2016), Krishna et al. (2016), Adhikary et al. (2019) and Kumari et al. (2024). These variations in fruit maturity may be attributed to climatic factors such as temperature and rainfall, as well as the genetic constitution of the germplasm (Godi et al., 2016).

Stone characteristics and pulp-to-stone ratio

The data on various stone parameters revealed significant variation among the genotypes. The minimum stone length (11.94 mm) was observed in Illaichi, succeeded by Kakrola Gola (18.94 mm) and Gola (19.55 mm) and the maximum stone length (28.88 mm) was found in Chhuhara. The genotype Illaichi had the minimum stone diameter (5.01 mm), succeeded by Goma Kriti (7.07 mm), Kaithali (7.14 mm) and Mudia Murhara (7.49 mm) and the maximum stone diameter (11.44 mm) was found in Narendra Ber Sel-1. Stone weight was recorded as the minimum (0.58 g) in Illaichi, succeeded by Goma Kriti (0.81 g) and Kaithali (0.86 g) whereas the maximum stone weight (1.47 g) was reported in Narendra Ber Sel-1. Further, maximum pulp/stone ratio (26.64) was noted in Narendra Ber Sel-2, followed by Narendra Ber Sel-1 (24.64) and Kaithali (24.53). The minimum pulp/stone ratio (9.53) was recorded in Illaichi. Similar results regarding minimum stone length in ber were reported by Gupta (2018). The findings of the present study align with those of Singh et al. (2019), who reported that the genotypes displayed a broad range of diversity in various morphological traits. Similar variations in stone characteristics among different ber germplasm were reported by Sathyanarayana et al. (2010), Godi et al. (2016), Gupta (2018), Abdel-Sattar et al. (2021) and Rai et al. (2022). This variability in stone adherence across different ber genotypes may be attributed to a combination of factors, including the genetic makeup of the genotypes, environmental conditions, cultivation practices and positioning of the fruit. These factors collectively impact the size, shape, and weight of the stones. Such variabilities are critical for selecting superior genotypes with desirable traits for breeding and improvement programs (Gupta, 2018).

There is mix correlation between different parameters some parameters have weak while other have moderate and strong correlation. The colour in the correlogram indicate that the greenish colour has positive correlation, greener more positive correlation,

as the colour become lighter the correlation becomes weaker. None of the correlation is showed saffron colour correlogram means no negative correlation between parameters. Strong positive correlation were observed between stone length with fruit length, fruit diameter with fruit length and stone diameter, stone diameter with stone weight and fruit length, and stone weight with fruit weight. As per Fig. 1 none of the correlation is negatively correlated with the other studied parameter. In this figure, the values above 0.80 has very strong correlation, and values 0.60 to 0.79 has strong correlation.

Conclusions

This study was planned to identify suitable genotypes with higher consumers acceptability and potential for inclusion in breeding programme. Variability in the measured parameters was observed among the different genotypes. However, this variability showed varying degree of correlation with other traits. The physical or visual variation is one of the most important criteria for breeders when selecting genotypes for a breeding programme. Therefore, greater emphasis was placed on physical parameters in the present study.

Table 1. Time taken from fruit set to maturity (days), fruit maturity group and pulp to stone ratio of different ber genotypes under semi-arid conditions of Haryana.

Genotypes	Time taken from fruit set to maturity (days)			Fruit maturity group	Pulp to stone ratio		
	2022-23	2023-24	Mean		2022-23	2023-24	Mean
Gola	117.3	120.0	118.7	Early	21.27	20.97	21.12
Umran	143.7	145.3	144.5	Late	18.60	20.30	19.45
Kaithali	120.3	122.3	121.3	Mid	24.09	24.97	24.53
Chuhhara	132.7	130.7	131.7	Mid	17.77	15.96	16.87
Goma Kriti	122.3	124.7	123.5	Early	21.99	21.19	21.59
Thar Sevika	130.7	129.7	130.2	Mid	19.06	18.86	18.96
Thar Bhubraj	131.7	132.7	132.2	Mid	23.56	23.08	23.32
Narendra Ber Sel-1	136.0	134.3	135.2	Mid	24.11	25.16	24.64
Narendra Ber Sel-2	132.7	132.0	132.3	Mid	27.48	25.80	26.64
Rohtak Safeda	131.0	130.0	130.5	Late	17.31	15.61	16.46
Bawal Sel-1	151.7	152.3	152.0	Late	16.75	15.32	16.04
Bawal Sel-2	146.3	145.3	145.8	Late	18.26	16.60	17.43
Kakrola Gola	126.3	127.7	127.0	Early	17.94	18.44	18.19
Mudia Murhara	135.0	134.3	134.7	Mid	22.34	22.64	22.49
Katha Phal	148.7	151.7	150.2	Late	16.98	15.35	16.16
Illaichi	135.7	133.0	134.3	Mid	10.18	8.89	9.53
Range	**117.3-151.7**	**120.0-152.3**	**118.7 - 152.0**		**10.18-27.48**	**8.89-25.80**	**9.53-26.64**
C.D (p = 0.05)	**3.1**	**3.6**	**2.9**		**1.75**	**1.39**	**1.12**

Table 2. Length, diameter and weight of fruit of different ber genotypes under semi-arid conditions of Haryana.

Genotypes	Length of fruit (mm)			Diameter of fruit (mm)			Weight of fruit (g)		
	2022-23	2023-24	Mean	2022-23	2023-24	Mean	2022-23	2023-24	Mean
Gola	32.70	30.65	31.67	28.16	27.45	27.80	23.73	24.75	24.24
Umran	37.18	37.25	37.21	27.17	26.04	26.60	25.47	27.27	26.37
Kaithali	33.87	31.22	32.54	24.24	23.52	23.88	21.25	22.49	21.87
Chhuhara	37.98	39.74	38.86	23.08	22.63	22.86	18.77	17.78	18.27
Goma Kriti	31.58	32.90	32.24	22.49	23.28	22.88	17.94	18.63	18.29
Thar Sevika	35.82	36.99	36.40	24.67	24.34	24.50	23.11	23.97	23.54
Thar Bhubraj	35.06	34.31	34.68	23.89	24.21	24.05	22.43	21.83	22.13
Narendra Ber Sel-1	40.03	41.95	40.99	38.73	39.07	38.90	36.31	39.06	37.69
Narendra Ber Sel-2	36.24	34.90	35.57	28.53	29.00	28.77	26.36	25.73	26.04
Rohtak Safeda	29.30	29.20	29.25	26.96	25.51	26.24	24.66	23.36	24.01
Bawal Sel-1	35.44	38.42	36.93	29.45	28.24	28.84	19.42	17.50	18.46
Bawal Sel-2	34.73	36.67	35.70	28.40	30.12	29.26	20.29	19.36	19.82
Kakrola Gola	30.61	27.97	29.29	26.55	25.03	25.79	24.94	25.49	25.21
Mudia Murhara	38.86	37.19	38.03	25.33	24.70	25.02	22.71	24.12	23.41
Katha Phal	29.72	31.42	30.57	27.51	28.06	27.78	21.58	20.37	20.97
Illaichi	21.21	19.47	20.34	18.03	17.13	17.57	6.11	5.99	6.05
Range	**21.21 - 40.03**	**19.47 - 41.95**	**20.34 - 40.99**	**18.03 - 38.73**	**17.13 - 39.07**	**17.58 - 38.90**	**6.11 - 36.31**	**5.99 - 39.06**	**6.05 - 37.69**
C.D (p = 0.05)	**1.92**	**1.52**	**1.29**	**1.28**	**1.48**	**0.97**	**1.62**	**1.35**	**1.07**

Table 3. Stone parameters of different ber genotypes under semi-arid conditions of Haryana.

Genotypes	Length of stone (mm)			Diameter of stone (mm)			Weight of stone (g)		
	2022-23	2023-24	Mean	2022-23	2023-24	Mean	2022-23	2023-24	Mean
Gola	19.24	19.85	19.54	9.45	9.90	9.67	1.12	1.16	1.14
Umran	24.19	25.48	24.84	8.40	8.20	8.30	1.30	1.28	1.29
Kaithali	23.59	24.30	23.95	7.21	7.07	7.14	0.85	0.87	0.86
Chhuhara	28.47	29.28	28.88	7.92	7.72	7.82	1.00	1.05	1.02
Goma Kriti	22.90	23.43	23.16	7.11	7.02	7.06	0.78	0.84	0.81
Thar Sevika	27.54	26.73	27.13	8.78	8.48	8.63	1.15	1.21	1.18
Thar Bhubraj	23.82	22.65	23.24	8.08	7.82	7.95	0.91	0.91	0.91
Narendra Ber Sel-1	23.20	23.87	23.54	11.33	11.55	11.44	1.45	1.49	1.47
Narendra Ber Sel-2	20.17	20.25	20.21	8.48	8.86	8.67	0.93	0.96	0.94
Rohtak Safeda	19.54	20.87	20.21	10.71	10.58	10.65	1.35	1.41	1.38
Bawal Sel-1	26.47	25.79	26.13	9.80	9.61	9.70	1.09	1.07	1.08
Bawal Sel-2	20.48	21.72	21.10	9.02	9.29	9.16	1.05	1.10	1.08
Kakrola Gola	18.62	19.25	18.94	10.13	10.34	10.24	1.25	1.27	1.26
Mudia Murhara	27.76	28.66	28.21	7.64	7.33	7.48	0.97	1.02	1.00
Katha Phal	19.97	20.19	20.08	11.06	10.84	10.95	1.20	1.25	1.22
Illaichi	11.27	12.60	11.94	5.05	4.97	5.01	0.55	0.61	0.58
Range	**11.27 - 28.47**	**12.60 - 29.28**	**11.94-**	**5.05-**	**4.97-**	**5.01-**	**0.55 - 1.45**	**0.61 - 1.49**	**0.58 - 1.47**
C.D (p = 0.05)	**1.27**	**1.48**	**1.07**	**0.89**	**0.93**	**0.62**	**0.04**	**0.04**	**0.03**

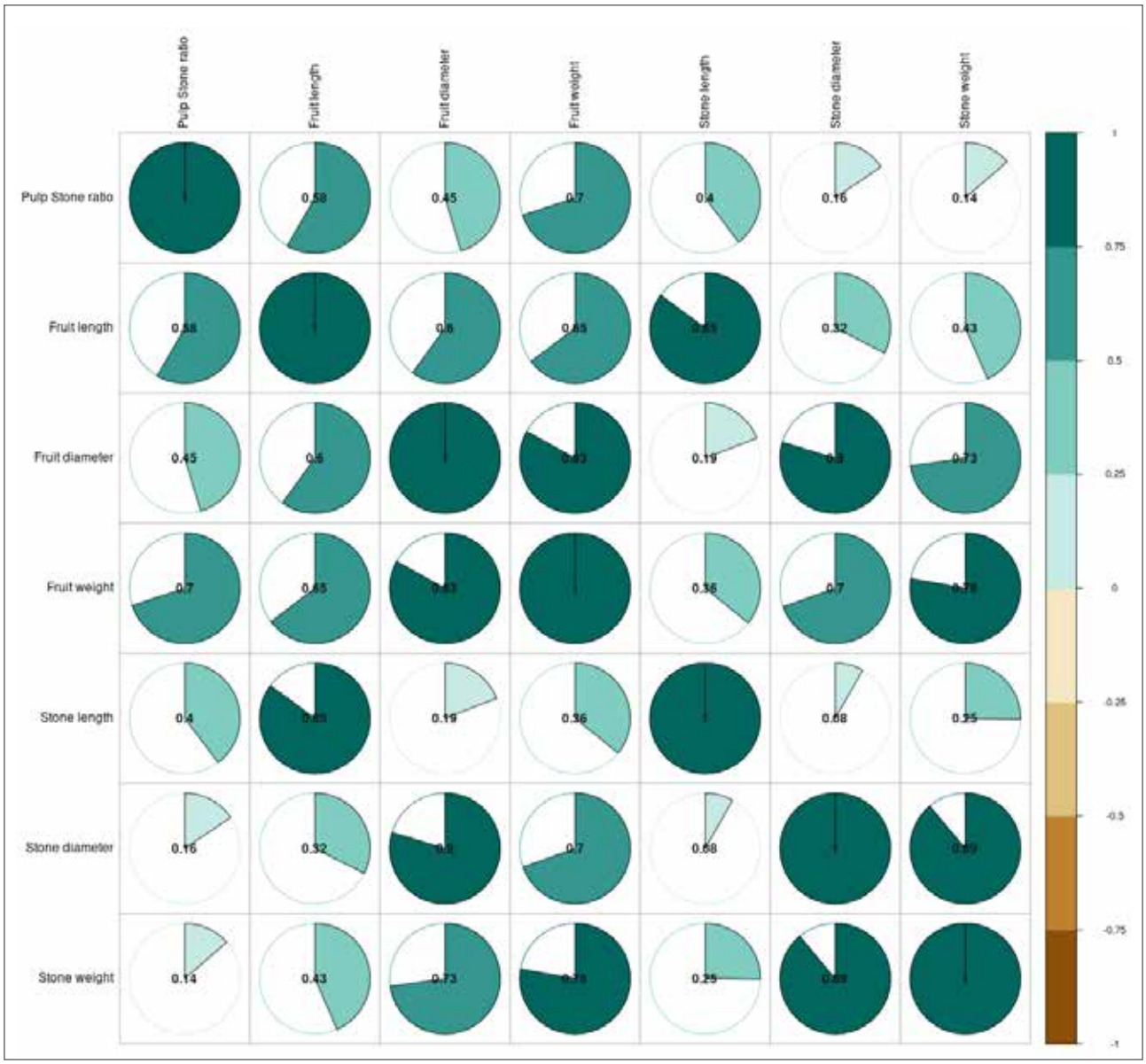

Figure 1. Correlogram between different parameters.

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