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Genetic Variability of Ker (*Capparis deciduas*) Germplasm in Hot Arid Region of India

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Abstract: Ker (*Capparis deciduas*) is one of the important indigenous fruit crop locally known as Kair, Taiti, Karil, Teent found in gochars, rangeland and wastelands tracts of Rajasthan, Punjab, Haryana and Gujarat states in arid and semi-arid climatic regions. It is a multipurpose small woody perennial, much-branched, leafless with attractive pink to red veined flower during summer when temperature is very high (45°C or more). This multipurpose plant easily survives in drought, saline and poor nutrients soil ecological conditions. Its fruit has been used in vegetable, pickles and condiments since fruits are rich in proteins (8.6%), vitamin C (130 mg 100 g^{-1} fruit pulp) carbohydrates, fiber and minerals (Ca, and Fe). Its seeds are rich in oil (20.3%) of which 68.6% is unsaturated fatty acid. Immature green pea size stage dried fruit is an important ingredient of a traditional vegetable of Rajasthan known as 'Panchkutta'. Total 15 accessions are being maintained at Field Gene Bank of ICAR-NBPGR, Regional Station, Jodhpur which were evaluated in the present study based on morphological characters during 2020-21. Genetic variation was recorded on ripened fruit weight (2.5 to 13.8 g), fruit length (12.1 to 21.77 mm) and fruit width (10.30 to 19.7 mm). IC103393 was found promising in term of higher fruit weight (13.8 g) with pink color flower and IC103362 was found red veined flower color with medium fruit size (4 to 6 g) while round the year flowering reported from IC103395.

Key words: Germplasm, Ker, Flower color, Fruit weight, Arid.

Ker (*Capparis decidua* Forsk) belongs to the Capparidaceae family, and it is locally known as Kair, Karil, Teent, Della, and Neptiin. It is an indigenous, multipurpose small woody perennial much-branched, leafless bushy shrub widely grown without much care on farm boundaries, orans, gochars and wastelands tracts of arid and semi-arid regions (Meghwal and Tiwari, 2002). Its xerophytic characteristics, such as deep root system, scanty foliage, mucilaginous sap and tough conical spine, make it an ideal plant for stabilizing sand dunes and controlling soil erosion by wind during the hot desiccating summer in the Thar desert of western Rajasthan (Muthana, 1993 and Pareek 1978). However, it easily survives in desert conditions characterized by temperatures ranging from -8 to +48°C or more, drought, saline and poor nutrients soil ecological conditions (Vyas *et al.,* 2005). Prime reason for its tree's significance of ability to survive in regions where no other vegetation cannot grown in general, ker is naturally spread all over the Indian subcontinent but mostly available to the arid and semi-arid regions of western India, mainly in the Jaisalmer, Barmer, Bikaner, Jodhpur, Nagaur, Sikar and Pali districts of Rajasthan (Singh and Singh, 2011). It is also naturally occur in rangeland of Haryana, Gujarat and Punjab states of India. Ker is used in the community for its varied medicinal value in diabetes, rheumatism, hypertension, vomiting and inflammations and in curing cardiac troubles. Fruit is an important ingredient of a traditional vegetable of Rajasthan known as 'Panchkutta'. Its fruit is rich in proteins, carbohydrates, fiber and minerals (Ca, P and Fe). Since ker is available for a limited period, it is essential to process or preserve it for off season use, when other vegetables are scarce (Meena *et al*., 2022). This fruit species is facing the depletion of natural populations due to overexploitation, urbanization and agricultural reasons. There is high risk of genetic erosion; therefore, strategic technique for germplasm conservation is essential. Presently, NBPGR, Regional Station Jodhpur has conserved 15 accessions for improvement of this important desert

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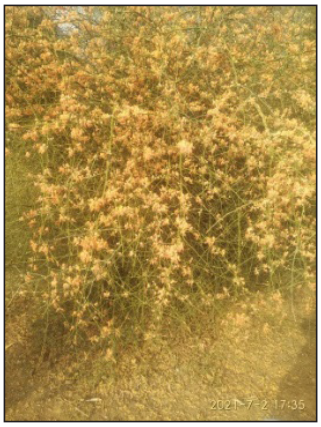
Flowering in IC103393

Higher fruit wt. in IC103393



IC103395 (Saffron color flower)

IC103362 (Red veined flower)

fruit species. Another cause of worry is the shorter storage duration as the seeds are either recalcitrant or are desiccation-sensitive. In this study an attempt has been made to evaluate all 15 diverse germplasm conserved at field gene bank of NBPGR, Regional Station Jodhpur for morphological as well as for qualitative and quantitative traits during 2020-21 and 2021-22. Considerable variability was found in term of morphological, biochemical and yield related attributes. Promising germplasm with distinctive traits such as flower color, fruit weight, fruit color, biochemical data have been generated which could be useful for improvement of yield and quality of this important arid fruit crop.

Materials and Methods

The experiment was carried out at the National Bureau of Plant Genetic Resources (NBPGR), Regional Station, Jodhpur (26°15′25.6″N, 73°00′01.9″E), India. Fifteen accessions, planted at 2 m × 2 m spacing, in randomized block design under rainfed conditions were used as experimental material. The plants with uniform canopy were selected in each accession. The fruit material was collected during two consecutive fruiting seasons in 2020-21 and 2021-22 for assessing the physical and biochemical properties.

The soil of experimental field was sandy loam with pH 7.95, organic carbon 0.25% and electrical conductivity 0.24 dS m^{-1}. Available macronutrients viz. phosphorous (47 kg ha^{-1}) and potassium (573.75 kg ha^{-1}) was in medium and high range, respectively. As a regular cultural practice, 10 kg well rotten farm-yard manure applied to tree basin and mixed at the onset of monsoon every year. Since ker bears fruits during April-May. All accessions were maintained under rainfed condition. Weeding and hoeing were performed during July to October as per the need. More than hundred fresh fruits with uniform size without signs of defect and visual injuries were harvested at proper maturity from all aspects of selected plants, out of which, twenty fruits were randomly selected for recording data on fruit physico-chemical characters during both the years. Twenty-two fruit related parameters that include 10 quantitative traits in all 15 genotypes, and 10 qualitative parameters determined in superior germplasm.

Table 1. Mean performance of 15 ker germplasm on yield contributing traits

IC/EC No.	Tree height (m)	Plant spread (m) E-W	Plant spread (m) N-S	Trunk girth (cm)	Fruit length (mm)	Fruit width (mm)	Fruit weight (g)	Mature fruit color	Fruits/ cluster	Fruits /plant	Yield/ plant (kg)
NIC 1990	2.5	0.8	0.7	20	15.30	15.10	3.89	Pink	2.3	256	5.630
NIC 1991	4.1	3.3	3.0	60	16.10	15.65	3.95	Pink	3.0	433	6.262
NIC 1993	5.6	3.2	2.7	80	12.10	10.35	4.12	Pink	2.2	130	1.085
NIC 638	1.2	0.7	0.8	23	15.66	12.50	2.52	Pink	2.1	230	5.200
IC 103046	1.6	0.5	0.7	25	16.55	13.60	2.72	Pink	2.2	225	4.750
IC 103119	3.9	3.1	2.9	71	19.59	19.08	5.56	Red	2.5	322	5.257
IC 103120	2.2	0.8	0.9	36	17.45	16.00	5.30	Red	2.0	280	5.120
IC 103319	5.2	4.3	3.1	78	15.40	16.59	3.74	Pink	3.5	427	5.123
IC 103362	3.2	2.8	2.5	29	19.50	16.23	4.07	Pink	3.2	329	3.803
IC 103364	3.2	3.2	2.8	43	17.26	12.97	2.54	Pink	3.0	339	9.281
IC 103390	6.1	3.3	4.2	60	19.11	19.70	5.83	Pink	2.9	403	12.605
IC 103391	4.6	2.7	3.1	41	16.60	16.53	3.98	Pink	3.0	351	3.571
IC 103393	5.5	3.4	3.2	65	21.77	19.52	13.80	Red	2.5	480	15.306
IC 103395	3.2	3.1	3.0	65	18.05	15.37	3.94	Red	2.9	400	14.782
IC 103399	2.3	2.0	1.9	29	15.69	13.26	2.98	Red	2.4	410	8.398
CD (0.05)	1.31	1.26	1.11	6.63	4.22	3.56	4.75		2.24	8.64	8.960
CV	16.08	19.85	19.32	8.03	12.22	9.88	14.74		12.26	19.32	15.190

Average fruit weight measured by electronic weighing machine whereas, fruits length, fruits width, measured with the help of hand held digital Vernier caliper. The total soluble solids recorded with the help of Erma hand refractometer (0-32°Brix). Ascorbic acid content was estimated by titration method (Ranganna, 1986) using 2, 6-dichlorophenol indophenol dye solution. Acidity was estimated by titration method (AOAC, 2000). The data were analyzed statistically for analysis of variance and standard error (Panse and Sukhatme, 1985); estimation of variability, heritability and genetic advance (Burton and DeVane, 1953), correlation.

Results and Discussion

Evaluation of the germplasm is primarily first step to collect basic information of respective taxon before initiating any further breeding programme for crop improvement through conventional or non-conventional method. Knowledge of the inter relationship of quantitative and qualitative traits of economic importance is very crucial for the improvement and utilization. In the present study, ker germplasm were evaluated for their morphological as well as genetic characteristics, and findings are discussed in this section. The ker germplasm evaluated in the present study showed the wide range of variability for all the quantitative and qualitative traits studied.

Table 1 indicates that adequate variability existed among morphological characters viz. tree height (1.2 to 6.1 feet), plant spread E-W (0.5 to 4.3 m), plant spread N-S (0.7 to 4.2 m), tree girth (20 to 80 mm), fruit weight (2.54 to 13.80 g), fruit length (12.10 to 21.77 mm) fruit width (10.35 to 19.70 mm), fruits/cluster (2.0 to 3.5) fruits/plant (130 to 480), yield (1.08 to 15.20 kg) respectively. It is apparent from the data given in table 1 that the fruit weight significantly influenced by different ker genotype during the period of study. IC103393 was found promising in term of higher fruit weight (13.8 g) with pink color flower and IC103362 found red veined flower color with medium fruit size (4 to 6 g) while round the year flowering reported from IC103395.

Phenotypic correlation coefficients, in general, were slightly higher in magnitude than of the corresponding genotypic correlation coefficients which indicate the apparent association of two traits is not only due to genes but also due to influence of environmental interactions. The meager differences revealed that the effect of the genotype is stronger than that of the environment (Table 2). Heritability values along with genetic advance as percentage of mean, together, are more useful tools for selection than either of them alone. In the present study, the trunk growth and plant spread showed high heritability along with low

Table 2. Estimates of variance and coefficient of variation in canopy related parameter in 15 ker genotypes

Parameters	Genotypic variance	Phenotypic variance	Environmental variance	Genotypic coefficient of variation	Phenotypic coefficient of variation
Tree height (m)	3.98	4.60	0.61	40.97	44.01
Trunk girth (cm)	458.82	474.44	15.62	43.52	44.26
Plant spread E-W (m)	3.71	4.27	0.57	50.80	54.54
Plant spread N-S (m)	2.92	3.36	0.44	49.92	53.53
Fruit length Feb. (mm)	12.66	20.18	7.53	19.12	24.14
Fruit length April (mm)	5.15	13.01	7.86	12.36	19.65

genetic advance indicating the prevalence of non-additive genes and so improvement could be made through heterosis breeding (Table 3).

It is indicated by Table 3 that high heritability observed for the characters trunk girth (96.71) and plant height (86.65) while fruit length have low heritability (39.59). This indicates that selection for such characters could contribute desirable results for selecting ker genotypes with high heritability. Relative comparison of heritability estimates along with genetic advance as per cent of mean would give an idea about the nature of gene action governing a particular character, improving the effectiveness selection which is estimated based upon the heritability, genetic variability and selection intensity. The variation of different traits under this study revealed that the phenotypic coefficient of variation (PCV) were higher than genotypic coefficient of variation (GCV) for all the characters studied indicating the role of environmental variance in the total variance (Table 2). The traits trunk girth followed by fruit length (13.01) showed high PCV estimates. Hence, these characters can be relied upon and simple selection can be practiced for further improvement. High genetic advance as percentage of mean was observed in plant spread (97.47) followed by trunk girth (88.17). Genetic advance as per cent of mean (GA) is more reliable index for understanding the effectiveness of selection in improving the traits because the estimates are derived by involvement of heritability, phenotypic standard deviation and intensity of selection. Thus, genetic advance along with heritability provides clear picture regarding the effectiveness of selection for improving the plant characters (Gidey *et al*., 2013).

Conclusion

The genotypes IC103393 was found promising in term of higher fruit weight (13.8 g) with a better yield potential which could be used in improvement programme by heterosis breeding or selection for effective utilization of the germplasm.

Authors' Contribution

Conceptualization of research (VSM); Designing of the experiments (AK); Contribution of experimental materials and Execution of field/lab experiments, data collection (RB, KS, NS); Analysis of data and interpretation (VSM, VG); Preparation of the manuscript (VSM, NS).

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Table 3. Estimates of heritability, genetic advance (GA) and GA as percentage of mean among 15 ker genotypes

Parameters	Heritability (%)	Genetic advance (GA)	GA as percentage of mean (%)
Tree height (m)	86.65	3.83	78.57
Trunk girth (cm)	96.71	43.39	88.17
Plant spread E-W (m)	86.76	3.69	97.47
Plant spread N-S (m)	86.97	3.28	95.90
Fruit length Feb. (mm)	62.70	5.80	31.19
Fruit length April (mm)	39.59	2.94	16.03

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