Genetic Variability of Ber (*Ziziphus mauritiana* Lamk.) and its Prospects for Crop Improvement

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Diverse germplasm of ber assembled at Central Institute for Arid Horticulture, Bikaner, Rajasthan repository consisting of 338 genotypes/strains from different parts of the country were evaluated with respect to morphometric characters, yield and yield attributes for further utilization in improvement programme so as to meet the future demand of growing population. Out of the genotypes collected through explorations AKS/NRCAH-15 was observed to be a precocious and prolific bearer. IC322120 and IC322121from Gujarat were found promising with respect to yield and yield attributing traits. The local variety Illaichi was found prolific bearing in clusters that could be potentially used as parental line in systematic hybridization programme. Variety Rashmi was found superior over Umran – a leading variety, in terms of fruit taste, flavour and palatable attributes. Many collections, *viz.* IC322120, IC322121, AKS/NRCAH-15 and Illaichi seems to be utilized in processing, through drying with excellent quality. This paper discusses the performance of promising ber genotypes and status of the conservation of ber genotypes in the field repository being maintained and evaluated under hot arid ecosystem of Thar dessert.

Key words: Conservation, Germplasm, Variability, *Ziziphus mauritiana*

Introduction

Indian ber (*Ziziphus mauritiana* L.) (family Rhamnaceae) is said to be indigenous fruit crop while *Ziziphus jujuba* Mill. is native to China Indo-Malaysia region is the centre of both evolution and distribution of the genus *Ziziphus* (Liu and Cheng, 1995). However, De Candolle (1886) stated that Myanmar (Burma) and India are the home of ber. Its cultivation is more common in Uttar Pradesh, Haryana, Rajasthan, Gujarat and Maharashtra. This fruit crop has vast scope of growing in wasteland like salt affected marginal forest soil (Shukla, 1996). Ber being cross pollinated and heterozygous crop, growing of plants through seed may results in maximum variability in seedlings. A wide range of variability exists in ber in India (Sharma and Kore, 1990). The variation has been observed for all the characters suggesting substantial scope for improvement (Pathak and Pathak, 1993). Sometime, specific genotype(s) may be obtained from the seedling population, that may arise due to natural outcrossing or spontaneous mutation. Identification and selection of desired ideotypes may results in improvement of fruit crops. Moreover, some rare types of variability are extinct from the nature (due to deforestation or natural disaster) which may be the potential source for resistant to biotic and abiotic stresses. In India a number of ber cultivars have been developed largely by the growers through selection in different regions. Maximum variability of ber is observed in Rajasthan, Gujarat, Haryana, Punjab, Madhya Pradesh and Uttar Pradesh. In Gujarat, Mehsana, Anand, Panchmahal, Patan and Sabarkata districts have rich diversity in ber (Shukla *et al.*, 2004a). It is also reported that the smaller fruits of Umran is known as Chameli in Gujarat (Shukla *et al.*, 2003b). There are many unexplored area of ber variability from where promising types need to be collected for further characterization and evaluation. Historically central part of the country is supposed to be the richest area in the wild ber germplasm (Shukla *et al.*, 2004a). Therefore, it is highly desirable to identify the elite germplasm, collect them and maintain for their utilization in crop improvement programme of either through conventional and or biotechnological approaches.

Materials and Methods

There were two approaches adopted for the collection of the ber germplasm. In the first approach commercial varieties and genotypes were collected in the form of bud stick for *in situ* budding or direct planting of budded plants through survey at farmers field and forest area and also those maintained by different institutes. In second approach, survey for the identification of elite type germplasms were conducted by the institute. Selective sampling method was adopted for the identification of elite genotypes. While identifying the plant about 30 fruits were collected from each elite plants of ber for development of progeny line and analysis of physico-chemical attributes. The plant height and spread was recorded with the help of scale and long bamboo stick or ranging rod and average fruit weight was recorded.

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Vernier Callipers was used for taking observation on fruit size. TSS was recorded with the help of hand refractometer. The bud wood of identified plants were collected and budded *in situ*. Further, *in situ* budding is recommended technology for establishment of the new genotypes under hot-arid ecosystem (Shukla *et al.*, 2004b). For this purpose rootstock were planted at the recommended distance (6.0 x 6.0 m) and after its establishment in the field *in-situ* budding was performed.

Results and Discussion

A total of 338 genotype/strains of ber have been collected and maintained in the national repository of CIAH, Bikaner. Out of that 89 genotypes/strains were collected through survey from Rajasthan (Chirana, Jobner, Bhusawar, Udaipurvati, Banar and Sirohi) Gujarat (Patan, Mehsana, Anand, Panchmahal and Sabarkata), Andaman, Uttarakhand (Udham Singh Nagar, Nainital, Haridwar, Dehradun and Pauri) and Uttar Pradesh (Raibareli, Pratapgarh, Allahabad, Mirzapur, Varanasi, Deoria, Gorakhpur and Faizabad) and remaining 244 cultivars/ genotypes and five exotic species/cultivars of ber were collected and maintained from different institutes. Among the genotypes collected through survey IC322117 was found cluster bearer and partly tolerant to infestation by fruit fly. Further, in two genotypes (IC322120 and IC322121) there were two types of fruits (Table 1) – the fruits of early setting type having bigger size (4.35x3.45 cm and 5.23 x 4.14 cm, respectively) and the fruits of late setting type locally known as Chameli were smaller (2.47x2.23 cm and 3.13x2.54 cm, respectively (Shukla *et al.*, 2003b). The average fruit weight of bigger size fruit was 27.71g in IC322120 and 39.97g in IC322121. However, the average fruit weight of Chameli type fruit varied from 5.42g (IC 322120) to 9.22g (IC 322121). However, the genotype AKS/NRCAH-15 was found promising under hot arid ecosystem which is precocious and prolific bearer. The average fruit weight was about 27g, TSS 23%, total sugar 4.29% and ascorbic acid content was 60mg/100 g fruit. Average stone weight was 1.3g, dry matter content was 19.87% (Annual Report, 2002; Shukla *et al.*, 2003; Dhandar *et al.*, 2003). In most of the genotypes flowering period were observed between first week of September to first week of November (Table 2). Number of flowers per cluster varied from 08 to 25. Likewise the colour of the petiole varied from the light green to green and its length varied from 0.5 cm to 2.00 cm. However, the information with respect to growth characteristics of the important genotypes of ber, presented in the Table 2. In ber maturity behaviour of fruit is one of the most important traits which determines the economics of the crops and better adaptation to arid environment. This aspects was studied crucially and some of the genotypes like AKS/NRCAH-15 and CIAH Hybrid 1 were found very promising having characteristics of early ripening. Variability within the clone was noticed under this investigation. A clear variability was observed in different strains of Gola collected from various region like Haryana, Gujarat and Rajasthan. Remarkable variability was exhibited in strains of Mundia. Characteristics of dwarfism were also very important morphological character of plants and played important role in orcharding under different agro-ecological conditions. Under drought condition and storms and speedy wind weather vagaries, dwarf cultivar/genotypes performed well. Some of the genotypes such as AKS/ NRCAH-15, Illaichi, found physiologically dwarf having short internodes, poor apical dominance and slow growth and development of the branches. This morphological variability will be useful in molecular characterization of the germplasm for development of linkage map and quantitative traits loci (QTL) and isolation of desired genes. Moreover, the biodiversity of ber collected at the CIAH, will be useful in the improvement programme for the development of new varieties to meet out the challenges of future competitive market and consumer demands.

Table 1. Yield attributes of ber genotypes

IC/ Collector No	Average fruit weight (g)	Fruit size (cm)		TSS(%)
		Length	Width	
IC322112	13.00	3.83	2.54	18
IC322113	1.40	4.23	2.44	16
IC322114	15.80	4.68	3.14	16
IC322115	17.16	3.99	2.34	16
IC322116	2.09	1.54	1.67	19
IC322117	2.67	3.12	2.73	17
IC322118	11.47	2.65	2.48	16
IC322119	15.08	3.00	2.50	17
IC322120	(i) 27.71 (ii) 5.42	(i) 4.35 (ii) 2.47	(i) 3.45 (ii) 2.23	(i)19 (ii)18
IC322121	(i) 39.97 (ii) 9.22	(i) 5.23 (ii) 3.13	(i) 4.14 (ii) 2.54	(i) 14.4 (ii) 15.4
IC322122	4.92	1.73	1.73	18
IC322123	4.31	1.82	2.14	20
IC322124	6.42	2.34	2.22	19
IC322125	4.27	1.82	1.84	18
IC322126	5.00	3.15	2.54	17
AKS/NRCAH 15	27.00	4.60	3.00	23

Table 2. Characteristics of important genotypes of ber

IC/ Collector No	Source	District	State	Plant Height (m)	Plant Spread (m)		Leaf size (cm)	Petiole length (cm)	Foliage colour	Petiole colour	Flowering Period			Number of flower per cluster
					E-W	N-S					Initiation	Peak	End	
IC322112	Farmers field	Sirohi	Rajasthan	2.50	4.00	4.00	9.1x6.1	2.00	Green	Light green	10.9	4.10	15.11	19
IC322113	Farmers field	Sirohi	Rajasthan	2.75	2.50	2.00	8.1x3.2	1.70	Dark Green	Green	19.9	4.10	18.11	13
IC322114	Farmers field	Sirohi	Rajasthan	2.10	3.00	2.00	7.9x6.1	1.90	Green	Light green	12.9	4.10	16.11	19
IC322115	Farmers field	Sirohi	Rajasthan	2.50	4.00	3.00	9.2x6.4	2.00	Green	Green with purple tinge	11.9	4.10	14.11	24
IC322116	Farmers field	Patan	Gujarat	2.75	3.00	3.00	2.1x2	1.00	Light green	Light green	9.9	4.10	17.11	22
IC322117	Farmers field	Patan	Gujarat	3.50	3.00	3.00	3.7x2.1	1.60	Light green	Light green	19.9	13.10	25.11	12
IC322118	Farmers field	Patan	Gujarat	2.75	3.00	2.50	7.1x3.6	2.00	Green	Light green	19.9	4.10	15.11	12
IC322119	Farmers field	Mehsana	Gujarat	3.00	4.00	4.00	5.1x3.2	1.20	Green	Light green	28.9	27.10	22.11	14
IC322120	Orchard	Mehsana	Gujarat	2.75	4.00	4.00	6.3x3.7	1.30	Dark green	Green	19.9	4.10	12.11	17
IC322121	Orchard	Mehsana	Gujarat	3.00	5.50	5.00	8.7x6.1	2.10	Dark green	Green	19.9	4.10	19.11	14
IC322122	Farmers field	Anand	Gujarat	2.50	3.00	4.00	3.7x2.6	1.30	Green	Light green	28.9	27.10	19.11	08
IC322123	PWD guest house	Anand	Gujarat	3.50	4.00	4.00	4.2x2.8	1.00	Green	Light green	20.9	26.10	22.11	13
IC322124	Farmers field	Panch-mahal	Gujarat	2.00	4.00	2.00	5x3.2	1.20	Light green	Light green	20.9	5.10	12.11	14
IC322125	Farmers field	Panch-mahal	Gujarat	3.75	3.00	3.00	4.4x3.6	0.50	Green	Light green	5.10	25.10	22.11	08
IC322126	Orchard	Sabar-kata	Gujarat	3.00	4.00	3.75	5.5x2.8	1.20	Green	Light green	15.9	5.10	17.11	12
AKS/ NRCAH 15	Farmers field	Bharat-pur	Rajasthan	3.30	4.75	3.60	8.37x4.3	1.67	Green	Light green	05.9	15.9	10.11	25

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References

Annual Report (2002) Central Institute for Arid Horticulture, Bikaner.

De Candolle, A (1886) Origin of cultivated plants. *Bibliotheque Scientifique Internationale* **43:** Paris.

Dhandar DG, AK Shukla, BB Vashishtha and C Umamaheswari, (2003) Promising ber Selection–1 under evaluation for release. *CIAH Newsletter* **2(1) :** 1.

Liu MJ and CY Cheng (1995) A taxonomic study of the genus *Ziziphus Acta Hort.* 390.

Pathak RK and RA Pathak (1993) Improvement of minor fruits In: Advances in Horticulture Vol (I) (Eds. KL Chadha and OP Pareek) Malhotra Publishing House New Delhi. pp 407-421.

Sharma VP and VN Kore (1990) Ber In: Fruits Tropical and Sub-tropical (TK Bose and SK Mitra Eds.) Naya Prokash Calcutta. pp 592-615.

Shukla AK, DG Dhandar, BB Vashishtha and C Umamaheswari (2003a) New promising ber varieties from CIAH. *Indian Horticulture.*

Shukla Anil Kumar (1996) Efficacy of drip and mulching on young plantation of aonla + ber cropping model in sodic soil. MSc. (Ag) Thesis submitted to NDUAT, Faizabad.

Shukla Anil Kumar, Shukla Arun Kumar and BB Vashishtha (2004a) Ber in "Fruit breeding approaches and achievements". Pub. By International Book Distributing Co. Lucknow, pp 217-232.

Shukla Anil Kumar, Shukla Arun Kumar, DG Dhandar and JI Patel (2003b) Genetic variability of ber and aonla in Gujarat. National Symposium and Silver Jubilee of Agroforestry Initiative in India, Jhansi, 7-9 November. pp 126-127.

Shukla Anil Kumar, BB Vashishtha, Shukla Arun Kumar and DG Dhandar (2004 b) Swasthane kalikayan se ber ka saphal uttpadan (In Hindi). *Krishi Chayanika* **25(3):** 8-11.