Variability and Scope of Improvement in Lasora (*Cordia myxa*)

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ABSTRACT

A rich reserve of genetic variability in hardy fruit species such as khejri, lasora, jharber, bordi, ker, pilu, etc. in the traditional arid farming system has sustained substantial nutritional needs and livelihood of the desert dwellers. Lasora is an important fruit species and is considered as a herbal tree in rural India. Two explorations were made during 2000 and 2001 for the surveys and collections of lasora variability in the state of Rajasthan. The germplasm was collected from 95 sites with varied agro-climatic conditions. A wide range of variations was observed for the important characters on plant growth, leaf size, fruit size, fruit quality and yield components. The analysis of variance revealed that there were high and significant differences among the thirty groups of lasora population. The estimation of GCV and PCV for fruit weight and leaf size was high and therefore, good scope for improvement through selection. High estimate of heritability along with high genetic advance as per cent of mean was estimated for fruit weight (79.95), leaf size (89.72) and leaf width (53.73). Positive and highly significant correlations were observed between fruit weight and fruit length and diameter. On the basis of correlation studies, it could be suggested that plants with large sized leaves would give bigger sized fruits and *vice-versa*

Key words: *Cordia myxa, genetic variability, arid region*

1. INTRODUCTION

In spite of environmental constraints, arid region has a great fruit production potential by exploiting the native rich gene reserve in fruit yielding multipurpose species such as khejri (*Prosopis cineraria*), lasora (*Cordia myxa*), ker (*Capparis deciduas*), jharber (*Ziziphus nummularia*), pilu (*Salvadora oleriodes*) etc.(Pareek and Samadia, 1999). These under exploited species are not only tolerating drought conditions but also have high productivity potentials in the arid farming systems under extremes of environmental stresses (Pareek and Sharma, 1993). According to Rai and Gupta (1996), lasora is distributed through out the country especially in warmer regions of northwest and central India.

The genetic resource of above mentioned fruit species is under severe threat of erosion due to manifold reasons of social and economic nature. Among those, shrinkages of the *Orans* (a type of conventional arid plant resources management systems on common lands for harvesting of indigenous fruits and livelihood products and also for animal grazing) and more attraction towards profit making crops are the important reasons. The indigenous plant diversity is playing significant role in the life of land owners and large number of landless people for sustained nutrition and livelihood product. On the other hand, modern communication network has increased the awareness in the world community about rich potentiality of the under exploited horticultural species and their herbal values (Samadia, 2003).

Need of the hour is to exploit the existing genetic diversity in the selected under exploited fruit species of arid regions by identifying the suitable multipurpose genotypes for their systematic cultivation. Realizing the facts and issues on conservation of native genetic resources, intensive crop specific explorations for the surveys and collection of genetic variability of targeted fruits were conducted from 2000 to 2002 under National Agricultural Technology Project (NATP) on sustainable management of plant biodiversity. Thus, the present work discussed here, was undertaken to survey, collect and conserve the seedling originated variability of lasora (*Cordia myxa*) from arid and semi arid regions of North-Western India. Beside, in depth analysis have been done to develop long-term strategies for the conservation of gene pool and its utilization in crop improvement to develop better genotypes.

2. MATERIALS AND METHODS

Rajasthan (23°3'-30°12' N and 69°3'-78°17' E) is the largest state in the country covering approximately 34.2 million hectare of geographical area, out of which an area of 27.1 m ha (79.08 % of total state area) is lying in arid and semi arid climate, spread over 21 out of 32 districts. Over a large part of the state of Rajasthan, agriculture is a struggle against inhospitable nature. Low precipitation, extremes of temperatures and high vapour pressure deficit are the environmental characteristics. The annul rainfall is low (185-600 mm) and is confined from July to September.

Realizing the above stated facts, two explorations were undertaken during May 2000 and 2001 under National Agricultural Technology Project on "Sustainable management of plant bio-diversity". Both the explorations were planned and undertaken in such a way that the maximum areas of distribution of lasora in the state can be covered from the districts of Ajmer, Jaipur, Alwar, Bharatpur, Pali, Dausa, Sikar, Bhilwara, Chittorgarh, Udaipur, Rajsamand, Jalore, Barmer, Jodhpur, Nagour, Bikaner, Churu and Jaisalmer (Fig. 1). Lasora germplasm in the form of fruits was collected from a wide range of locations falling under arid, semi arid and sub-humid agro-climatic zones. A total of 95 sites were surveyed from which 65 fruit samples were collected, selectively or randomly from the population consisting trees of 5 to 50 (or more) years age group. Both individual and population sampling was adopted. Thirty groups were formed from the 65 collected samples to assess the extent of genetic variability in the population. Tree age and size (primary and secondary sources of population) and distinct fruit size (big and small) and specific agro climatic conditions of the district were the criteria used for developing core groups. The potential individual trees were marked for the collection of bud wood.

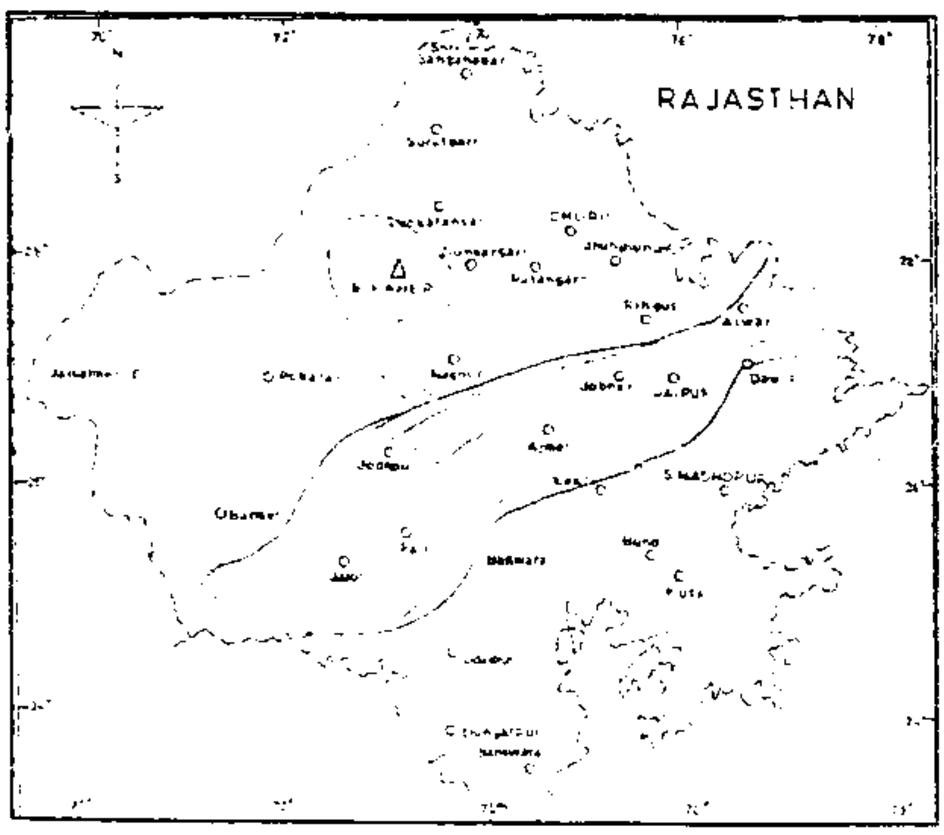

Fig. 1. Map showing lasora growing areas and hot variability pockets in Rajasthan

During explorations, in depth discussions were done with the growers to assemble the realistic information on characters of plant growth, flowering and fruiting behaviour, fruit yield and quality, crop management, specific practices, post-harvest practices, marketing, socio-economic and medicinal uses were recorded. The passport information was compiled in relation of agro-climatic, soil and topography, extent of population variability, farming system, etc. Data were analyzed critically adopting various approaches to quantify the extent of lasora variability in the state of Rajasthan.

3. RESULTS AND DISCUSSION

Lasora, lehsua, gunda, sebesten or Indian cherry (*Cordia myxa* Roxb. Syn. *Cordia dichotoma* Forst.) is a minor fruit and is considered as important herbal tree in rural India. Lasora belongs to family Boraginaceae and genus *Cordia* having about 300 species, probably originated in India. It is medium sized tree, grows throughout in arid and semi arid regions. The lasora plants are tolerating to drought conditions. It is not grown as orchard under cultivation but grows abundantly and unsystematically on non-cultivable lands, back yard or near the houses, along farm boundaries or roadside or in farm land as scattered trees. Several arid zone fruit crop workers (Pundir, 1987; Singh, 1989; Pareek *et al.*, 1999; Samadia, 2003 and Kaushik and Dwivedi, 2004) have reported the importance and availability of lasora in the state of Rajasthan.

Greater variability in the initial breeding material insures better chances of producing desired plant type. Thus, the primary objective of germplasm collection and conservation is to preserve the genetic variability in indigenous fruit producing crop species to make it available to present and future generation. In arid and semi arid areas of Rajasthan, the lasora populations have sprung up through natural regeneration and seedling plantations. It has lot of variations and so far there is no named variety for the systematic orchards. A wide range of variability do exist and was recorded with regards to size and spread of trees, leaf size, flowering and fruiting behaviour, fruit maturity, fruits per cluster, fruit size, seed size, pulp: seed ratio, fruit quality and fruit yield (Table 1 to 4) in the regions explored. Lasora germplasm was collected from a wide range of agroclimatic conditions (hyper arid, arid and semi arid and sub-humid) in 18 districts covering 95 sites. Among the locations screened for the variability studies, Pushker valley of Ajmer, Sadri area of Pali, parts of Jodhpur, Barmer, Jalore, Jaipur, Bhilwara and Nagour were the core spots and exhibited the rich variability in lasora. During the surveys, candidate trees were identified and marked with a view to collect the bud wood for *ex situ* clonal conservation.

The analysis of variance revealed that there was high and significant difference among the thirty groups of lasora population for the characters studied which indicated that all the groups were highly diverse (Table 1 & 4). The plant height and crown spread ranged from 3.48 to13.34 m and 2.84 to 10.05 m with a population mean of 7.08 and 6.08, respectively. Very high range of variations were obtained for tree canopy volume (11.5 to 596.3 m^3). The wide range of variations for tree characters

Table 1. Tree growth characters and fruit yield of lasora population in Rajasthan

Characters	Range values
Tree height (m)	3.48-13.34
Crown spread (m)	2.84-10.05
Tree canopy volume (m^3)	11.55-596.37
Fruit yield potential (q/tree) of 5 >50 years old age seedling trees, practically maintained under zero inputs.	0.12-10.12
Returns / tree from the 5 to >50 years age group trees, annually (whole sale market rate @ Rs 4=00 per kg).	48-4049

Table 2. Growth characters and fruit yield potential of lasora trees in core variability sites in the districts of Ajmer, Pali, Jalore and Barmer

Age groups (years)	Tree height (m)	Crown spread (m)	Tree canopy volume (m^3)	Fruit yield potential (q/tree)
< 5	3.96	3.44	12.91	0.114
5-10	4.95	5.42	44.15	0.825
11-20	6.82	6.26	96.81	1.268
21-30	8.51	8.42	202.75	2.285
>30	10.21	9.64	334.12	4.355

Plant spread (m)=Average of East -west + North -south

Tree canopy volume (m^3)= 4/3 a b. where a is half of the tree height and b is crown spread

Table 3. Fruit yield and quality contributing characters of potential lasora trees in the core variability sites in the districts of Ajmer, Pali, Jalore and Barmer

Characters	Mature unripe fruits	Ripen fruits
Period of availability of fruits	First week of April to third week of May	Second week of May to second week of June
Number of fruits per cluster	3.2-8.5	-
Number of clusters per bunch	2.5-4.7	-
Number of fruits per bunch	15.5-25.7	-
Fruit weight (g)	9.21-11.42	12.84-14.22
Fruit length (cm)	2.51-2.84	2.75-3.11
Fruit diameter (cm)	2.64-2.93	2.87-3.27
Seed length (cm)	1.21-1.35	1.24-1.45
Seed width (cm)	1.21-1.47	1.24-1.56
Seed thickness (cm)	0.78-0.95	0.78-0.98
Weight of seed (g)	0.654-0.722	0.702-0.741
Weight of pulp / fruit (g)	8.54-10.61	12.09-13.45
Pulp : seed ratio	13.05-14.77	17.22-18.15
TSS (^{0}Brix)	-	5.55-18.24

among the groups of lasora might be due to two reasons. Of them, the first is genetically heterogenous seedling population and age of the trees. The second is crop management practices and environmental condition of the production sites. To obtain the real information on growth characters, seedlings of uniform age group were observed among the individuals in the locations of core spots. In general there were two forms of trees, tall and vigorous growth habit and another medium sized and widely spread in type. In core variability pockets, there were three groups in seedling population. Of which the first group belongs to very old (>50 years) trees at the village

Table 4. Components of genetic variability in lasora seedling population

Characters	Code	Range	Mean	CV (%)	CD (5%)	GCV (%)	PCV (%)	Heritability (Broad sense)	Genetic advance as percent of Mean (5% SI)
Leaf length (cm)	LL	8.98-20.14	14.60	1.45	0.34	22.36	22.38	99.9	46.04
Leaf width (cm)	LW	5.21-17.18	11.84	1.69	0.32	26.10	26.12	99.9	53.73
Leaf size (cm^2)	LS	47.52-346.01	182.03	2.56	7.62	43.58	43.60	99.9	89.72
Fruit weight (g)	FW	1.84-11.50	7.33	8.26	0.99	39.10	39.39	98.5	79.95
Fruit length (cm)	FL	1.51-2.82	2.24	4.67	0.17	15.36	15.59	97.0	31.16
Fruit diameter (cm)	FD	1.23-2.86	2.35	4.55	0.17	18.39	18.58	98.0	37.51
Weight of 5 seeds (g)	W5S	1.30-2.79	2.00	1.95	0.06	22.00	22.03	99.7	45.26
Seed length (cm)	SL	0.99-1.52	1.26	1.69	0.03	10.46	10.50	99.1	21.46
Seed width (cm)	SW	1.04-1.72	1.33	1.72	0.03	13.22	13.25	99.4	27.15
Seed thickness (cm)	STN	0.56-1.32	0.89	2.57	0.03	22.25	22.30	99.6	45.73

common places, forest nurseries or near the houses located in the field or near to open wells and these plants were in few numbers. These old trees might probably be originator of the secondary (full grown or mature trees of 20-25 age group) and the third generation new seedling populations (<10 years age) which is now at the farmers field and in orchards.

In general, two typical leaf sizes *i.e.* small and big, and a relative pattern in size of leaves and fruits in the trees were observed. During the surveys, it was realized that leaf size could be the one of the marker character. Therefore, leaf characters data were worked out for extent of variations and relationship between the size of leaf and fruits in *lasora*. The leaf length and width in the population ranged from 8.98-20.14 and 5.21-17.18 cm, pectively. The leaf area (length x width) ranged between 47.5-346 cm^2. During the course of study, it was noted that the majority of trees were of big sized leaf where as very few trees were of smaller leaf size. While interacting with the growers, two points emerged out the first one is that the plant having big sized leaves produces commercially importance fruits and the tree with small sized leaf produces smaller fruit, which has no consumer preference. Therefore, the farmers did not allow them to grow in the field. The scattered trees having small sized leaves were available at few forest and government nurseries, near open wells or community lands/places in the villages or as trees shade yard (e.g.- thick shade yard for buffaloes in Jalore and Barmer area).

The data in table 4 revealed a wide range of variation for fruit characters studied and it was for weight (1.84-11.50 g), length (1.51-2.82 cm) and diameter (1.23-2.86 cm) of fruits. Variations were also recorded for weight, length and width of seeds from the mature fruits and these are important fruit quality characters. Besides leaf and fruit size, quality and productivity of fruits are the major attributes to spot out the superior trees from the natural population, which could be later on multiplied clonally for *ex situ* germplasm evaluation and conservation. Considering the grower's experiences and their skills on the fruit quality and yield components, some potential trees were marked and observations were recorded in the hot spots of lasora growing locations (Table 2-3). Among the observations recorded, wide variations were observed for number of fruit per cluster and bunch, fruit yield per plant, duration of harvesting and period of availability of tender fruits and fruit quality components.

Genotypic and phenotypic coefficient of variation (GCV and PCV) studies on leaf, fruit and seed traits indicated that there is an ample scope for the improvement of this crop (Table 4). In general, the estimates of PCV were higher than GCV for the above said characters but the differences were very less. In such situations, selection can be effective on the basis of the phenotype alone. However, all these traits exhibited very high heritability (broad sense). The genetic advance expressed as percentage of mean ranged from 21.46 to 89.72 and the character such as fruit weight (79.95), leaf size (89.72) and leaf width (53.73) exhibited higher estimates. In the present study, fruit weight was found to be highly variable and might be responsible for variations in fruit size and other related components.

The genotypic correlation coefficients, in general, were higher in magnitude than the corresponding phenotypic once (Table 5) among the various characters studied. Positive and highly significant correlations between fruit

weight and fruit length and diameter were observed both at genotypic and phenotypic level indicating mutual association of these traits. Thus, it revealed that in addition to direct selection pressure on fruit for yield, selection for fruit weight would lead to faster genetic improvement for yield per plant. Significant and high positive correlations were obtained between leaf length, width and size with fruit weight, length and diameter indicating strong association between these traits. It could be suggested from correlation estimates that plants with large sized leaf will give bigger sized fruits and *vice-versa*. Thus, the positive association of the characters for size of leaf and fruit should aid in the survey and evaluation work while identifying the elite trees of lasora.

A multipurpose lasora tree of about 10-12 year old yields 250 300 kg fruits and can easily generate Rs. 1000/- annually. Being tolerant to biotic and abiotic stresses, it is suitable for arid and semi-arid and drought prone areas of tribal region of the northern western part of the country. Because of pre-dominance of seed propagation, great variability exists in lasora. In spite of wide variability there is no named cultivars for organized farming. Hence, the naturally occurring variations need to be exploited by offering selection as a method of improvement. An oval-round shape fruits, green to dark green colour at unripe mature stage and big size (9-12 g) producing genotype would be ideal. The fruits with small size seed stone and high pulp content with better quality would be better for processing. Besides these high fruit yielding and longer harvesting period genotypes would be considered potential. There is also need for commercializing this by exploring the possibilities of its uses in gums, confectionery and other processing industries.

Table 5. Genotypic (G) and phenotypic (P) correlation coefficients among leaf and fruit characters in lasora.

Characters		Leaf length	Leaf wirth	Leaf size	Fruit weight	Fruit length	Fruit diameter
Leaf length	G		0.924	0.968	0.893	0.672	0.847
	P		0.923**	0.968**	0.886**	0.662**	0.838**
Leaf width	G		-	0.976	0.891	0.761	0.843
	P			0.976**	0.884**	0.748**	0.835**
Leaf size	G			-	0.881	0.709	0.804
	P				0.875**	0.698**	0.797**
Fruit weight	G				-	0.761	0.941
	P					0.753**	0.932**
Fruit length	G					-	0.696
	P						0.684**
Fruit diameter	G						-
	P						

Significant at 1 (* *) and 5 (*) percent, respectively.

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