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AGRICULTURE
Research Article

Genetic Variability Studies of lasoda (*Cordia Myxa Roxb*.) Genotypes for Jhalawar district in Rajasthan, India

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Received: January 16, 2015; **Published:** September 14, 2015

Abstract

In order to ascertain the overall degree of morphological variations and extent of dissimilarities in fruit quality, 12 landraces of lasoda (*Cordia myxa Roxb*.) were studied. Significant variations in traits of leaf and high heritability values were observed for all leaf parameters. There were considerable differences in fruit characters based on genotypic and phenotypic coefficients of variation indicating the influence of environment on these characters. Within the studied characters, GCV and PCV were found to be high for weight of bunch and number of fruits/bunch. All characters showed high values of heritability for fruit weight (89.51%), weight of bunch (99.39%), number of fruit branches/bunch (86.74%), number of fruits/bunch (97.07%), total soluble solids content (96.32%) and pulp: stone ratio (98.79%) indicating dominant epistasis for all these characters. High genetic advance for characters like fruit weight (61.13%), weight of bunch (82.63%), no. of fruit branches/bunch (70.87), no. of fruits/bunch (98.60) and pulp: stone ratio (132.42) indicates the predominance of additive gene influence of these characters and would favour in improvement of lasoda genotypes through selection process. High heritability for fruit characters of lasoda in consonance with high genetic advance suggests ample scope for selection of desirable type of genotypes.

Keywords: *Lasoda; Heritability; Phenotypic variation; Genotypic variation*

Introduction

Lasoda (*Cordia myxa Roxb.*) is a minor and underutilized fruit popularly eaten by people from ancient times and it is known as Indian Cherry, Sebestyen Lehua, Lasora or Gonda Peter KV. [1]. It is commercially important and is available during May-June in the market with considerable quantities. The fruit is not being cultivated commercially as an orchard crop but grows wild in wastelands and in fruit orchards. It is found growing along farm boundaries, on farm land as scattered trees and also on road sides. Lasoda plant is found grown in wild form in the states of Rajasthan, Punjab, Haryana, Uttar Pradesh, Madhya Pradesh, Maharashtra, Gujarat etc. In Rajasthan, considerable stand of Lasoda density is found in Pali, Jalore, Sirohi, Bikaner, Udaipur, Kota and Jhalawar district.

The importance of Lasoda fruit is well recognized both in rural as well as urban masses. Its fruit is edible, sweet and mucilaginous. The tender mature fruits are mostly pickled and also used for vegetable purpose. Fruits have medicinal feature and are considered as anthelmintic, diuretic, demulcent and expectorant. They are rich source of carbohydrates, phosphorous (60 mg/100g of pulp) and calcium (40 mg/100g of pulp). It is rich in sugars but typically acid less in nature. Study and evaluation of the variation is the first step for any breeding programme and tree breeding depends on the existing variability in the nature under different edaphic-climatic conditions.

The agro climatic conditions of Jhalawar, Rajasthan state are highly congenial for lasoda production during summers (May-June). The state is rich in its biodiversity under natural habitats where seedling trees come up in plethora naturally. Very scanty work on morphological variation in leaf traits and fruit quality has been reported on lasoda genotypes. The evaluation of existing germ plasm in nature followed by selection and preservation of germ plasm in field gene banks will be helpful in screening the potential of lasoda which is in

the way of utilization of the untapped potential of the wild germ plasm for mankind. The morphological traits show a plethora of gene and environment interactions both in intra and inter plant population Stern L and Roche K. [2]. A good knowledge of genetic wealth might also help in identifying desirable cultivars for commercial cultivation.

The present study was an attempt to gather information about genetic variability, heritability and genetic advance among the important traits of lasoda crop. The objective of this study was to describe the variability in 12 selected lasoda genotypes and to identify the most useful variables for discrimination among genotypes, and detect relationships among genotypes.

Materials and Methods

A survey to explore the population of (*Cordia myxa Roxb*.) in Jhalawar district of Rajasthan state, India was undertaken during two consecutive years (2012-2013) to identify the wild potential growing sites under *Hadoti* region of Rajasthan. The sampling procedure included the delineation of the forest area in Jhalawar district comprising 12 different locations depending upon the landraces variability with a wide variation in the morphological characters.

Experiment Design

In the present study, 12 sites of Jhalawar district were selected namely *Naulaon, KotlaGutti, Mandawar, Asnawer, Haripura, Ratadevi, Teliakheri, Manpura, Malipura, Aktasha, Govardhanpura and Sarolakala*. Four naturally growing trees of *Cordia myxa* from each selected site having uniform age and canopy were selected. Trees were selected after evaluation of over 50 trees on the basis of regular fruit production and observed phenotypic diversity. Selections of genotypes were made according to relevant morphological traits of the tree. The selected trees were marked and fruit sampling was done from each site for measuring observations on various physico-chemical traits.

Measurements

Leaf length and width were measured with a ruler and expressed in cm. Leaves (20 per land race) were sampled from median section of 1 year old branches during sampling time. Leaf thickness of the mid rib was measured using Vernier Callipers and expressed in mm. Fruit weight was recorded using an electronic balance with instrument sensitivity of 1 mg. Fruits/bunch was calculated by counting the total number of fruits in each bunch, in the marked shoot. Hundred fruits from each of the identified trees were collected from all the four orientations of the tree, i.e. 25 from north, 25 from south, 25 from east and 25 from west. Weight of 25 fruits was divided by total number of fruits to obtain the average fruit weight. Pulp weight of 25 selected fruits per tree was estimated by deducting the stone weight from the total fruit weight. Thereafter pulp: stone ratio was obtained by dividing the pulp weight by stone weight and average was calculated. Total soluble solids content and acidity was determined as described by AOAC [3]. Genotypic and phenotypic coefficient of variation was calculated according to Singh RK and BD Chaudhury [4]. Genetic advance (GA) and genetic advance per cent (GA %) were estimated as proposed by Johnson HW., *et al*. [5], Allard RW. [6]. Heritability estimate in the broad-sense (h^2b) on mean basis for each location and combined locations was used as suggested by Eckebil TP., *et al*. [7] as follows:

$$\text{Heritability } (h^2) = \frac{\sigma 2g \times 100}{\sigma 2p}$$

Where σ2g is: genotypic variance of the population and σ2p is phenotypic variance of the population

Statistical Analysis

The data obtained were subject to analysis of variance using randomized block design using Indostat Software. The twelve sites were considered as treatment and the individual selected tree at each site was taken as the replication. The coefficient of variation for leaf traits and fruit quality was also calculated.

Results and Discussion

Leaf characters

All examined land races are highly adapted to the environmental conditions in Jhalawar district of South Eastern Rajasthan and could be a very interesting source of genetic diversity. The results of this study indicated high morphological diversity of lasoda genotypes Vis a Vis leaf morphology. The results exhibited in table 1 revealed high levels of morphological variation in leaf length (12.06 cm to 19.00 cm) in Provenance I to Provenance VIII; leaf width ranged from (9.00-15.30 cm) in Provenance I to Provenance V; perimeter of leaf varied from (30.00-42.40 cm) in Provenance I to Provenance IX and leaf thickness showed significant range from (0.55-1.46 mm) in Provenance V to Provenance VII. The morphological variations in leaf length may be attributed to genetically control differential photosynthetic apparatus of the varied lasoda genotypes.

The coefficient of variation for leaf traits ranged between 0.84 to 2.91%.The phenotypic and genotypic coefficient of variation for leaf length was found to be 12.72 and 12.38, respectively. However heritability percentage for leaf length was found to be considerably high (94.78%) but genetic advance was moderate (24.83%). High heritability for leaf length indicates prevailing influence of environmental factors on this attribute and dominant epitasis.

In the present investigation, phenotypic and genotypic coefficients of variation for leaf width were noted to be 12.84 and 12.73%, respectively. Highest value of broad sense heritability (98.25%) for leaf width was observed however genetic advance was found low (26.00) under this trait. Genetic coefficient of variation represents the total genetic variation whereas heritability measures the proportion to which the variability of a character is transmitted to the offspring. The phenotypic and genotypic coefficient of variation for leaf perimeter was found to be under low values as 9.40 and 8.79, respectively. High heritability (87.42%) coupled with low genetic advance (16.94%) for leaf perimeter was noticed.

Fruit Quality Variation among Genotypes

The studied7 quantitative and qualitative traits showed a wide variability and therefore can be considered as traits of interest in breeding programme for future line of work. These traits are influenced by many factors such as climate, soil, slope of land etc. and are bound to vary under natural habitats.

The coefficient of variation in respect of all the 7 characters studied ranged from 2.62% to 17.77%. Data presented in table 3 reveals that average fruit weight of 12 lasoda genotypes on pooled basis varied from 2.61-14.45g with overall mean value of 9.60 g and contributed 10.73% coefficient of variation; T6 provenance recorded highest fruit weight (14.45g) which was statistically at par with T5 provenance. Minimum fruit weight (2.61g) was observed with fruits of T4 provenance. The data exhibited in table 3 depicted the phenotypic and genotypic variation for this trait was found to be 10.15 and 9.08, respectively.

The phenotypic and genotypic coefficients of variation were recorded to be 33.15 and 31.36, respectively. The heritability of this trait, observed to be 89.51% and the expected genetic advance was 61.13%. The better fruit size in some lasoda genotypes might be due to ecotype variation, genetically distinct, favorable soil conditions. There was wide variation recorded in no. of fruit branches/bunch amongst 12 lasoda landraces ranging from (5.00 to 15.00) under T9 provenance and T5provenance. Phenotypic and genotypic variation for this trait was 7.93 and 6.88, respectively. The phenotypic coefficient of variation was 39.66 and genotypic coefficient of variation was 36.34%, which were showed for this trait. The lesser phenotypic and genotypic variation suggests the ample influence of the prevailing climatic conditions on the lasoda genotypes.

The heritability value of this trait was 86.74%. The genetic advance was observed to be 70.87%. No. of fruits/bunch of 12 lasoda genotypes ranged from 5.00 to 18.00 with overall mean of 9.96.Phenotypic and genotypic variation for this trait was observed to be 24.13 and 23.13, respectively. The phenotypic and genotypic coefficients of variation were observed to be 48.58 and 49.30, respectively. The heritability value was recorded to be 97.07% and the expected genetic advance was found to be 98.60%.High heritability value for no. of fruits/bunch indicates dominant epitasis, less effect of environment and high inheritance of this character from one generation to next generation.

Average weight of bunch/cluster varied from 41.50 in Provenance I to 175.60 under Provenance XII with a general mean of 89.51. The genotypic coefficient of variability was 40.28 and phenotypic coefficient of variation was 40.36%. The heritability value was recorded to be 99.39%. The expected genetic advance was recorded to be 82.63% and it might be due to high range of variation among studied genotypes. The data of experiment showed that total soluble solids content of lasoda genotypes ranged from 5.60 in Provenance VII to 7.20 under Provenance V with a general mean of 6.66. The phenotypic coefficient of variation was 8.30 and genotypic coefficient of variation was 8.15.

The heritability value was noted to be 96.32%. The expected genetic advance was recorded to be 16.48%. The data of experiment revealed that titratable acidity was observed within a narrow range of 0.06 to 0.11% genotypes indicating acid less nature of lasoda fruits. Pulp: stone ratio exhibited a wide range from 1.19 in provenance to 9.21 in Provenance V with a general mean of 4.17. The phenotypic coefficient of variation for this trait was 65.06 and genotypic coefficient of variation was observed to be 64.67%. The heritability value was found to be 98.79% and the expected genetic advance was observed to be 132.42. High pulp: stone ratio is a better quality indicator of lasoda fruit. In the present study, lot of variation exists particularly with respect to this parameter. High heritability coupled with high genetic advance for this character offers a great possibility that the improvement can be made for these traits through direct selection. The estimates of phenotypic coefficient of variation were in general higher than genotypic coefficient of variation. The results indicated higher influence of environment on the expression of characters under investigation. Estimates of different genetic variability parameters are presented in table 3. Although the genotypic coefficient of variation and phenotypic coefficient of variation are the measures of genetic variability however, the amount of genetic gain can be estimated from genotypic coefficient of variation and phenotypic coefficient of variation along with heritability. The observed variation in a character is partly composed of genetic (heritable) variation and partly of non-heritable. Findings related to genotypic and phenotypic variability in lasoda was reported by Nagar in a survey of lasoda genotypes in Thar Desert of Rajasthan.

The genetic advance expressed in per cent mean was notably high for some characters especially fruit weight (61.13%), weight of bunch (82.63%), no. of fruit branches/bunch (70.87%), no. of fruits/bunch (98.60%) and pulp: stone ratio (132.42%). This might be due to high range of variation among the genotypes. High values of heritability for characters like fruit weight (89.51%), weight of bunch (99.39%), no. of fruit branches/bunch (86.74%), no. of fruits/bunch (97.07%), total soluble solids content (96.32%) and pulp: stone ratio (98.79%) indicated high genetic divergence among the landraces indicating ample chances for plant selection. Likewise, Prasad and Rao (1989) recorded high estimates of heritability in lime for TSS, ascorbic acid, acidity, rind thickness and fruit volume. The higher values of genetic gain for characters like fruit weight (61.13%), weight of bunch (82.63%), no. of fruit branches/bunch (70.87), no. of fruits/bunch (98.60) and pulp: stone ratio (132.42) indicates the predominance of additive gene action for these characters and these characters would have possibilities towards desired selection.

Conclusion

From the analysis of the collected landraces, it appeared that there is considerable variation in physico-chemical attributes of the fruits. Out of 12 landraces, *Haripura* manifested maximum pulp: stone ratio which forms premier character for evaluation in view of mass of the edible part. Alongside, this landrace was having higher weight of bunch superseding all the landraces evaluated. High heritability effects suggest dominant epistasis, prevailing effect of environment and high inheritance of fruit characters from one generation to another generation. Rajasthan state is blessed with enormous diversity of lasoda fruit and there is a need to preserve this biodiversity as well as to assess its physico-chemical properties for making it more popular in order to evolve lasoda genotypes with better quality attributes.

Code	Provenances	Leaf length (cm)	Leaf width (cm)	Perimeter of leaf (cm)	Leaf thickness (mm)
I	Naulaon	12.06	9.00	30.00	1.09
II	KotlaGutti	16.50	11.50	37.60	1.06
III	Mandawar	13.70	13.80	39.30	0.81
IV	Asnawer	13.60	14.13	37.50	1.30
V	Haripura	15.20	15.30	42.10	0.55
VI	Ratadevi	13.00	13.20	41.63	1.16
VII	Teliakheri	15.00	13.80	39.10	1.46
VIII	Manpura	19.00	12.30	41.50	0.95
IX	Malipura	15.00	12.00	42.40	0.90
X	Aktasha	14.50	12.80	39.20	1.17
XI	Govardhanpura	13.30	11.20	36.10	1.37
XII	SarolaKala	14.00	12.20	37.40	1.20
Range		12.06-19.00	9.00-15.30	30.00-42.40	0.55-1.46
Overall Mean		14.57	12.60	38.65	1.08
CV (%)		2.91	0.84	2.88	2.61
SEm (±)		0.34	0.08	0.91	0.02
CD 5%		0.71	0.17	1.88	0.04

Data analyzed using Indostat Software.

Table1: *Morphological Variation in leaf samples of Lasoda Land races of Jhalawar district.*

S. No.	Characters	Phenotypic variation	Genotypic variation	PCV%	GCV%	Heritability%	Genetic advance%
1	Leaf length	3.43	3.25	12.72	12.38	94.78	24.83
2	Leaf width	2.63	2.58	12.84	12.73	98.25	26.00
3	Leaf perimeter	13.25	11.59	9.40	8.79	87.42	16.94
4	Leaf thickness	0.06	0.06	23.53	23.38	98.73	47.87

Data analyzed using Indostat Software.

Table 2: *Estimation of the genotypic coefficient of variation, phenotypic coefficient of variation, heritability and genetic advance for leaf characters under 12 land races of Lasoda in Jhalawar district.*

Code	Provenances	Fruit wt. (g.)	No. of fruit branches/bunch	No. of fruits/ bunch	Wt. of bunch (g.)	TSS (°brix)	% (Acidity)	Pulp: Stone ratio
I	Naulaon	9.00	8.75	5.50	41.50	7.20	0.06	1.19
II	KotlaGutti	9.27	6.50	5.00	43.50	7.04	0.06	8.64
III	Mandawar	6.89	6.75	5.50	72.50	6.80	0.09	6.16
IV	Asnawer	2.61	7.25	16.50	46.50	6.25	0.10	4.47
V	Haripura	13.93	15.00	8.75	158.75	7.41	0.08	9.21
VI	Ratadevi	14.45	6.33	7.00	72.71	5.80	0.08	4.79
VII	Teliakheri	9.38	7.00	10.00	79.33	5.60	0.09	2.30
VIII	Manpura	10.62	5.66	6.66	74.72	7.04	0.11	3.02
IX	Malipura	9.11	5.00	8.33	69.31	6.90	0.07	2.58
X	Aktasha	11.24	5.33	10.33	93.61	6.50	0.09	2.74
XI	Govardhanpura	8.73	6.33	18.00	146.13	6.70	0.10	2.24
XII	SarolaKala	10.07	5.33	18.00	175.60	6.78	0.06	2.74
Range		2.61-14.45	5.00-15.00	5.00-18.00	41.50-175.60	5.60-7.41	0.06-0.11	1.19-9.21
Overall Mean		9.60	7.10	9.96	89.51	6.66	0.08	4.17
CV (%)		10.73	14.44	8.43	2.62	1.59	17.77	12.13
SEm		0.84	0.83	0.68	1.91	0.08	0.01	0.41
CD 5%		1.74	1.73	1.42	3.97	0.17	0.02	0.85

Data analyzed using Indostat Software.

Table 3: *Physical Analysis for 12 land races of Lasoda in Jhalawar district.*

S.No	Characters	CV%	Phenotypic variation	Genotypic variation	PCV%	GCV%	Heritability%	Genetic advance%
1	Fruit weight (g)	10.73	10.15	9.08	33.15	31.36	89.51	61.13
2	Wt. of bunch. (g.)	2.62	10.00	10.61	40.36	40.28	99.39	82.63
3	No. of fruit branches/bunch	14.44	7.93	6.88	39.66	36.94	86.74	70.87
4	No. of fruits/ bunch	8.43	24.13	23.13	48.58	49.30	97.07	98.60
5	TSS (obrix)	1.59	0.30	0.29	8.30	8.15	96.32	16.48
6	% Acidity	17.77	0.0002	0.004	25.32	18.03	50.72	26.46
7	Pulp: Stone ratio	12.13	7.67	7.57	65.06	64.67	98.79	132.42

Data analyzed using Indostat Software

Table 4: *Estimation of the coefficient of variation, genotypic coefficient of variation, phenotypic coefficient of variation, heritability and genetic advance for 12 land races of Lasoda in Jhalawar district.*

Bibliography

1. Peter KV. "Horticulture Science Series". Fruit Crops, New India Publishing Agency 3 (2007): 353.
2. Stern L and Roche K. "Genetics of forest ecosystems". Ecological Studies 6.330 Series 70 Abb. Springer Verlag. Berlin-Heidelberg-New York (1974): 622-623.

3. AOAC "Official Methods of Analysis". Association of Official Analytical Chemists, Washington, DC., (1990) U.S.A
4. Singh RK and BD Chaudhury. "Biometrical Methods of Quantitative Genetic Analysis". Kalyani Pub, New Delhi (1985).
5. Johnson HW., *et al*. "Estimates of genetic and environmental variability in soybeans". *Agronomy Journal* 47.2 (1955): 314-318.
6. Allard RW. "Principles of Plant Breeding". John Willy and Sons. Inc. New York. 96.
7. Eckebil TP., *et al*. "Heritability estimates, genetic correlations and predicted gains from S1 progeny tests in three grain sorghum random mating populations". *Crop Science* 17.3 (1976): 374-377.
8. Hanson CH., *et al*. "Biometrical studies in yield in segregating populations of Korean Lespedoza". *Agronomy Journal* 48.6 (1956): 268-272.
9. Prasad MB NV and GSP Rao. "Genetic variability, correlations and path coefficient analysis for some morphological and biochemical constituents of acid lime fruit". *Scientia Horticulture* 41.1-2 (1989): 43-53.

Volume 2 Issue 2 September 2015