

Genetic Variability in the Germplasm of Mehndi (*Lawsonia inermis*)

Manjit Singh, S.K. Jindal and Rekha Sivadasan

Central Arid Zone Research Institute, Jodhpur 342 003, India

Abstract: *Lawsonia inermis* Linn., a dye yielding perennial shrub, is commonly known as mehndi or henna. Cuttings from 20 shrubs selected on the basis of high leaf yield, minimum flowering and fruiting, free from insect pests, etc., were collected from different sites of Rajasthan and Gujarat and evaluated in RBD with three replications. There were significant differences for plant height, plant spread, primary branches, fresh biomass, dry leaf yield and dry stem weight per plant except lawsone content. Accession Dhandhuka has been found to contain maximum lawsone content per plant and for immediate gains this accession can be multiplied at large scale and distributed to the farmers.

Key words: *Lawsonia inermis* Linn., genetic variability, germplasm improvement.

Lawsonia inermis Linn., native of North Africa and south-west Asia, is commonly known as mehndi or henna in India. It is an important dye yielding plant of the semi-arid area and is being cultivated under rainfed and irrigated conditions. It is under cultivation in over 30000 ha area and is increasing at 6% a year in Sojat region. It is a self-compatible insect pollinated species (Singh *et al.*, 2005). Until 2000 no work on its genetic improvement was done. In 2001 genetic improvement for higher foliage and lawsone content was undertaken and twenty clones from different sites were evaluated.

Materials and Methods

Exploratory surveys of arid and semi-arid areas of Gujarat and Rajasthan were undertaken during 2001 and cuttings from individual 20 shrubs with higher foliage, dark green and large leaves free from insect pests and diseases were collected from 20 different sites. The cuttings were rooted. These clones were transplanted in a single-

row-plot of 3 m length accommodating six plants per row in randomized complete block design with three replications at central research farm of the Institute, during August 2001. Plant to plant distance within and between rows was 0.5 m and 1.0 m, respectively. The study area (Jodhpur) is located between 26°15' N-26°22'30" N and 73°7'E-73°7'30"E at an elevation of 300 m. The mean monthly temperature varies from 17°C in January to 34.5°C in May. Average total annual rainfall is 366 mm, of which about 90% occurs during rainy season, but frequent droughts are also not uncommon. Mean monthly wind speed ranges from 7.3 km h⁻¹ (December) to 20 km h⁻¹ (May).

Data on height, spread of the plant, number of primary branches per plant, fresh biomass, dry leaf weight (including fruits) and dry stem weight were recorded on three randomly selected plants from each plot during October 2003. The lawsone content was estimated using method of Pratibha and Korwar (1999) taking random

sample of leaves from the three plants marked for recording morphological observations. The mean values were used to compute analysis of variance (ANOVA), phenotypic coefficient of variation, genotypic coefficient of variance, heritability and genetic advance. The genotypic variance (σ^2_g) was obtained following Burton (1952). Heritability was obtained from the variance component analysis (Hanson *et al.*, 1956) and the expected genetic advance (%) was calculated (Johnson *et al.*, 1955).

Results and Discussion

There were significant differences for plant height, plant spread, primary branches, fresh biomass, dry leaf and dry stem (Table 1). From table it is clear there was wide range of variability among different clones for all but one trait i.e., lawsone content.

The highest PCV was observed for dry leaf weight per plant followed by dry stem weight per plant and fresh biomass per plant. Comparatively low PCV were

observed for plant spread and plant height. The magnitudes of GCV were lower than PCV. A similar trend was observed in other perennials by Khajuria *et al.* (1986) in peach, Vijulan Harris *et al.* (1994) in cashew and Sharma and Chandrababu (1997) in almond. Heritability estimates were high for plant height, followed by fresh biomass and dry stem weight indicating a high response to selection for all these characters. Dry leaf yield is greatly influenced by the environment, thus showed low heritability.

A low genetic advance implies that the heritability of a particular character in a specific environment was mainly due to non-additive gene action (dominance and epistasis), whereas if the heritability was due to additive gene effects it would be associated with high genetic advance. In this study, moderate heritability coupled with high genetic advance was observed for fresh biomass and dry stem weight showing variability in these characters might be attributed to additive gene action. On the other hand, high heritability with low

Table 1. ANOVA for various morphological characters and lawsone content in mehndi

Source of variation	d.f.	Mean square						
		Plant height	Plant spread	Primary branches	Fresh biomass	Dry leaf	Dry stem	Lawsone content
Blocks	2	0.06*	67.2	14.40*	94058*	2178	32396*	0.03
Accessions	19	0.12**	243.6*	5.61*	136776**	1402*	34230**	0.17
Error	38	0.02	109.8	2.96	28214	743	7584	0.11
Heritability (%)		68.3	28.9	23.0	56.2	22.8	53.9	16.9
Genetic advance		0.32	7.4	0.93	294.38	14.58	142.67	0.13
GA as % of mean		22.4	8.82	12.64	49.98	27.46	50.23	6.30
G CV		13.1	8.0	12.8	32.3	27.9	33.2	7.4
PCV		15.8	14.8	26.7	43.0	58.4	45.2	17.9
ECV		8.9	12.5	23.4	28.5	51.3	30.7	16.3
Minimum		1.00 m	72.7 cm	5.43	275 g	23.3 g	0.6 kg	1.50%
Maximum		1.74 m	104.3 cm	10.8	983 g	98.3 g	1.95 kg	2.32%

* P<0.05 and ** P<0.01.

Table 2. Mean performance of different accessions for morphological traits and lawsone content in mehndi

Accession	Plant height (m)	Plant spread (cm)	Primary branches/plant	Fresh biomass/plant (g)	Dry leaf/plant (g)	Dry stem/plant (g)	Lawsone content (%)
Amirgarh	1.55	75.7	6.43	495	28.3	325	2.22
Anand	1.27	77.7	8.80	394	43.9	177	2.21
Dhandhuka	1.70	86.0	8.10	889	86.1	409	2.00
Khedsam	1.74	90.7	7.77	983	81.7	495	1.86
Kothara	1.53	74.3	10.80	661	52.8	320	2.32
Malav	1.63	87.0	9.87	805	55.0	398	2.08
Malpur	1.61	102.0	6.10	783	35.0	434	2.15
SK Nagar	1.40	92.0	5.80	494	46.1	230	1.91
Sarotra	1.43	86.3	7.30	600	51.9	272	1.48
Sidhpur	1.58	79.3	8.33	589	41.4	298	1.88
Vasda	1.30	78.0	6.37	442	30.6	212	1.94
Ajmer	1.38	88.0	6.23	500	51.1	207	2.20
Bikaner	1.31	87.7	7.20	597	71.1	249	2.13
Jobner	1.50	104.3	7.67	894	71.1	426	2.07
Jodhpur	1.04	76.3	6.80	300	42.4	154	1.82
Jadiya	1.45	72.7	7.10	450	24.5	242	2.21
Pali	1.53	89.7	6.90	856	98.3	348	1.67
Panchotiya	1.20	80.0	7.80	416	79.6	167	1.50
Sojat	1.00	73.0	5.43	275	47.8	126	1.85
Wav	1.34	78.3	5.97	367	23.3	187	2.13
Grand Mean	1.42	83.9	7.34	589	53.1	284	1.98
CD 5%	0.22	18.0	2.95	288	46.7	140	NS
CD 1%	0.30	24.6	4.04	395	64.0	204	NS

genetic advance for plant height indicated non-additive gene action and hence, limited scope for selection for this character. Low GA is because of presence of low PCV and GCV.

Mean performance of individual clones is given in Table 2. Mean plant height was 1.42 m and it ranged between 1.00 m for accession Sojat to 1.74 m for accession Khedbram. Similarly mean values were 83.9 cm for plant spread, 7.34 for number of primary branches, 589 g for fresh biomass per plant, 53.1 g for dry leaf weight per

plant, 284 g for dry stem weight per plant and 1.98% lawsone content of dry leaves. For dry leaf weight per plant the accessions that showed more than 40% increase over mean of the population were Pali, Dhandhuka, Khedbram and Panchotiya. For lawsone content, only accession Kothara (2.32%) showed more than 15% lawsone over mean of the population.

Genotypic and phenotypic correlations showed significant and positive association of plant height with plant spread, fresh biomass and dry stem weight (Table 3).

Table 3. Genotypic and phenotypic correlation coefficients among various morphological traits and lawsone content in mehndi

Source of variation	Plant height	Plant spread	Primary branches	Fresh biomass	Dry leaf weight	Dry stem weight	Lawsone content
Plant height	–	0.47	0.679	0.897	0.269	0.973	0.443
Plant spread	0.462*	–	-0.053	0.732	0.361	0.631	-0.273
Primary branches	0.190	-0.127	–	0.655	0.410	0.683	0.725
Fresh biomass	0.786**	0.684**	0.206	–	0.661	0.964	0.052
Dry leaf weight	0.260	0.447*	0.215	0.625**	–	0.412	-1.117
Dry stem weight	0.817**	0.653**	0.117	0.934**	0.411	–	0.266
Lawsone content	0.106	0.033	-0.034	-0.013	-0.167	0.077	–

Above diagonal (genotypic correlations) * P<0.05, ** P<0.01. Below diagonal (phenotypic correlations).

Similarly, the associations were positive and significant for dry leaf yield with plant spread and fresh biomass. Number of primary branches per plant and lawsone content did not show significant association with other characters. For most of the cases, genotypic correlation coefficient values were more than phenotypic ones.

High heritability and genetic advance for fresh biomass and dry leaf weight indicated that variability for these characters might be due to additive gene action. At present, there are no varieties of mehndi. For immediate gains accession Dhandhuka, which ranked first for lawsone content per plant, can be multiplied and distributed to the growers.

Acknowledgements

The present study is the part of National Agricultural Technology Project – Genetic Improvement of Economically Important Plants/Shrubs of Arid Regions being funded by ICAR. The same is acknowledged.

References

- Burton, G.W. 1952. Quantitative inheritance in grasses. *Proceedings of the 6th International Grassland Congress* 1: 277-283.
- Hanson, C.H., Robinson H.F. and Comstock R.E. 1956. Biometrical studies of yield in segregating population of korean lespedeza. *Agronomy Journal* 48: 268-272.
- Johnson, H.W., Robinson, H.F. and Comstock, R.E. 1955. Genotypic and phenotypic correlations in soybeans and their implications in selection. *Agronomy Journal* 47: 477-483.
- Khajuria, H.N., Nijjar, G.S. and Chanana, Y.R. 1986. Variability studies in Peach (*Prunus persica* Batsch). In *Advances in Research on Temperate Fruits* (Eds. T.R. Chandha, V.P. Bhutani and J.L. Kaul), pp. 30-35. Proceedings of the National Symposium on temperate fruits; 1984 March 15-18, Dr. Y.S. Parmar University of Horticulture and Forestry, Solan (India).
- Pratibha, G. and Korwar, G.R. 1999. Estimation of lawsone in henna (*Lawsonia inermis*). *Journal of Medicinal and Aromatic Plant Sciences* 21: 658-660.
- Sharma, R.K. and Chandrababu, R.J. 1997. Genetic variability studies in almond. *Plant Genetic Resources Newsletter* 112: 93-94.
- Singh, Manjit, Jindal, S.K. and Singh, Deepa 2005. Natural variability, propagation, phenology and reproductive biology of henna. In *Henna – Cultivation, Improvement and Trade* (Eds. Manjit Singh, Y.V. Singh, S.K. Jindal and P. Narain), pp. 13-18. CAZRI, Jodhpur.
- Vijulan Harris, C.R., Suthanthira, Pandran, I.R. and Tangavelu, S. 1994. Variability studies in metric traits in Cashew (*Anacardium occidentale* L.). *South Indian Horticulture* 42: 13-14.