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VARIABILITY IN INDIAN *ALOE*

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Forty-four populations of Indian Aloe *were evaluated for agro-botanical characters and aloin content. Analysis of the data has shown that aloin content was positively correlated with short, broad and thick leaves. Eight promising lines have been identified for comparative evaluation and domestication. A chemical test has shown that 13 lines were showing Klunge negative test suggesting a need for further taxonomic validation of Indian material under* Aloe barbadensis.

Aloe barbadensis is a xerophytic perennial herb with short stem, fleshy convex leaves having distant spiny margin and tapering towards the top. The leaf lamina is streaked with small dull-white spots or lines. The species is occasionally raised as a potted plant and is propagated by suckers. It is native of north Africa, Canary islands, Spain but has spread during distant past to Italy, China, India, East and West Indies and host of other countries. Its main active principle is aloin or barbaloin (Groom and Reynold, 1987) which has been shown to occur in 85 out of 240 *Aloe* species (Reynold, 1985). However, this is the solitary species reported in India and it has 2 or 3 easily recognisable varieties (Anon, 1985). *Aloe* species are used extensively in drugs and cosmetics industries. Aloin, the main purgative principle, is a mixture of anthracene derivatives (Fairbairn, 1949). Chemically it is a 10-glycopyranosyl derivative of aloe emodin anthrone [10-(1-deoxyglycosyl) aloe emodin anthrone]. The Indian species (*Aloe barbadensis*) also contains isobarbaloin; wherein another commercially prominent species *Aloe ferox* contains an amorphous barbaloin and aloinosides A and B (Anon., 1967).

Although aloe is commercially produced and traded under the name **mussabar** in Indian market for drug purpose, the populations growing in India have never been a subject of detailed evaluation for economic potential. It was decided to collect and evaluate the germplasm with emphasis on relative contribution of qualitative characters of the plant in biosynthesis of aloin.

MATERIALS AND METHODS

Explorations were organised to collect *Aloe* species from different districts of Rajasthan in the year 1987 and 1990 during October and November. This was augmented by materials collected from some growers

in the state nurseries and obtained from the stocks maintained at Regional Research centres of Central Council of Research for Ayurveda and Siddha medicines. The NBPGR has assembled and grown a total stock of 44 populations at Issapur Experimental Research Farm, New Delhi. These plantlets were raised on a small plot each representing a (6 m long) row. A spacing of 60 cm between the rows and 30 cm between the plantlets in a row was maintained. This crop was irrigated once a month except May and June when two irrigations per month were given. Leaves were collected for analysis during November and December, 1990 for their qualitative characters and aloin content. For this purpose, five mature leaves of nearly same age were picked from the outer part of the plant from each germplasm populations. Observations were recorded for following qualitative characters based on an average of the five leaves. (1) Fresh weight/leaf (gm), (2) Length/leaf (cm), (3) Breadth (lower)/leaf (cm), (4) Breadth (middle)/ leaf (cm), (5) Breadth (Upper)/leaf (cm), (6) Thickness (Lower)/leaf (cm), (7) Thickness (upper)/leaf (cm) and (8) Volume of latex/leaf (ml).

After recording the above characters, transverse incisions were made on the leaves and latex oozed out and collected in the beaker. A part of the latex was allowed to dry and aloin content was determined as aloin per cent of dry weight. of latex. The second part of the latex was transferred to separating funnel and repeatedly extracted (4 x 25 ml) with ethyl acetate. The combined ethyl acetate extracts were evaporated under reduced pressure and low temperature (< 50°C). This dried extract was analysed for aloin content per 100 ml of latex by the usual colorimetric method (Anon., 1967).

An isobarbaloin test was also simultaneously carried out. This is based on Klunge test (Anon., 1983) and used for the differentiation of *Aloe barbadensis* from other allied species.

RESULTS AND DISCUSSION

The variation in population for qualitative characters and aloin content in the germplasm is shown in Table 1 and 3. In one year old plant (collected during the year 1990), the fresh weight varied from 40 gm to 373 gm per leaf. Similarly volume of latex exudate varied from 1 ml to 65 ml and its aloin content (mg/100 ml) from 1.62 to 68.74 or in term of aloin percentage being 0.23 to 5.17. The statistical analysis of the values shown through correlation matrix (Table 2) suggested a strong positive correlation amongst different characters such as between length, breadth, fresh weight, thickness and volume of exudates. It was significant to find negative correlation between the length of the leaf and aloin content of the exudate at 5 per cent level of significance.

The variations in agro-botanical and chemical traits are found to be maintained with age in four year old plants collected and planted during the year 1987 (Table 3) and the trend for correlation (Table 4) amongst the values of characters is more or less similar to those recorded for one year old plants. However, an interesting correlation was observed between breadth and thickness of the leaf with its aloin content at 1 per cent level of significance.

Table 1. Range of variation in agrobotanical and chemical characters of 44 germplasm lines (one year old plants)

	Characters	Minimum	Maximum
1.	Av. length/leaf (cm)	19.00	46.00
2.	Av. breadth/leaf (cm)	2.10	8.20
3.	Av. breadth/leaf middle (cm)	2.00	6.20
4.	Av. breadth/leaf upper (cm)	1.00	4.10
5.	Av. thickness lower (cm)	0.40	2.50
6.	Av. thickness upper (cm)	0.20	1.30
7.	Av. volume of latex/leaf (ml)	1.00	65.00
8.	Aloin content ,g/100 (ml)	1.62	68.74
9.	Aloin content percent dry wt. of latex	0.23	5.17
10.	Av. fresh wt./leaf (gm)	40.00	373.00

Based upon this study, we may conclude that small size plant with broad and thick leaves is the ideal type for domestication; it produces higher yield of aloins. The chemical analysis has identified some promising lines in term of aloin content viz. IC-112526 (4.21 %), IC-112529 (4.63 %), IC-112535 (4. 21 %), IC-112536 (5.17 %), IC-111267 (4.71 %), IC-111271 (4.07 %), IC-111273 (4.31 %) and IC-111280 (4. 83 %). Since mature leaves from the outer periphery of the plant, were used for analysis of aloin content in this experiment, this was found to be low (up to 5.17 %) compared to the aloin content in younger leaves attached just below the apex. In fact, a very high percent of aloin in the young leaves of different species have been recorded (Groom and Reynold, 1987) and maintained at Kew Botanical Garden. Aloin level decreases in older leaves but weight by weight, these leaves constitute the main farm produce.

Table 2. Correlation matrix between agrobotanical and chemical characters

	1	2	3	4	5	6	7	8	9	10***
1	1.00									
2	0.577**	1.000								
3.	0.602**	0.858**	1.000							
4.	0.277	0.709**	0.861**	1.000						
5.	0.398*	0.781**	0.676**	0.593**	1.000					
6.	0.277	0.527**	0.485*	0.434	0.745	1.000				
7.	0.502*	0.629**	0.507**	0.269	0.507	0.246	1.000			
8.	0.305	0.257	0.091	0.118	0.353	0.141	0.169	1.000		
9.	0.412*	0.084	0.094	0.052	0.110	0.057	0.127	0.936**	1.000	
10.	0.607	0.610**	0.437*	0.095	0.509**	0.206	0.846**	0.134	0.108	1.000

* Significant at 5 % level

** Significant at 1 % level

*** Numbers indicate the characters mentioned in Table 1.

Furthermore, Klunge test (Anon., 1983) has been used to identify isobarbaloin containing populations in the Indian material. This has brought

Table 3. Range of variation in agrobotanical and chemical characters of 44 germplasm lines(4 years old plants)

	Characters	Minimum	Maximum
1.	Av. length/leaf (cm)	14.80	37.50
2.	Av. breadth/leaf (Lower) (cm)	3.20	7.08
3.	Av. breadth/leaf (Middle) (cm)	2.30	5.25
4.	Av. breadth/leaf (Upper) (cm)	1.00	2.25
5.	Av. thickness (Lower) (cm)	1.00	2.00
6.	Av. thickness (Upper) (cm)	0.50	1.04
7.	Av. volume of latex/leaf (ml)	4.00	37.50
8.	Aloin content (mg/100) (ml)	5.73	53.06
9.	Aloin content (percent dry wt. of latex)	0.56	4.83
10.	Av. fresh wt/leaf (gm)	32.00	227.00

out that 13 germplasm lines amongst a total 44 accessions examined showed absence of isobarbaloin compound *i.e.* showing Klunge negative test. Obviously, these do not confirm to description of the taxa under *Aloe barbadensis*. This has opened up a need for detailed study and redefining taxonomic characterisation of the Indian taxa by making further grouping.

Table 4. Correlation Matrix between agrobotanical and chemical characters

	1	2	3	4	5	6	7	8	9	10
1.	1.000									
2.	0.756**	1.000								
3.	0.749**	0.975**	1.000							
4.	0.586*	0.632**	0.695**	1.000						
5.	0.366	0.722**	0.729**	0.625**	1.000					
6.	0.387	0.648**	0.633**	0.687**	0.904**	1.000				
7.	0.813**	0.819**	0.805**	0.678**	0.517	0.537	1.000			
8.	0.323	0.492	0.470	0.667**	0.477	0.611**	0.422	1.000		
9.	0.247	0.457	0.406	0.462	0.521	0.642**	0.433	0.825**	1.000	
10.	0.848**	0.812**	0.785**	0.590*	0.343	0.402	0.882**	0.328	0.349	1.000

* Significant at 5 % level

** Significant at 1 % level

*** Numbers indicate the characters mentioned in Table 3.

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