Indian J. Genet., 51 (1): 134–138 (1991)

VARIATION OF CHEMO-BOTANICAL CHARACTERS IN THE INDIGENOUS COLLECTIONS OF *RAUVOLFIA SERPENTINA*

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(Received: November 7, 1983; accepted: April 5, 1990)

ABSTRACT

The National Bureau of Plant Genetic Resources undertook the collection of *Rauvolfia serpentina* L. from its natural habitats in the Western Ghats of the country. The highest range of variation for total root weight/plant and No. of secondary roots/plant was observed in the collections from Coondapur and Conacana regions of Karnataka and Goa, respectively. These two characters contribute to high alkaloid recovery. The Coondapur region gave the highest range (1.58–2.03) of total alkaloids with a mean of 1.81. The same pattern was observed for reserpine content with the range of 0.07–0.24 and mean value of 0.16%. Such chemo-botanical variation in these materials is natural due to their geographic, ecological and topographic variation. On the basis of these studies, it is highly desirable to make more intensive and systematic collection of these types from these regions for conservation and utilization.

Key words: *Rauvolfia serpentina*, floristic zones, reserpine, alkaloids, ecological nitches.

Sarpagandha (*Rauvolfia serpentina* L.) Benth ex Kurtz, an Indian plant first mentioned by Sushruta in 600 B.C., has been in use in numerous Ayurvedic formulations since long. Though the first record of its therapeutic application in hypertension in India was reported recently, in the vast rural areas of India, at the first signs of insomnia, melancholia schizophrenia or more violent mental disorders, the old ladies or the village physician used to soak the roots of *Sarpagandha* in rose water and administer it [1]. The plant being indigenous has scattered distribution in the different floristic zones of the country with a lot of natural diversity.

The National Bureau of Plant Genetic Resoures made its sizeable collection from the Western Ghats of India during 1976, 1977 and 1978 to conserve the existing genetic variation [2]. These collections provide a good sample of the variability that exists in the natural habitats. The collected variability could be utilized better, only if an integrated study on biology and chemistry of these natural populations is undertaken. Thus, studies on the variation pattern of botanical characters, including the active principles found in them, were

undertaken with the explicit object of screening, pinpointing the pockets of diversity and isolating the types with high root yield, besides being rich in alkaloid content.

MATERIALS AND METHODS

The collections made from the Western Ghats of India covering Karnataka and Goa, were raised at NBPGR, New Delhi in pots [3], keeping one plant per pot and 10 pots for each region to record observations on the botanical characters. The plants were uprooted to study different root characters after 18 months of growth under the new environment. Observations were recorded on total root weight/plant, No. of secondary roots/plant, total shoot weight/plant, and No. of branches/plant. The data collected were analysed separately to determine mean, range, standard error and coefficient of variation (Table 1). The phenotypic coefficient of variation (PCV) was estimated as suggested [4] and shown in Table 1. The roots from the ten pots assigned to each region were bulked, dried and powdered. Random samples of 50 g of powdered root were drawn from each region for the estimation of total alkaloids and reserpine content [5].

Table 1. Range, mean, CV and SD of various root and shoot characters in *R. serpentina*

Character	Karnataka		Goa					Overall
	Coondapur	Mangalore	Qupem	Sanguem	Conacana	Molleum	Valpoi	mean
Total root wt., g/plant:								
Range	15.3–24.1	12.5–18.7	18.0–22.5	9.3–27.1	13.4–31.2	16.8–19.0	8.0–20.4	
Mean	21.2	16.1	19.8	17.1	19.5	18.2	15.5	18.2
CV (%)	12.9	12.9	8.8	30.6	30.5	5.5	22.9	
SE	2.72	2.08	1.75	5.22	5.95	0.99	3.54	
No. of secondary roots/plant:								
Range	4.6–7.8	2.8–3.5	3.2–6.8	2.0–6.8	3.0–6.5	3.4–4.6	3.4–5.5	
Mean	6.0	3.2	5.0	4.7	4.7	4.1	4.5	4.6
CV (%)	16.0	6.9	22.0	35.3	28.2	10.0	13.8	
SE	0.96	0.22	1.10	1.66	1.32	0.41	0.52	
Total shoot wt., g/plant								
Range	5.6–11.6	7.3–12.5	8.3–12.5	4.0–20.0	7.3–19.2	9.8–13.8	9.6–20.3	
Mean	9.2	9.6	11.2	10.8	14.7	11.8	13.2	11.7
CV (%)	19.4	22.1	15.4	33.0	33.9	13.3	24.2	
SE	1.78	2.11	8.72	3.56	4.98	1.63	3.20	
No. of branches/shoot								
Range	1.2–6.9	1.1–2.0	1.0–2.0	1.0–4.2	1.1–1.6	1.1–1.2	1.1–2.9	
Mean	1.5	1.6	1.5	1.5	1.3	1.1	1.0	1.5
CV (%)	15.6	17.4	28.8	51.7	13.2	5.2	15.7	
SE	0.23	0.27	0.35	0.77	0.17	0.17	0.05	

Root characters. The t test of number of secondary roots indicated that the Karnataka material was, in general, significantly superior to that from Goa for number of secondary roots. The Coondapur (Karnataka) material gave significantly higher number of secondary roots as compared to the Sanguem, Valpoi and Mangalore materials. The Goan accessions did not differ significantly from each other, either in total root weight or for the formation of secondary roots.

Shoot characters. The number of branches/plant was significantly higher in the Mangalore and Coondapur materials (Karnataka) than in those of Molleum (Goa). However, total shoot weight in the collections from Valpoi and Conacana (Goa) was significantly higher than in the Karnataka material. The remaining collections from both areas did not show significant differences amongst themselves.

Chemical assessment. The range of variation and mean alkaloids along with reserpine content have been worked out for different regions (Table 2). In general, the Karnataka material was superior to that from Goa, both for total alkaloid and reserpine content. The Coondapur region had the widest range (1.58–2.03%) for total alkaloids with the mean content of 1.81%. The same pattern was observed for reserpine content, with the range of 0.07–0.24% and mean 0.16%. The t test (3.56^{**}) clearly revealed that the material from Coondapur had significantly higher alkaloid content than all other regions under study. Similar was the case for reserpine content, whose level was higher than all other locations except the Conacana material which was at par. Further detailed studies were carried out for different locations (collection sites) within each region. In Karnataka, Dehrana in Mangalore regions showed much higher mean reserpine content (Table 3) than the mean of 0.108% for the region (Table 2). Similarly, samples from Kuntmakky (0.17%) and Mavingule (0.20%), both in the Coondapur region, were superior to the regional mean reserpine content of 0.16%. The results indicate that these locations should be explored intensively for superior chemotypes with high reserpine content. Similarly, the Sanguem and Conacana regions of Goa could be a good source of high yielding genotypes. Such large chemo- botanical variation in the materials from these regions is natural due to their geographic, ecological and topographic variations. In

Table 2. Range of variation and means of total alkaloid and reserpine content in *R. serpentina* collections from different regions

Source	Total alkaloid %		Reserpine %	
	range	mean	range	mean
Karnataka				
Mangalore	1.30–1.74	1.52	0.01–0.24	0.11
Coondapur	1.58–2.03	1.81	0.07–0.24	0.16
Goa				
Sanguem	0.73–1.81	1.17	0.04–0.11	0.07
Conacana	1.09–2.30	1.73	0.07–0.15	0.11
Valpoi	0.74–1.47	1.13	0.08–0.12	0.01
Qupem	1.00–1.50	1.31	0.07–0.09	0.04

Karnataka, the latitudinal range was 12°–16°N while the areas in Goa extended from 15° to 16°N. Similar was the variation in soil and rainfall that varied from red laterite with the average rainfall of 1000-1500 mm in Karnataka to red loamy soils with the average precipitation of 3000 mm in Goa. The temperature in Karnataka during summer is higher and ranges from 38–45°C, whereas it is comparatively lower (27°–35°C) at Corgi in Goa [6]. Large variation was observed in the total alkaloid content in *R. serpentina* roots from 0.95 to 2.72% in the natural populations collected from Bihar [7]. Variable alkaloid content was observed in different geographical races of *R. serpentina* even after growing them under uniform environments. [7]. It was emphasised that the cause of this variation was genetical rather than environmental.

Table 3. Range and mean of alkaloid and reserpine content in *R. serpentina* from different pockets of each region in Karnataka

Location	Total alkaloid %		Reserpine %	
	range	mean	range	mean
Mangalore:				
Dehrana	1.35–1.50	1.42	0.23–0.24	0.23
Gundia	1.30–1.62	1.50	0.04–0.10	0.06
Marigunda	—	1.52	—	0.01
Coondapur:				
Seethanady	—	2.03	—	0.07
Madamakky	—	1.89	—	0.09
Kuntamakky	1.61–1.71	1.46	0.10–0.24	0.17
Thingale	1.67–2.03	1.85	—	0.19
Mavingule	1.53–1.77	1.55	0.16–0.24	0.02

Note: Range not reported when sample number was small.

Similarly in our studies, though the material was collected from different ecological conditions, the variability was studied by growing them in the same environment. Therefore, the botanical and chemical variations observed in the above studies can be attributed to genotypic differences. Similarly, morphological variations under different ecological nitches has been reported [8]. It is, thus, highly desirable that more intensive and systematic collections of these types are made in *Rauvolfia*, now a vanishing species, for conservation and ultimate utilization as early as possible.

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