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Exploration and Collection of Genetic Resources of Salparni (*Desmodium gangeticum* L.) in India

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ABSTRACT

Salparni (Desmodium gangeticum L.) is an important medicinal plant used in various indigenous systems of Medicine in India. Roots are the economic parts used astringent, analgesic, anti-inflammatory, diuretic, laxative and nervine tonic and in the preparation of Dasmoolarista, an important ayurvedic medicine. Developing cultivars with high root yield and quality are the important breeding objectives in salparni. Lack of germplasm accessions forms an impediment to the improvement of salparni. The main objective of the study is to explore the natural population and to conserve the variability in the gene bank. An exploration and collection mission for wild populations of salparni was carried out during 2008 to 2011 in India. Four exploration missions were undertaken and forty-three accessions were collected and regenerated ex situ for conservation. Morphologically accessions showed distinct variability for leaf size, leaf shape, leaf weight and plant height. The accessions will form a base for improvement yield and quality of salparni.

***Keywords*:** Salparni, *Desmodium gangeticum*, Exploration, Collection, Germplasm

INTRODUCTION

Salparni (*Desmodium gangeticum* (L.) DC.) is a perennial shrub belongs to the family Fabaceae and is an important member of *laghupanchamula* groups of plants coming under *dasamula* group. It is commonly known as 'Salpan', 'Salpani' in Hindi and 'Shalparni' in Sanskrit, and is used in Ayurveda, Siddha and Unani systems of medicine either as a single drug or in combination with other drugs (Indraji and Vanaspatishastra, 1998). Roots are the economic parts used commonly as astringent (Meena *et al.*, 2010), analgesic and anti-inflammatory (Rathi *et al*., 2004), diuretic (Niranjan and Tewari, 2008), laxative and nervine tonic(Meena *et al.*, 2010). Root decoction is used in folk medicine for treating fever. Roots are used in combination with other drugs for affections of chest and brain (Rastogi *et al*., 2011; Mishra *et al.*, 2005). It is one of the components of Chyavanpras, Dashmul Tail, Dasamula kwatha, Dasmoolarishta and Shalparni-adi-kwath preparations used in ancient systems of medicine (Kirtikar and Basu, 1935, Chopra *et al*., 1956). The unani preparation "Ark dashmul" contains roots of Salparni (Jabbar *et al.*, 2004). Root of plant growing on an ant-hill is made into a paste with water and given in cases of diarrhea (5-10g dosages) (Singh *et al.*, 2015). The plant is rich in flavonoids, alkaloids and pterocarpanoids which are responsible for its medicinal properties (Bhattacharjee *et al.*, 2013).

Salparni is native to Asian tropics and Australia and distributed in tropical parts of Asia (India, Sri Lanka, Himalayas, Thailand, Myanmar, Indo-china, Malaysia, China and Taiwan), Tropical Africa and Australia (Schrire, 1988). In India, the plant is widely distributed in the tropics and subtropics, predominately in the lower Himalayan regions and Gangetic plains (Singh, 2012; Kalkame *et al*., 2016). It grows wild in the forests up to 1500 m height from the mean sea level. It is cultivated in the plains and in the lower Himalayas for its traditional use. The plant is under shrub, grows up to 1 m height with Leaves ovate or lanceolate shape. Flowers are white, purple or lilac found in elongated terminal and axillary racemes of 10-30 cm, 2–6-flowered at each node (Lakhani and Nanavati 1962). Flowering and fruiting occur twice a year, from May to June and from September to October. Chromosome number is 2n=22, diploid (Sanjappa and Bhatt, 1985) and mode of pollination

is self-pollinated (Nandanwar and Manivel, 2014). Salparani is one among the 70 medicinal plant species in high trade (exceeds 1000 MT) sourced from tropical forests (Ved and Gorya, 2008).

Even though salparni is being cultivated, the availability of high yielding varieties limits its large-scale cultivation. Hence, the development of high yielding varieties with desired quality is the needed in order to increase the production and productivity. Germplasm constitute the basic raw materials required for the improvement of salparni. Only a few germplasm collections of this crop have been collected and maintained. The present exploration was planned with an objective to collect various germplasm for conservation and their use in breeding.

MATERIALS AND METHODS

The study was conducted at ICAR-Directorate of Medicinal and Aromatic Plants Research, Anand, Gujarat during the year 2008 to 2011. Exploration trips were conducted at Uttarakhand, Himachal Pradesh, Gujarat, Rajasthan, Tamil Nadu and West Bengal as well as north-east regions of the country. An exploration conducted during September to December as per the availability of plants as well as seeds. Location of exploration was decided looking at the flora of the location (Lakhani and Nanavati, 1962 ; Pullaiah and Chennaiah, 1997; Verma *et al.*, 1993) and based on review of literature (Sharma, *et al.*, 2002; Warrier *et al.*, 1994; Jayaprada and Geekiyanage, 2016). The data on passport information containing ecological conditions (*viz*. altitude, latitude, longitude) and morphological observation *viz.*, plant height (PH), internode length (IL), petiole length (PL), lamina length (LL), lamina width (LW), leaf area (LA) and leaf fresh weight (LFW) were collected at the collection site and leaf dry weight (LDW) was recorded later in the lab. The data on altitude, latitude and longitude were recorded at the collection site using handheld GPS (eTrex 10, Garmin Ltd, Olathe, Kansas, USA) and route maps were prepared using Map Source Software (Garmin Ltd, Olathe, Kansas, USA). The plant height was measured from base to the tip of inflorescence using scale and expressed in cm. The internode length is the distance between leaf nodes was measured with the help of scale and was expressed in cm. The petiole length was measured with the help of scale and was expressed in cm. The lamina length was measured with the help of scale and was expressed in cm. The leaf area was derived using Leaf area meter (LI-3000A, Li-Cor Inc, Lincoln, Nebraska) and expressed cm^2. Fresh leaves weight per plant expressed in grams. Dry leaves weight per plant was measured as weight of the leaves after oven drying at 60ÚC for 24 hours was measured in grams for each plant. Whole plant as well as seeds were collected for regeneration *ex situ*. Collections were multiplied and maintained at the ICAR-Directorate of Medicinal and Aromatic Plants Research (DMAPR), Anand, Gujarat, India for further study and use.

RESULTS AND DISCUSSION

The objective of exploration was to collect germplasm accessions for conservation and their use in breeding. As there were a very few salparni collections maintained at DMAPR, four exploration trips were undertaken during 2008 to 2012 and a total of forty-three accessions were collected from Gujarat (16), Maharashtra (5), Rajasthan (4), Tamil Nadu (3), Andra Pradesh (3), Uttarakhand (3), Orissa (3), Madhya Pradesh (2), West Bengal (1), Assam (1), Jharkhand (1) and Dadar haveli (1) states of India. The collections were made from an altitude of 15 m to 2264 m from the mean sea level. The list of collections along with their passport were presented in Table 1 and depicted in Figure 1. Considerable variation was observed for morphological characters among the collections (Table 2). Plant height (cm) ranged from 13.3 cm (DDG-26) to 207.7 cm (DDG-5) in the collection indicating wide variability. Other traits such as Internode length (cm), Petiole length (cm), Lamina length (cm), Lamina width (cm), Leaf area (cm^2), Leaf fresh weight (g) and Leaf dry weight (g) also showed variability in collections indicating existence of diversity.

The accessions were regenerated at ICAR-DMAPR, Anand after collection during 2008-2012 and distinct morphotypes were identified viz., prostrate dwarf plant (DDG-6) was collected from Dholvani forest range, Sabarkanta, Gujarat, tall erect type (DDG-15), narrow long leaf (DDG-29), broad large leaf (DDG-8), white flower (DDG-18), pink flower (DDG-8), ovate leaf shape (DDG1),

Table: 1. Passport information of the germplasm accessions of salparni (*Desmodium gangeticum* L.)

Accession no.	Village	District	State	Type of Material	Alt. (m)	Latitude	Longitude
DDG-1	Waghai	Dang	Gujarat	Whole plant	528	20° 44.221’	73° 41.835’
DDG-2	Waghai	Dang	Gujarat	Whole plant	500	20° 43.270’	73° 41.680’
DDG-3	Rambhas	Dang	Gujarat	Whole plant	505	20° 59.568’	73° 28.250’
DDG-4	Rambhas	Dang	Gujarat	Whole plant	521	20° 44.672’	73° 41.632’
DDG-5	Rambhas	Dang	Gujarat	Whole plant	523	20° 44.659’	73° 30.124’
DDG-6	Dholvani forest range	Sabarkantha	Gujarat	Whole plant	320	23° 59.148’	73° 17.920’
DDG-7	Dholvani forest range	Sabarkantha	Gujarat	Whole plant	267	23° 59.179’	73° 12.536’
DDG-8	Gandhinagar	Gandhinagar	Gujarat	Whole plant	235	23° 14.359’	72° 40.576’
DDG-9	Pavagadh	Panchmahal	Gujarat	Whole plant	113	22° 25.841’	73° 35.743’
DDG-10	Girnar Hill	Junagadh	Gujarat	Whole plant	170	21° 31.374’	70° 30.103’
DDG-11	Suruhi falla	Teni	Tamilnadu	Whole plant	403	09° 39.583’	77° 18.365’
DDG-12	Veerappayainar	Teni	Tamilnadu	Whole plant	325	10° 03.149’	77° 26.862’
DDG-13	Tanipare	Virudhnagar	Tamilnadu	Whole plant	192	09° 42.140’	77° 37.743’
DDG-14	Eastern Ghats- Central region	Vishakhapatnam	Andhra pradesh	Whole plant	164	17° 45.537’	82° 32.639’
DDG-15	Eastern Ghats- Central region	Vishakhapatnam	Andhra pradesh	Whole plant	747	17° 53.122’	82° 20.685’
DDG-16	Dholvani forest range	Sabarkantha	Gujarat	Whole plant	267	23° 59.179’	73° 12.536’
DDG-17	Sasan	Junagadh	Gujarat	Whole plant	125	21° 10.366’	70° 30.103’
DDG-18	Eastern Ghats- Central region	Vishakhapatnam	Andhra pradesh	Whole plant	92	17° 40.565’	82° 36.623’
DDG-19	Hathni	Damoh	Madhya pradesh	Whole plant	1198	23° 45.317’	79° 27.849’
DDG-20	Meghnagar	Zabua	Madhya pradesh	Whole plant	1250	23° 00.569’	74° 40.858’
DDG-21	Kamrup	Kamrup	Assam	Whole plant	-	26° 9.56.81’	91° 42.21.19’
DDG-22	Vasano	Dadra Nagar Haveli	UT	Whole plant	15	21° 11.850’	73° 02.755’
DDG-23	Dhaga Bhavan	Wardha	Maharashtra	Whole plant	1193	21° 01.228’	78° 28.325’
DDG-24	Abu road	Sirohi	Rajasthan	Whole plant	4256	24° 37.859’	72° 45. 954’

DDG-25	Paliyakheda	Udaipur	Rajasthan	Whole plant	1935	24° 23. 524’	73° 31.317’
DDG-26	Banswara	Banswara	Rajasthan	Whole plant	621	23° 30.692’	74° 22.802’
DDG-27	Umedganj forest	Kota	Rajasthan	Whole plant	915	25° 07. 963’	75° 56. 469’
DDG-28	Kalyani	Nadiya	West Bengal	Whole plant	-	-	-
DDG-29	Toroda	Gondia	Maharastra	Whole plant	969	21° 27. 805’	80° 11. 243’
DDG-30	Ghodezan	Chandrapur	Maharastra	Whole plant	789	20° 23. 791’	79° 43. 383’
DDG-31	Lohara	Chandrapur	Maharastra	Whole plant	708	19° 58. 511’	79° 21. 724’
DDG-32	Chorbawli	Nagpur	Maharastra	Whole plant	1198	21° 29. 086’	79° 19. 297’
DDG-33	Eastern Ghat Forest	Jamshedpur	Zarkhand	Whole Plant	492	22° 49.414’	86° 12.671’
DDG-34	Eastern Ghat Forest	Nayagadh	Orissa	Whole plant	241	20° 08.11’	84° 58.315’
DDG-35	Eastern Ghat Forest	Phulbani	Orissa	Whole plant	422	20° 23.317’	84° 45.335’
DDG-36	Eastern Ghat Forest	Phulbani	Orissa	Whole plant	490	20° 21.966’	84° 47.581’
DDG-37	Ramgadh	Nainital	Uttara Khand	Whole plant	569	29° 18.818’	79° 20.785’
DDG-38	Ramgadh	Nainital	Uttara Khand	Whole plant	569	29° 18.818’	79° 20.785’
DDG-39	Nr. BHowali	Bhowali	Uttara Khand	Whole plant	411	29° 27.392’	79° 08.606’
DDG-40	Rajpipla	Narmada	Gujarat	Whole plant	507	21° 44.817’	73° 28.913’
DDG-41	Mandvi	Surat	Gujarat	Whole plant	449	21° 24.626’	73° 30.118’
DDG-42	Motapondha	Valsad	Gujarat	Whole plant	140	20° 22.044’	73° 02.005’
DDG-43	Malegam	Dang	Gujarat	Whole plant	2264	20° 35.199’	73° 44.505’

Table: 2. Variability among the accessions for various morphological characters of salparni (*Desmodium gangeticum*)

Accession no.	Plant height[a] (cm)	Internode length[b] (cm)	Petiole length[c] (cm)	Lamina length[d] (cm)	Lamina width[e] (cm)	Leaf area[f] (cm^2)	Leaf fresh weight[g] (g)	Leaf dry weight[h] (g)
DDG-1	119.0	2.9	3.0	5.2	5.2	36.24	8.9	2.6
DDG-2	78.4	2.6	2.6	5.8	5.8	36.98	10.8	3.7
DDG-3	163.1	2.7	2.6	6.7	6.7	45.36	12.1	4.1
DDG-4	95.3	2.3	1.8	4.9	4.9	24.27	6.2	2.4
DDG-5	73.0	3.9	2.0	4.8	4.8	20.87	5.3	2.1
DDG-6	60.0	3.1	2.2	4.8	4.8	24.44	6.3	2.8
DDG-7	157.1	2.8	1.8	6.4	6.4	44.68	9.1	5.0
DDG-8	161.4	4.2	2.1	5.7	5.7	39.77	8.5	3.8
DDG-9	173.7	3.1	2.7	4.9	4.9	27.83	6.4	2.0
DDG-10	157.1	2.1	1.9	4.8	6.4	24.27	6.2	2.4
DDG-11	76.0	1.4	2.4	3.3	3.3	11.59	4.2	1.3
DDG-12	52.0	2.2	2.8	6.0	6.0	44.23	12.3	4.1
DDG-13	80.7	3.0	2.1	6.3	6.3	36.13	11.0	3.8
DDG-14	62.5	1.8	2.5	4.2	4.2	19.11	6.0	1.9
DDG-15	201.7	2.7	2.9	4.5	4.5	28.91	8.6	3.0
DDG-16	128.7	2.6	3.1	4.9	6.4	24.27	6.2	2.4
DDG-17	35.0	2.3	3.0	6.8	6.8	49.30	12.0	4.0
DDG-18	153.8	3.3	2.4	5.1	5.1	27.59	8.1	2.5
DDG-19	84.2	3.8	2.9	7.0	7.0	50.30	16.7	5.4
DDG-20	126.1	3.1	1.5	5.7	5.7	34.99	11.2	3.9
DDG-21	133.7	2.8	2.9	6.7	6.7	46.83	12.7	3.9
DDG-22	111.4	3.2	1.5	4.1	4.1	18.34	5.2	2.0
DDG-23	61.0	1.8	2.4	6.7	6.7	45.29	12.6	3.9
DDG-24	137.7	3.6	2.3	2.8	2.8	9.60	3.5	1.3
DDG-25	134.0	2.2	2.3	5.2	5.2	33.27	9.7	3.1
DDG-26	13.3	2.2	2.6	5.1	5.1	32.54	8.0	2.1
DDG-27	168.1	2.9	2.2	4.5	6.4	24.27	6.2	2.4
DDG-28	175.8	2.5	3.0	4.1	4.1	21.99	6.4	2.1
DDG-29	197.7	2.9	2.6	6.1	6.1	43.32	12.5	3.7
DDG-30	62.3	3.7	2.6	3.9	3.9	21.32	7.9	2.7
DDG-31	125.0	2.7	2.1	6.0	6.0	40.44	12.1	3.0
DDG-32	84.0	3.0	2.9	5.7	5.7	47.31	13.5	3.8
DDG-33	138.0	2.8	2.3	4.5	4.5	25.65	8.2	2.7
DDG-34	119.0	2.4	2.5	5.5	5.5	35.55	10.4	2.9
Range	**13.3-207.7**	**1.4-4.2**	**1.5-3.1**	**2.8-7**	**2.8-7**	**9.6-50.3**	**3.5-16.7**	**1.3-39.5**
Mean	**114.7**	**2.78**	**2.43**	**5.26**	**5.40**	**32.26**	**3.11**	**4.07**
SD48.09	**0.62**	**0.43**	**1.03**	**1.06**	**11.13**	**8.97**	**6.34**	

(a= mean of 3 plants; b= mean of 20 internodes; c-f=mean of 20 leaves each; g & h= 1000 leaf each)

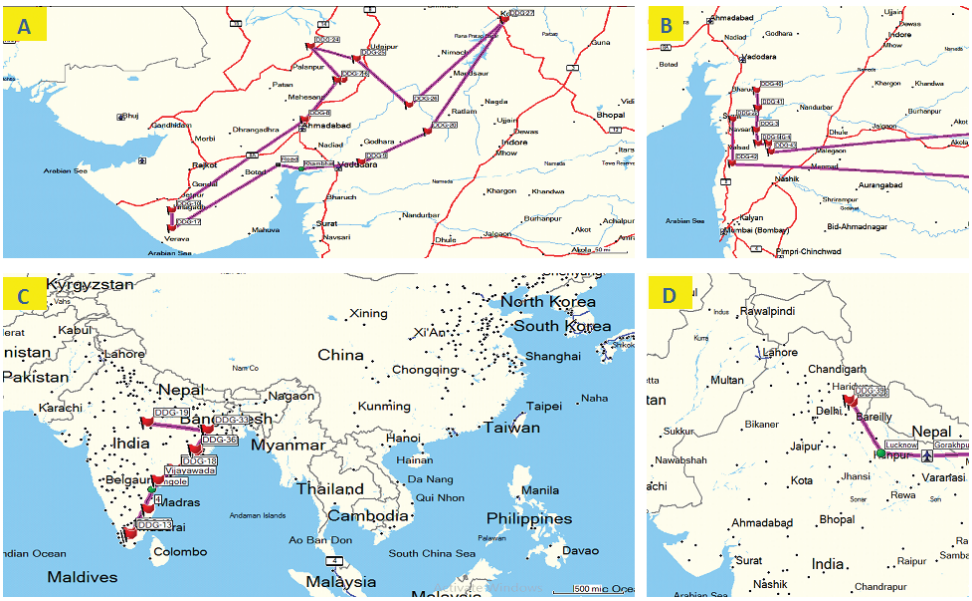

Fig. 1 : Exploration trips (A-D) undertaken to collect germplasm accessions of Salparni (*Desmodium gangeticum*).

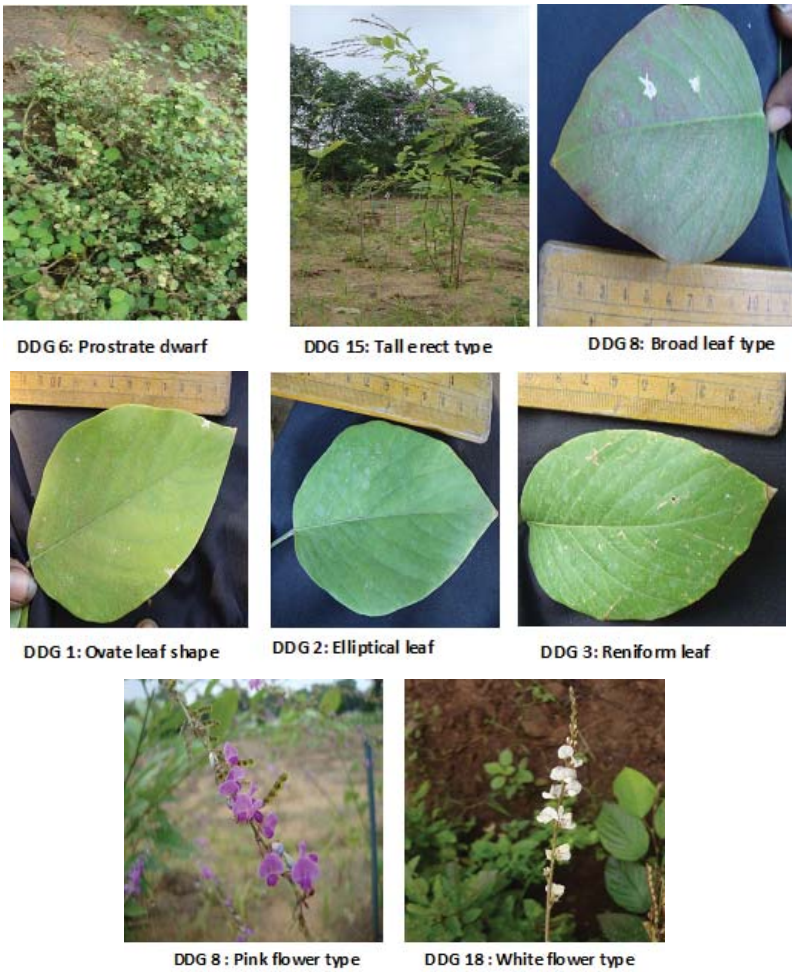

Fig. 2: Distinct morphotypes of Salparni (*Desmodium gangeticum*) identified.

elliptical leaf shape (DDG2), reniform leaf shape (DDG-3) (Figure 2). Such qualitative markers (morphotypes) were identified for the first time in salparni and will form a base for germplasm characterization and utilization.

CONCLUSION

Four exploration missions were undertaken and forty-three accessions were collected and regenerated *ex situ* for conservation. Morphologically accessions showed distinct variability for leaf size, leaf shape, leaf weight and plant height. Distinct morphotypes were identified will form a base for improvement yield and quality of salparni.

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