PROGRESS REPORT

Assessment of morphological, reproductive and cytological variability in *Vitex negundo* L. in Jammu Province

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Project Title: Assessment of morphological, reproductive and cytological variability in *Vitex negundo* L. in Jammu Province

Objectives:

- Exploring Jammu province for tagging distribution sites of *Vitex negundo*
- Study morphology and reproductive strategy operative in the species
- Determine morphological variability in two populations.
- Study male meiosis and associated anomalies.

Project details:

Introduction:

Vitex negundo Linn., commonly called as banna/nirgundi, is a member of Lamiaceae, classified under sub-family Viticoideae. Described variously as *Vitex paniculata*, it is now accepted as *V. negundo*. The species grows in wild in Africa, China and some of the south-east Asian countries including India, Pakistan, Philippines, Malaysia, Thailand and Sri Lanka. *V. negundo* possessing anti-inflammatory, anti-cancerous, anti-rheumatic, hepato-protective, antioxidant, anticonvulsant properties.

Material and methods:

1. Field explorations were made for the location of wild populations from Jammu
2. Morphological variability was assessed vis-a-vis plant habitat; plant height; number, shape and size of leaves; inflorescence type and number of flowers per inflorescence, colour, shape and size of flowers.
3. Meiotic studies were carried out from the young buds of different accessions.
4. Reproductive studies were also carried out in detail.

Results:

Distribution:

Twenty populations of *Vitex negundo* from different regions of Jammu province have been tagged. Data gathered on locations and habitats of different populations are presented in Table 1.

Table 1: Distribution sites of *Vitex negundo* and their geographical coordinates.

S. No.	District, Locality	Habitat	Elevation		Altitude (masl)
			Latitude N	Longitude E	
1.	Kathua, Palli Morh	Fields and road-side	32°25.510′	75°26.432	344
2.	Kathua, Govindsar	Waste-land	32°24.122′	72°32.73	424
3.	Kathua, Kharoot Morh	Road-side	32°32.510′	72°26.395	343
4.	Kathua, Billawar	Road-side	32°25.472′	75°25.274	630
5.	Jammu, Jammu University	Botanical Garden	32°25.433′	75°25.433	402
6.	Jammu, Domana	Fields and Waste-land	32°25.433′	75°25.433	315
7.	Rajouri, BGSBU	Road-side	33°23.624′	74°20.432″	915
8.	Akhnoor , Jammu	Fields and road-side	32°53′57.78″	74°44′32.73″	335
9.	Marh, Jammu	Road-side	32°53′39.16″	74°50′10.91″	630
10.	Nagbani, Jammu	Fields and road-side	32°46′31.31″	74°46′50.63″	296
11.	Jhiri, Jammu	Fields and road-side	32°49′48.15″	74°43′56.75″	297
12.	Shamachak, Jammu	Waste-land	33°49′35.94″	74°44′36.95″	300
13.	Ghrota, Jammu	Road-side	32°51′22.97″	74°43′39.41″	306
14.	Gorah Pattan, Jammu	Waste-land	32°52′24.48″	74°44′32.73″	305
15.	Chenani, Udhampur	Fields and road-side	33°02′06.99″	75°17′04.88″	1109
16.	Samba, Samba	Waste-land	32°33′12.17″	75°06′42.59″	363

17.	Phalata, Udhampur	Fields and road-side	32°53′53.70″	75°03′01.15″	656
18.	Dansal, Jammu	Road-side	32°52′11.77″	74°59′48.75″	363
19.	Kot Bhalwal, Jammu	Fields and road-side	32°48′46.13″	74°48′58.97″	404
20.	Jourian, Jammu	Waste-land	32°49′57.50″	74°34′37.57″	284

Out of 20 populations five populations were further studied for morphological and cytological details.

Morphology

Individual trees ranging in height from 2.7-2.9 m, have brown woody stem and dense branching pattern. They shed nearly half of their leaves from mid December to mid January. New leaves start emerging by the last week of February and continue till mid April.

Table 2. Population wise data of quantitative floral traits of five populations

Character		Govindsar	Palli Morh	Kharoot Morh	Domana	Billawar
Tree height (m)		2.72±0.16	2.90±0.27	2.96±0.11	2.83±0.22	2.99±0.11
Central leaflet (cm)		12.12±0.3	10.73±0.26	14.18±0.3	12.12±0.3	10.73±0.26
Larger median-lateral leaflet(cm)		9.8±0.21	8.91±0.17	11.97±0.20	9.7±0.21	8.1±0.17
Smaller median-lateral leaflet (cm)		8.50±0.35	8.51±0.25	10.8±0.27	8.50±0.35	8.51±0.25
Larger youngest-lateral leaflet (cm)		5.35±0.22	4.86±0.38	7.19±0.18	5.35±0.22	4.86±0.38
Smaller youngest –lateral leaflet(cm)		4.03±0.25	3.93±0.30	6.46±0.18	4.03±0.25	3.93±0.30
Inflorescence	Length (cm)	15.66±0.56	19.27±1.06	15.84±0.34	12.59±0.43	20.26±1.6
	Number of lateral pair of branches	12.8±0.54	16.76±0.54	11.6±0.46	10.26±0.18	13.3±0.83
	Number of flowers per lateral pair of branches	22.66±10.34	21.9±1.52	24.63±2.80	13.56±0.59	30±2.24
	Number of flowers per inflorescence	293.9±13.4	284.6±13.4	307.4±12.7	159.63±10.4	392.8±6.1
Length of calyx tube (cm)		0.32±0.010	0.36±0.011	0.36±0.008	0.34±0.013	0.35±0.01
Length of corolla tube (cm)		0.94±0.009	0.95±0.012	0.95±0.012	0.94±0.009	0.95±0.02

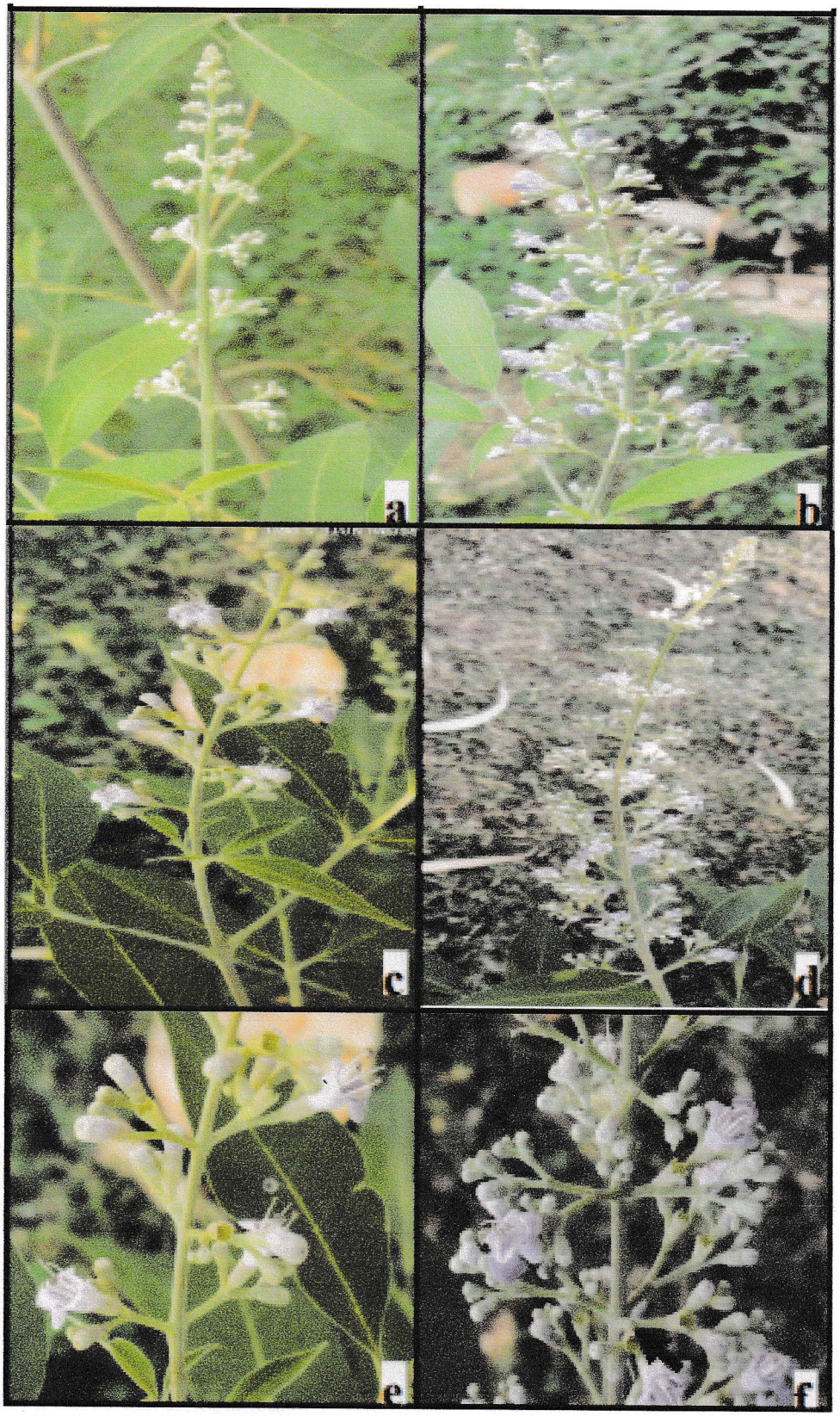

Fig a-f A young inflorescence (Fig. a), mature inflorescences bearing 14 (Fig. b) and 7 paired branches (Fig. c), an inflorescence supporting 16 triplets of lateral branches (Fig d). Enlarged view of c and d showing two and three branches arising from single node (Figs. e-f).

Length of long stamen (cm)	0.54±0.01	0.55±0.012	0.55±0.010	0.55±0.013	0.55±0.02
Length of short stamen (cm)	0.44±0.013	0.45±0.012	0.45±0.012	0.44±0.013	0.45±0.01
Style length (cm)	0.85±0.013	0.84±0.010	0.84±0.012	0.84± 0.013	0.85±0.01

Reproductive biology

Studies pertaining to reproductive biology were carried out for only Palli Morh population

Table 3. Fruit and seed set in open pollinated (15) and unassisted selfed inflorescences (15) of Palli Morh population.

Flowers	Number of flowers per inflorescence (Range)	Number of fruits per inflorescence (Range)	Fruit set (%) per inflorescence (Range)	Seed set (%) per fruit
Open pollinated	199.5±11.32 (152-297)	47.46±9.27 (28-135)	23.99±4.54 (11.4-67.16)	25
Unassisted selfed	172.2±8.32 (108-220)	-	-	-

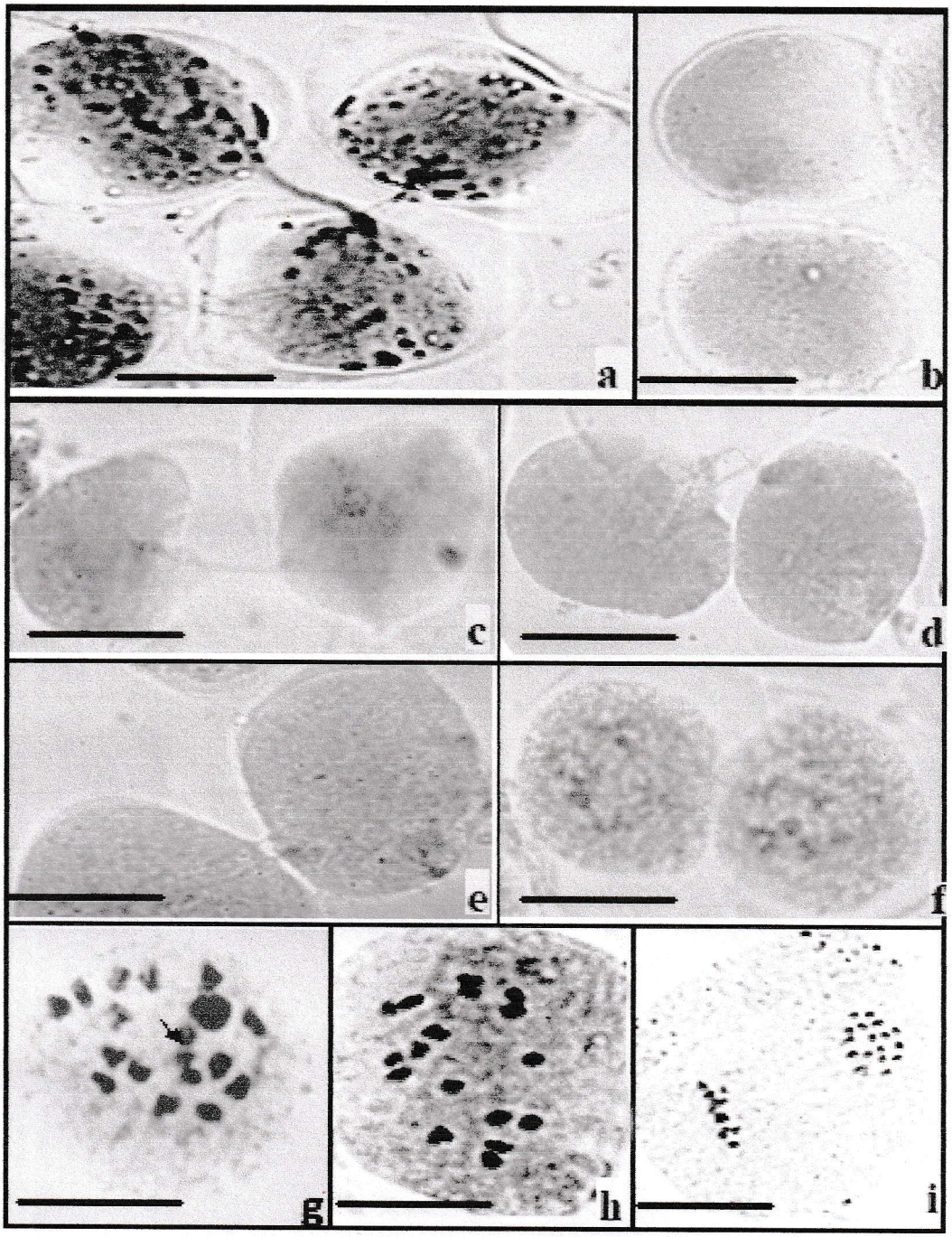

Fig. a-f Cytomixis between PMCs of Kolka population.

Three PMCs at diakinesis showing chromatin transfer (Fig. a), two PMCs connected by one (Figs. b-d) and two cytoplasmic connections (Fig. e), two connected PMCs showing chromatin transfer (Fig. f).

Fig. g-i PMCs at diakinesis showing 1 VI (arrowed) and 14II (Fig. g), at metaphase I with 17 II (Fig. h) and at anaphase I exhibiting 17:17 segregations (Fig. i).

Cytological studies

Of the two populations analysed morphologically and cytologically presence of cytomixis. Was seen. Also the common diploid count found in populations was 2n=34.

Table 4. Details on the cytological aspects of five population

Populations (masl) (Untreated Anther)	Cytomictic connections /channels (Number/total)	Concurrently involved in cytomixis	PMCs (%)	Chromosome Number	Associations	% age (Number/Total)
Govs	54.63 (212/388)	2 (48.11%) 3 (31.13%) 5 (20.75%)	54.50	34	17II	100 (68/68)
Palm	75.92 (412/542)	2 (100%)	75.92	34	17II 1IV+14II+2I	67.03 (61/91) 32.96 (30/91)
Kharoot Morh	61.29 (152/248)	2 (97.36%) 4 (2.63%)	61.34	34	17II 16II+1III+1I 1IV+15II	84.48 (49/58) 10.34 (6/58) 5.17 (3/58)
Billawar	36.54 (148/405)	2 (97.29%) 4 (2.70%)	34.95	34	17II	100 (34/34)
Domana	34.95 (172/492)	2 (40.69%) 3 (59.30%)	29.90	34	17II 1VI+14II	81.25 (26/32) 18.75 (6/32)

Across the cytomictic cells existing at different meiotic stages, maximum have been witnessed at diakinesis-anaphase I. Cytomixis percentage was found above 30% in all species. Chromosome number was 2n=24 in all populations. In most of the populations bivalents were seen but few also witnessed the presence of multivalent.

Inference: Current studies indicate that *Vitex negundo* exhibits wide distribution ranging from 296 to 1109 masl. Five of the studied populations of the species are quite diverse in phenotypic and cytological features. Existence of cytomictic connection of varying width and length between meiocytes is an important notable feature of this species which needs further investigation.

Utilization certificate

Certified that out of Rs. 100,000/- (one lakh rupees) of grant sanctioned during the year 2019-20 for *ASSISTANCE TO ASSISTANT PROFESSORS FOR STRENGTHENING RESEARCH NEEDS OF THE FACULTY, IN ORDER TO PROMOTE RESEARCH IN THE EMERGING AND INNOVATIVE AREAS UNDER RUSA 2.0.* vide order no: RUSAJU/2/2019-20/36/3428-3499, dated: 5-11-2019 sum of Rs 99,649/- has been utilized for the year 2019-20 for which it was sanctioned. An amount of Rs. 351/- remained unspent.

Geeta

Signature

Dr Geeta (PI, RUSA project)