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RESEARCH ARTICLE

MORPHOLOGICAL, PHENOLOGICAL AND MEIOTIC ANALYSIS OF *BUDDLEJA CRISPA* BENTH. FROM JAMMU PROVINCE

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Abstract: *Buddleja crispa* Benth. is an important species growing on high altitudinal sites of Jammu province. Presently, two populations from Pouni and Batote of Jammu province were analysed for morphological, phenological and meiotic aspects. The plants of this species remain in vegetative stage from late September to mid-February, form buds from mid-February to early March, show full blooming from early March to mid-May and fruiting from May to June. Morphological comparison using one way ANOVA reveals Batote population is vigorous in comparison of Pouni population which seems to be an outcome of prevailing climatic conditions. Meiotic studies revealed all PMCs having diploid count of 38. These chromosomes paired as 19 bivalents at diakinesis and metaphase I and separated equally (19:19) at anaphase I. The second meiotic division was also regular. The percentage pollen stainability and viability as determined using 1% acetocarmine, triphenyl tetrazolium chloride (TTC) and fluorescein diacetate (FDA) respectively valued as 88.65%, 53.82% and 62.6% which points towards cytological stability of the species.

Keywords: *Buddleja crispa*, Meiosis, Phenology, Jammu province

INTRODUCTION

The genus *Buddleja* Houst. ex L. of family Scrophulariaceae is represented by 11 species from India (Santapau and Henry, 1973). *Buddleja crispa* is an important shrubby species of this genus, which grows on high elevations of Himalaya (Polunin and Stainton, 1984). Because of releasing compounds like benzaldehyde and lilac aldehyde, this species is highly attractant to butterflies (Gong *et al*., 2015). Its leaf extracts, containing anti-oxidant and anti-inflammatory components are known to lower blood pressure (Ahmad *et al*., 2008; Gilani *et al*., 2009; Bukhari *et al*., 2016).

While studying diversity aspects of *Buddleja* species growing in Jammu province, we found two populations of *B. crispa* at Pouni and Batote. Lack of information on morphological, phenological and cytological aspects of this species prompted us to study these features at population level.

MATERIALS AND METHODS

Study sites

Field surveys conducted in different areas of Jammu Province during 2023-2025 led to identification of two populations from Pouni and Batote of Reasi and Ramban districts respectively (Table 1).

Table 1. Details of study sites of two *B. crispa* populations

District	Location	Latitude (N)	Longitude (E)	Altitude (masl)
Reasi	Pouni	33.080˚	74.836˚	1200
Ramban	Batote	33.112˚	75.350˚	1390

Morphological and phenological analysis

The plants of tagged populations were screened for qualitative traits like leaf shape, apex, base, margin, pubescence, inflorescence colour and type. The quantitative traits studied included plant height, leaves per 30 cm branch, leaf size, petiole length, inflorescence length, flower length, sepal and petal length as well as dimensions of anther, stigma and style. Besides, onset and duration of different phenological events as vegetative stage, bud stage, flowering and fruiting were recorded by regularly visiting the study sites. For the data generated on quantitative traits, the values of mean and standard error were determined and significant variation in traits across populations was determined by employing one way ANOVA using MS Excel.

Meiotic analysis

For meiotic studies, young floral buds were collected at 9 am and fixed in Carnoy's fluid (absolute ethanol; glacial acetic acid as 3:1) for 24 hrs (Sharma and Gohil, 2013) and preserved in 70% ethanol (4°C). The anthers were squashed in 0.7% propino-carmine.

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For determining pollen stainability, pollen grains from freshly dehisced anthers were squashed in 1% acetocarmine. Similarly, pollen viability was determined using triphenyl tetrazolium chloride (TTC) and fluorescein diacetate (FDA) wherein filled and coloured pollen were considered viable, whereas empty and shriveled were taken as non-viable.

RESULTS AND DISCUSSION

Morphology and Phenology

The studied *B. crispa* plants (Fig 1a) have simple, opposite, sub-sessile, ovate, pubescent leaves with obtuse apices, cordate bases and undulated margins. The inflorescence of this species is an indeterminate spike (Fig 1b). The purple flowers (Fig 1c) of this species have 4 fused sepals and petals as accessory organs. The pistil of *B. crispa* is represented by clavate stigma, minute style and ovoid ovary (Fig 1d) showing axile placentation (Fig 1e) and containing translucent ovules (Fig 1f). Male reproductive organs are represented by four epipetalous stamens with anthers being basifixed and dithecous (Fig 1g). The plants of *B. crispa* remain in vegetative phase for nearly 5 months (late September to mid-February) and differentiate floral buds from mid-February to March. The blooming occurs from early March to mid-May and fruit formation from May to June (Table 2).

Figure 1 (a) Plant in full bloom; (b) inflorescence; (c) V.S. of flower; (d) clavate stigma, style and ovary; (e) T.S. of ovary; (f) ovules; (g) dehisced and undehisced anthers and (h) different developmental stages of flower from bud to fruit initiation.

Table 2. Duration of different phenological phases: vegetative ( ), bud ( ), blooming ( ) and fruiting phase ( ) of *B. crispa*

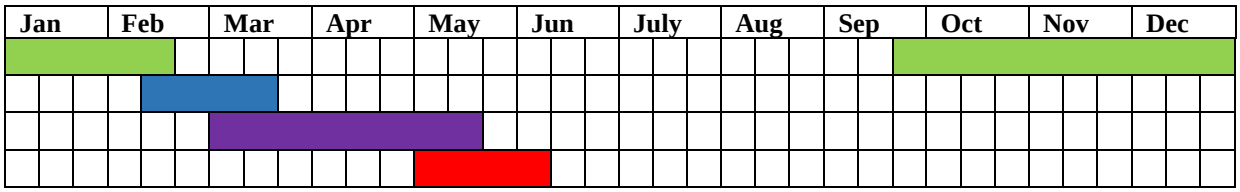

Table 3. Matrices of quantitative traits of *B. crispa*

Traits	Pouni	Batote	F- value
Tree height (m)	2.83±0.13	2.07±0.19	9.44
Leaves/unit branch	50.3±1.18	62.5±2.51	17.33*
Inflorescence length (cm)	2.24±0.17	2.81±0.21	3.67
Flowers per inflorescence	38.5±1.07	42.6±2.85	1.625
Petiole length (cm)	0.46±0.03	0.57±0.07	1.58
Leaf length (cm)	1.94±0.1	4.97±0.18	186.73*
Leaf width (cm)	2±0.04	2.04±0.12	36.87*
Internode length (cm)	4.72±0.29	3.28±0.26	11.72*
Flower length (mm)	11.8±0.16	11.3±0.26	2.31
Petal length (mm)	5.78±0.12	8.45±0.19	121.49
Petal width (mm)	2.86±0.07	2.56±0.13	3.391
Sepal length (mm)	4.75±0.12	3.4±0.13	46.53*
Anther length (mm)	2.1±0.03	1.95±0.04	7.10*
Anther width (mm)	1.24±0.06	0.99±0.05	7.47*

Stigma length (mm)	1.05±0.06	0.99±0.04	0.49
Ovary length (mm)	1.91±0.15	1.96±0.22	0.03

*asterisk marked indicates the traits showing significant differences ($p<0.05$)

Analysis of quantitative traits of Pouni and Batote populations of *B. crispa* showed marked differences in various foliar and floral traits. Significant variation among these two populations exists in leaves per unit branch, leaf size, internode length, sepal length and anther size (Table 3). Of the two populations, the plants of Batote bearing greater number of large sized leaves per unit branch and larger inflorescences supporting more flowers seem more vigorous compared to these of Pouni population. The noted difference in phenotypic traits of studied populations may be the outcome of varying climatic conditions of the two locations as also recorded in *Mentha longifolia* (Devi and Sharma, 2022).

Meiotic Studies

Meiotic studies in *B. crispa* revealed their pollen mother cells uniformly having 2n=38 chromosomes, the count earlier recorded for this species by Moore (1961), Bedi *et al.* (1981), Khatoon and Ali (1993) and Chen *et al*. (2007) who referred it as diploid. This is unlike *B. candida*, *B. fallowiana*, *B. davidii* showing tetraploidy (Moore, 1947, 1960, Chatha and Bir, 1987), *B. delavayi*, *B. nivea*, *B. albiflora*, *B. forestii* depicting hexaploidy (Moore, 1947, 1960) and *B. colvilei* plants displaying higher ploidy levels represented by 2n=152, 300 and 456 chromosomes (Moore, 1947, Janaki Ammal, 1954, Gadella, 1980).

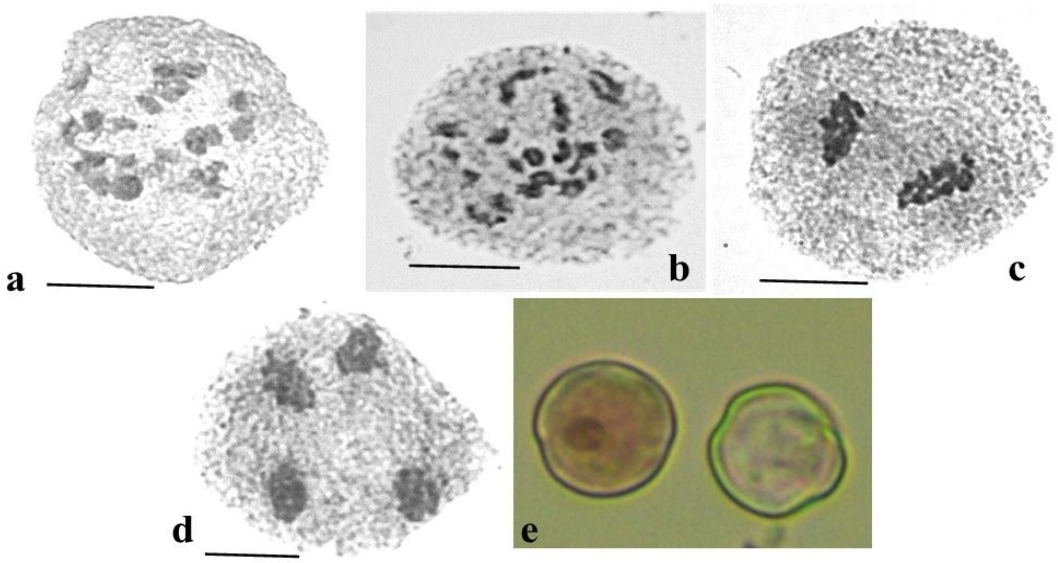

Figure 2: PMCs of *B. crispa* at showing 19 II at (a) diakinesis; (b) metaphase; (c) anaphase I displaying 19:19; (d) anaphase II showing 19:19:19:19 segregation; (e) viable and non-viable pollen grain; Scale=10 µm.

So far behaviour of chromosomes of this species is concerned, 38 chromosomes were present as 19 bivalents at diakinesis and metaphase I (Fig 2a-b). At anaphase I (Fig 2c), equal disjunction patterns were met. Likewise, regular 19:19:19:19 separation of chromatids was seen at anaphase II (Fig 2d). The pollen stainability as determined using 1% acetocarmine and pollen viability as estimated using triphenyl tetrazolium chloride (TTC) and fluorescein diacetate (FDA) came out to be 88.65%, 53.82% and 62.6% respectively (Fig 2 e). As such, *B. crispa* on account of showing normal chromosome behaviour during meiosis and depicting high pollen stainability and good viability seems to be cytologically stable.

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