

Taxonomy of *Boenninghausenia* Reichenbach ex Meissner (Rutaceae) and its character variation in different phytogeographical regions

D. Maity and G.G. Maiti¹

Department of Botany, University of Kalyani, Kalyani 741235, Nadia, WB, India
debmaity@yahoo.com & ¹Corresponding author: gaurmaiti@yahoo.co.in

Abstract

Boenninghausenia Reichenbach ex Meissner (Rutaceae) is known by its four species distributed throughout the S.E. Asia from India to Japan. Presently only two of them viz. *B. albiflora* (Hooker) Reichenbach ex Meissner and *B. sessilicarpa* Leveille are recognized as good species and the rest two species, *B. schizocarpa* Hu and *B. brevipes* (Franchet) Leveille are treated as synonyms of *B. albiflora* and *B. sessilicarpa* respectively. However, the species *B. sessilicarpa* bears same features of *B. albiflora* except the length of the gynophore. Therefore, Franchet considered it as conspecific with *B. albiflora* and so treated as variety of *B. albiflora*. But most of the recent authors have treated *B. sessilicarpa* as a good species. The present study of a large number of specimens collected from different phytogeographical regions deposited at CAL and BSHC, reveals that both these species share similar features and even the length of gynophore also varies and a transitional phenomenon presents in few specimens based on which primarily *B. sessilicarpa* designated as a species. Thus, *B. sessilicarpa* is here again suggested to retain its varietal status as expressed earlier by Franchet.

Keywords: *Boenninghausenia*, Taxonomy, Phytogeography, Morphology.

INTRODUCTION

Boenninghausenia Reichenbach ex Meissner, *nom. cons.* (Rutaceae) is long been known with two species distributed from subtropical and temperate regions of India, Pakistan, Nepal, Bhutan and extending its distribution from China to Japan, south-east Asia to Philippines. Primarily the genus is known to have only 2 species namely *B. albiflora* (Hooker) Reichenbach ex Meissner and *B. sessilicarpa* Leveille. Later two other species were described as *B. schizocarpa* Hu and *B. brevipes* (Franchet) Leveille but these are considered as synonym of *B. albiflora* and *B. sessilicarpa* respectively (Nair & Nayar, 1997).

Till now the two taxa are considered as good species with the major differences as; leaves comparatively larger; gynophore 2 – 8 mm long for *B. albiflora* and leaves comparatively smaller; gynophore 1 – 2 mm long for *B. sessilicarpa*.

In course of the study of some recent collections of these two taxa from the Sikkim Himalaya it is observed that many of the characters, both vegetative and reproductive, are variable which leads to express the present status of these species as well as the later described two species *B. sessilicarpa* and *B. brevipes*. All these characters are very important parameters towards the better understanding of the identity of these two taxa and their proper taxonomic status. The observed variation of characters based on the herbarium specimens collected from different phytogeographical regions is presented in exsiccata studied.

Moreover, the present taxonomic status, variation of characters in respect to phytogeographical distribution lead to reassign these species considering the opinions of Franchet (*l.c.*) and Nair & Nayar (1997). The critical notes have been provided for better understanding of the proposed present status of the specimens and their intraspecific taxa. The present study put forwarded the demarcation of the characters for the delimitation of the species and the taxonomic treatment of *B. albiflora* (Hooker) Reichenbach ex Meissner and *B. sessilicarpa* Leveille for their present status with the help of some drawings of both qualitative and quantitative characters.

MATERIALS AND METHODS

The herbarium specimens are mostly studied housed in Central National Herbarium, Botanical Survey of India, Sibpur, Howrah, W.B. (CAL) and Sikkim Himalayan Circle, Botanical Survey of India, Gangtok, Sikkim (BSHC). All total 65 specimens are studied collected from Jammu & Kashmir, Himachal Pradesh, Uttaranchal, West Bengal, Sikkim, Meghalaya, Nagaland, Mizoram, Arunachal Pradesh of India; also from Nepal, Bhutan, China, Myanmar, Thailand, Philippines.

The camera lucida drawings of calyx and petals are provided to assess the qualitative character state for some of the collections and as well as their variation of characters in different gatherings collected from different phytogeographical regions. The quantitative estimations of the length of the carpophore is compared and correlated with that of the qualitative features of leaf rachis texture, size of leaflets, shape of the flower-bud, calyx lobe, and petals, glabrous or hairiness of the plants etc. Some of the earlier identified specimens are screened and considered to be of uncertain position due to variation of the length of carpophore.

Finally, the distributions of different species in different geographical localities are demarcated based on the deposited collections of specimens from India and from the other countries.

OBSERVATION

The two well recognized taxa under *Boenninghausenia*, *B. albiflora* and *B. sessilicarpa* are uniformly accepted by several authors and their distribution is known from India to Philippines. These two species are here discussed along with the comparison of character states with the other two taxa *B. schizocarpa* and *B. brevipes* and finally the present status of the other two taxa are stated.

Boenninghausenia albiflora (Hooker) Reichenbach ex Meissner, Consp. 197. 1828; Hook.f. in Hook.f., Fl. Brit. India 1: 486. 1875; Nair & Nayar in Hajra *et al.* (eds.), Fl India 4:357. 1997; *Ruta albiflora* Hook., Exotic Fl. 1: t. 79. 1823.

Distribution: INDIA: Jammu & Kashmir, Himachal Pradesh, Uttaranchal, Uttar Pradesh, West Bengal, Sikkim, Meghalaya, Nagaland, Mizoram and Arunachal Pradesh; PAKISTAN, NEPAL, BHUTAN, CHINA, MYANAMAR, THAILAND, JAVA, JAPAN and PHILIPPINES.

Boenninghausenia schizocarpa Hu [in J. Arn. Arb. 32:392. 1951] is established based on the character that the four carpels separated at base while attaining maturity. This character can not be considered as a distinct and constant feature to differ it from that of *B. albiflora* (Hooker) Reichenbach ex Meissner because the separation of the carpels at maturity is very often observed in many of the collections. So, this feature does not support any consistency of characters to consider and to treat a good species as well as any infraspecific taxa as discussed by Nair & Nayar (1997). Of course, it is sometimes considered as synonym of *B. albiflora* (Hooker) Reichenbach ex Meissner.

Boenninghausenia sessilicarpa Leveille in Feddes Repert. Sp. Nov. Regni Veg. 12: 182. 1913; Nair & Nayar in Hajra *et al.* (eds.), Fl. India 4 : 359. 1997; *B. albiflora* (Hook.) Reichb. ex Meissn. var. *brevipes* Franch. in Bull. Soc. Bot. France 33: 450. 1886; *B. brevipes* (Franch.) Lev., Cat. Pl. Yunnan 249. 1917.

Distribution : INDIA: Jammu & Kashmir, Himachal Pradesh, Uttaranchal, Uttar Pradesh, Sikkim, West Bengal, Meghalaya, Nagaland, Mizoram, Assam, and Manipur; NEPAL, BHUTAN, CHINA, MYANMAR, THAILAND, and PHILIPPINES.

Both the species *B. albiflora* and *B. sessilicarpa* are of sympatric distribution. Of course, Hu (*l.c.*) first reported the occurrence of *B. sessilicarpa* Lev. from Khasia Hills of Meghalaya in India. The present study supports its presence in other localities of India and abroad. The distinctive characters

Table 1: Differentiating characters of three taxa

Parameters	<i>B. albiflora</i>	<i>B. sessilicarpa</i>	var. <i>brevipes</i>
Leaf rachis texture	Glabrous	Softly pubescent at young	Not compared
Leaflet size	Large	Small	Not compared
Shape of flower bud	Obovoid	Subglobose	Not compared
Shape of calyx lobes	Triangular	Subglobose to rounded	Not compared
Shape of petals	Obovate	Suborbicular	Not compared
Length of gynophore	2 - 8 mm	Subsessile to 3 mm	Subsessile to 1 mm

for the consideration of *B. sessilicarpa* Leveille as good species are: leaf–rachis softly pubescent in young condition but glabrous or nearly so at maturity; leaflets comparatively smaller than *B. albiflora*; flower–buds subglobose before anthesis; calyx lobes suborbicular to rounded; petals suborbicular; disc fleshy, annular with a sessile or subsessile ovary (Table 1).

B. albiflora (Hooker) Reichenbach ex Meissner var. *brevipes* Franchet [Bull. Soc. Bot. France 33: 450. 1886] or *B. brevipes* (Franchet) Leveille [Cat. Pl. Yunnan 249. 1917] is also of doubtful taxon as there are much variations of characters (Fig. I) as well as the mixture of characters in different specimens. The variety *brevipes* of Franchet was described by the presence of sessile to subsessile gynophore. The glabrous and hairiness and length of gynophore (Table 2), and the calyx lobes and gynophore length (Table 3) are the variable features in the different gatherings. The variation is also observed in case of gynophore length whenever correlating with the obovate petals (Table 4) by which it can not be considered either as a good species or as a variety under *B. albiflora*.

Table 2: Variation of characters shown compare with glabrous feature of specimens with the length of gynophore in *B. albiflora* var. *brevipes*

Specimens	Exceptional feature	Length of gynophore
<i>Santapau</i> 28546-CAL	Glabrous throughout	1.5 mm
<i>Verma</i> 3790-BSHC	Do	1.5 - 2 mm
<i>Gopalan</i> 97525-BSHC	Do	1.5 mm
<i>Singh</i> 13961-BSHC	Do	2 mm

Table 3: Variation of characters shown compare with distinct triangular calyx lobes with the length of gynophore in *B. albiflora* var. *brevipes*

Specimens	Exceptional feature	Length of gynophore	Specific remark
<i>Santapau</i> 28546 - CAL	Calyx lobes distinctly triangular	1.5 mm	These specimens typical regarding indumentum feature
<i>Raju&Singh</i> 4154- BSHC	Do	Sessile	
<i>Maity</i> 21260 – BSHC	Do	1 mm	
<i>Chakraborty</i> 777- BSHC	Do	Up to 0.5 mm	
<i>Sinha&Pradhan</i> 16551- BSHC	Do	2 mm	

Table 4: Variation of characters shown compare with obovate petals with the length of gynophore in *B. albiflora* var. *brevipes*

Specimens	Exceptional feature	Length of gynophore
<i>Santapau</i> 28546 - CAL	Petals obovate	1.5 mm
<i>Gopalan</i> 97525-BSHC	Do	1.5 mm
<i>Verma</i> 3790-BSHC	Do	1.5 - 2 mm
<i>Krishna</i> 4665- BSHC	Do	1 - 3 mm

Table 5: Variation of characters shown compare with sparsely hairy young part with the length of gynophore in *B. albiflora* var. *albiflora*

Specimens	Exceptional feature	Length of gynophore
Without collector's name, 24520- CAL	Young parts sparsely hairy	2.5 – 4 mm
Without collector's name, 24520- CAL	Do	2 – 3.5 mm

Similarly for the typical variety *albiflora* the length of gynophore varies whenever there is the consideration of constant feature of sparsely hairy young part of the plants (Table 5). Large number of gatherings collected from Pakistan to Philippines kept at CAL and BSHC are examined and it shows that all these above stated characters varies except the sessile to subsessile nature of carpels and the gynophore at maturity which represent major differences. There is also the variation of the length of the gynophore which can be grouped with the ranges of the length of gynophore as observed in a few gatherings (Table 6) (Tenasserim, *Geo. Gallatly*, 192- CAL; Nepal, *I. H. Burkill*, 29595-CAL; Bhutan, *G. Sengupta*, 1605 – CAL; Sikkim, *B. Krishna*, 4665 – BSHC).

Nair & Nayar (1997) had retained *B. brevipes* as a good species based on the opinion of Franchet (*l.c.*, as variety), Leveille (*l.c.*). But the homogeneous nature of the both qualitative and quantitative characters are less frequent as the surface texture of the plant either hairy or glabrous to glabrescent; the size, shape and even coloration of leaflets; surface feature of peduncle either hairy or glabrous; shape of the calyx lobes and also the shape and size of petals are quite variable (Fig.-I).

Table 6: Specimens still uncertain position of taxonomic status

Specimens	Length of gynophore
<i>Sen Gupta</i> 1605 – CAL	1.5 – 3 mm
<i>Burkill</i> 29595 – CAL	2 – 2.5 mm
<i>Krishna</i> 4665 – BSHC	1 – 3 mm
<i>Gallatley</i> 192 – CAL	ca 2 mm
Without collector's name, 24533 – CAL	2 – 3.5 mm

Table 7: Ratio of the occurrence of two taxa in different geographical localities of India and other countries (based on the deposited 65 specimens at CAL and BSHC)

Geographical Localities	var. <i>albiflora</i>	var. <i>brevipes</i>
Himachal Pradesh	9	1
Uttaranchal	6	1
Nepal	2	0
West Bengal	6	4
Sikkim	4	11

Arunachal Pradesh	0	1
Meghalaya	0	2
Mizoram	0	2
Nagaland	1	2
Bhutan	2	2
Myanmar	2	0
China	3	1
Japan	0	1
Philippines	0	2

These characters are neither correlating with the phyto-geographical localities nor with that of the altitudinal responses. So, the characters are variable without any transitional or developmental stages. Moreover, there is less consistency in many of the features considered for delimitation of species.

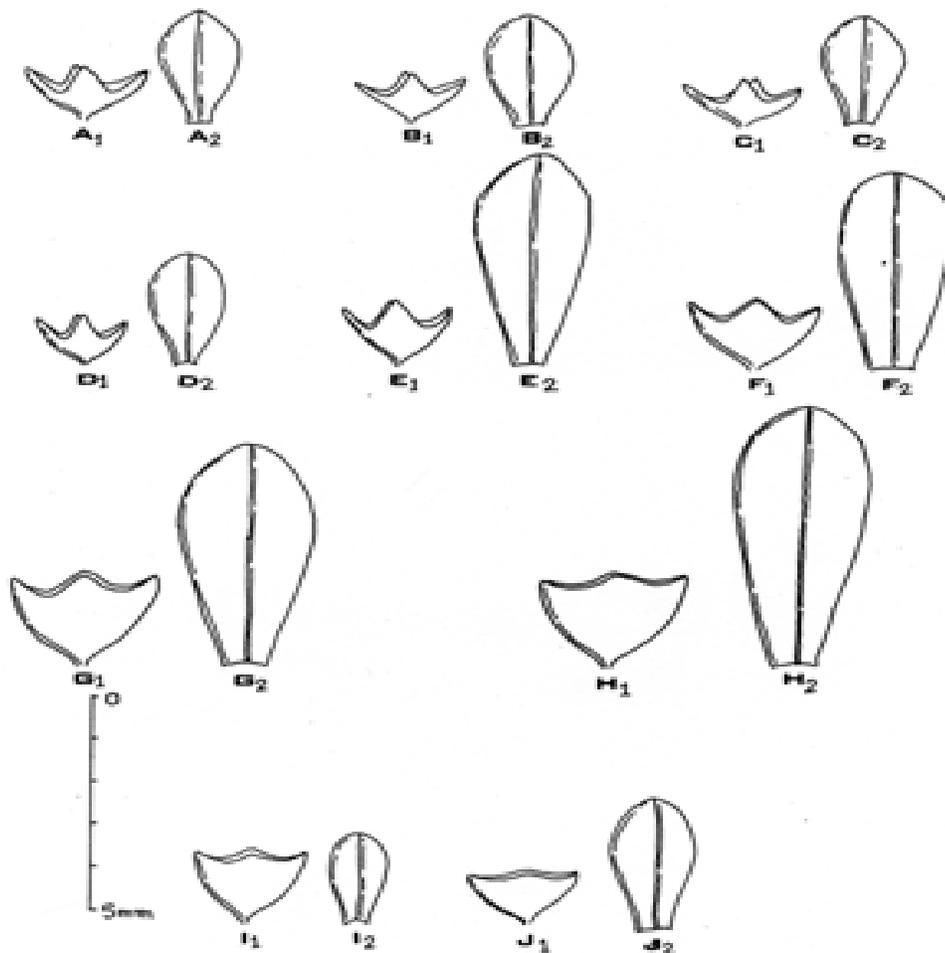


Fig.-I: A-J: *Boenninghausenia albiflora* (Hook.) Reichb. & Meissn.; A1-J1: Calyx; A2-J2: Petal; var. *brevipes*: A1 – A2 : Raju & Singh 4154; B1 – B2 : Maiti – 21260; C1 – C2 : Sinha & Pradhan 16551; D1 – D2 : Chakraborty 777; E1 – E2 : Santapau 28546; F1 – F2 : Gopalan 97525; G1 – G2 : Verma 3790; H1 – H2 : Krishna 4665; var. *albiflora*: I1 – I2 : Without collector's name 24520; J1 – J2 : Meebold 250 (Drawn by D. Maiti)

Table 8: Collection status of *B. albiflora*

Up to 1970			1970 onwards		
Total no of specimens	var. <i>albiflora</i>	var. <i>brevipes</i>	Total no. of specimens	var. <i>albiflora</i>	var. <i>brevipes</i>
46	29	17	19	03	16

While examining the specimens a few characters are further noted specially the correlation of morphological nature of the calyx and calyx – lobes and petal shape and size (Fig.-I). The shape of the petals is oblong and longer when the calyx lobes are inconspicuous while the petal shape is obovate–spathulate and commonly smaller when the calyx lobes are more distinctly triangular. But these correlations are again not uniform.

Moreover, it is seen that many of the previous collections of Sikkim and Darjeeling Himalayas are known as *B. albiflora* but almost all the recent collections from Sikkim Himalayas are matched with the species *B. sessilicarpa*.

Thus the difference of characters of these two taxa only can be emphasized based on gynophore features present at the maturity of carpels or in fruiting condition as:

1. Gynophore subsessile to 2 (-3) mm long *B. sessilicarpa*
- 1a. Gynophore 2-8 mm long *B. albiflora*

So, the status of *B. sessilicarpa* Leveille as a distinct species is raising some question and it is better to retain it as synonym of *B. albiflora* var. *brevipes* or as variety of *B. albiflora* as treated by Franchet (1886) as *B. albiflora* (Hooker) Meissner var. *brevipes* Franchet in Bull. Soc. Bot. France 33:450. 1886. Franchet (*l.c.*) was correct to identify the subsessile carpel and short gynophore structure (*Ovarium subsessile, stiple 1 mill longa*).

Ratio of the two taxa in different geographical localities as a point of interest can be stated here in regards to their present status (Table 7). It is surprising that up to West Bengal (Darjeeling District) from Jammu & Kashmir of Western Himalaya there is the maximum occurrence of var. *albiflora* than var. *brevipes*. In Sikkim the variety *albiflora* is less represented in compare to var. *brevipes*, so also absent to other eastern states (as per collection status). Bhutan is representing the equal proportion, but again increased in Myanmar and China for var. *albiflora* but absent in Japan and Philippines while the presence of var. *brevipes* is significant. It is again coincident about the collection status of var. *albiflora* and var. *brevipes* from different phytogeographical regions. The collection status of *B. albiflora* upto 1970 is more than that of the variety *brevipes* but later 1970 onwards there are more gathering of variety *brevipes* (Table 8).

DISCUSSION AND CONCLUSION

There is the opinion for the acceptance of the existing of 2 good species *B. albiflora* and *B. sessilicarpa* by many of the taxonomists. But the present observation is different whenever a comparison is made based on the diagnostic features of different collections made so far by different workers at different time from different geographical localities throughout the Himalayas as well as from the northern and north-eastern Indian states. The comparison is made based on the

differentiating features of texture of leaf-rachis, size of leaflets, shape of the flower buds, shapes of calyx lobes, shape of petals and finally the length of gynophore (Table 1). Furthermore, the comparison is done with the glabrous feature along with the length of gynophore showing the variation of the gynophore length (Table 2). Again the variation of gynophore length is compared in respect to the presence of distinct triangular calyx lobes as constant feature (Table 3). Considering the constant feature of obovate petals again there is the variation of the gynophore length (Table 4). The hairiness does not satisfy the consistency of the length of gynophore (Table 5) Moreover, there are some specimens which have the transition of the length of gynophore from 1 – 3 mm, 1.5 – 3 mm, or 2 – 2.5 mm, and even more or less 2 mm (Table 6). Thus it can be concluded that the length of gynophore varies and it often bears uncertain position of taxonomic status of *B. sessilicarpa* or even the species as *B. brevipes*. So the present circumscription is proposed to consider only one species *B. albiflora*.

Based on this present taxonomic status if the collections are segregated it consequently shows some point of interest on the geographical occurrence of varieties (Table 7). In the western Himalayan region, Nepal and in West Bengal there is the presence of more representative collections of var. *albiflora* than that of regions of eastern India. Sikkim shows exceptional occurrence. So also Bhutan where both the representatives are same. In case of Myanmar, China it shows affinities with Western Himalaya, Nepal and West Bengal, Japan and Philippines show similarity with north-eastern states. Furthermore, as a matter of coincidence there are more collections of var. *albiflora* up to 1970 and after that to recent time there are the more collections of var. *brevipes* (Table 8). It may reflect the fact that the reduction of gynophore length is a gradual phenomenon. Thus, the drawing of calyx lobes, petals are compare to think of again the circumscription and rank of *Boenninghausenia*.

Based on the above study it can be concluded that it is more suitable to treat this taxon as a single species with two varieties including the typical one as follows:

Boenninghausenia albiflora (Hooker) Reichenbach ex Meissner var. *albiflora* with basionym *Ruta albiflora* Hooker and synonym *B. schizocarpa* Hu; *Boenninghausenia albiflora* (Hooker) Reichenbach ex Meissner var. *brevipes* Franchet with synonyms *B. sessilicarpa* Leveille and *B. brevipes* (Franchet) Leveille.

Exiccata studied:

B. albiflora (Hooker) Reichenbach ex Meissner var. ***albiflora***

INDIA : Himachal Pradesh: Dalhousie, 6000 ft. (1800 m), 10 Sept. 1874, C.B. Clarke, 22099-CAL (gynophore up to 5 mm long in fruit; leaflets very small); Bashahr, 29 Jan. 1891, *J.H. Lace*, 984-CAL (gynophore 4 mm long in flowering); Murree, 7000 ft. (2100m), Sept. 1905, *Meebold*, 250-CAL (gynophore 4-5 mm long; leaflets very smaller, narrowly obovate, glabrous; Fig. 1. J1 & J2).

Uttaranchal: Mussourie, 6 – 7000 ft. (1800 – 2100 m), Aug. 1877, *Hook. Herb., s.n.* – CAL (gynophore ca 4 mm long in flowering); Nainital 7000 ft. (2100m), *s.d., R. Strachey & J. E. Winterbotton, s.n.,* acc. no. 72578 – CAL (gynophore more than 3 mm long); Garhwal, Anusuya, 2500m, 6 Oct. 1970, *B.D. Naithani*, 42049 – CAL (gynophore upto 6 mm long).

West Bengal: Darjeeling, *s.d., S.N. Basu*. 6166 – CAL (gynophore more then 3mm long); Darjeeling, 7000 ft. (2100m), 1862, *T. Anderson*, 421 – CAL (gynophore more than 3 mm long); Darjeeling, 7000 ft. (2100 m), 29 Aug, 1869, *C.B. Clarke* 8882 – CAL (gynophore more then 3 mm long); Darjeeling, Alua Barie, 8000 ft. (2600 m), 13 Nov, *K. Biswas*, 8712 – CAL (gynophore more than

3 mm long); Lebong, 23 Nov. 1996, without collector's name, 24520 – CAL (gynophore 2.5 – 4mm long, young parts sparsely hairy, Fig. 1. I1 & I2); Tiger hill road, 24 Nov. 1996, without collector's name, 24533 – CAL (gynophore 2- 3.5 mm long; sparsely hairy).

Sikkim: Eastern Himalaya, without any precise locality, *s.d.*, *G.H. Cave*, 6869- CAL (gynophore ca 4.5 mm long); Sikkim, without any precise locality, 6000 ft. (1800 m), 31 Aug. 1874, *G. King, s.n.*, acc. No. 72603 – CAL (gynophore ca 4 mm long); Without any precise locality. Sept., 1887, *King's collector, s.n.* – CAL (gynophore more than 3 mm long); without any precise locality, 1892, *G.A. Gammie*, 1220 – CAL (gynophore up to 5 m long).

Nagaland: Naga hills, Sirohee, 8000 ft. (2400 m), 19 Sept., 1948, *S.K. Mukerjee*, 3512 – CAL (gynophore 3–4 mm long; petals ca 3 x 1 mm).

NEPAL: Marshandi river, Sept., 1952, *Sasuko, Nakao, s.n.* – CAL (gynophore more than 3 mm long); Banepa to Hookse, 3300 ft. (9090 m), 6 Oct. 1960, *S.B. Malla & S.B. Rajbhandari*, 315 – CAL (gynophore more than 2 mm long).

BHUTAN: Paro, 2500 m, 19 Aug. 1963; *N.P. Balakrishnan*, 1259 – CAL (gynophore more than 3 mm long); Paro, 7500 ft. (2250 m), 11 Oct. 1963, *S.K. Mukherjee*, 5828 – CAL (gynophore more than 3.5 mm long).

CHINA: Yunnan, 4500 ft. (1350 m), without collector's name, 9011 – CAL (gynophore more than 3.5 mm long); W. Yunnan, 8–10000 ft. (2400 – 3000 m), June – July 1906, *Georage Forrest*, 4758 – CAL (gynophore more than 3 mm long); Su-tchuen Oriental, de Tchen – Keou – Tin, *R.P. Forges, s.n.*, acc. no. 72638- CAL (gynophore more than 3mm long).

MYANMAR: Chin Hills, June 1892, *Abdul Huk, s.n.*, acc. no. 7262- CAL (gynophore more than 3 mm long); Mogok, 4000 ft. (1300 m), June 1910, *A. Rodgeb*, 162 – CAL (gynophore ca 4 mm long).

SIAMESE PENINSULA : Without any precise locality, *s.d.*, *A.D. Garrett, s.n.*, acc. no. 72637 – CAL (gynophore more than 3 mm long).

B. albiflora var. *brevipes* Franchet

Jammu & Kashmir: Without any precise locality, *s. d.*, *H.B. Royle, s.n.*, acc. no. 72594-CAL (gynophore ca 2 mm long; leaflets gradually reduced in size, ca 3 x 2 mm).

Uttaranchal: Mussourie, 2000 m, 2Aug, 1963, *A. Santapau*, 28546 – CAL (gynophore ca 1.5 mm long in flowering; glabrous; Fig. 1.E1 & E2).

West Bengal: Mahananda Wild Life Sanctuary, *s.d.*, *S. Chandra & K.L. Maity*, 21596 – CAL (gynophore ca 0.5 mm long, young parts densely hairy; older ones sparsely hairy); Kalimpong, 4–5000 ft. (1200 – 1500 m), 10 Aug. 1814, *Thornton Ripley*, 45 – CAL (gynophore less than 2 mm long); Darjeeling, 6000 ft. (1800 m), Oct. 1879, *J.S. Gamble*, 7195 – CAL (gynophore ca 2.5 mm long); Tashigaon, Buxaduar, 1200 m, 29 Nov. 1975, *J. K. Sikder*, 4025 – CAL (gynophore less than 2 mm long).

Sikkim: Without precise locality, 6500 ft. (1950 m), 1 Oct., 1908, *W.W. Smith*, 338 – CAL (gynophore up to 2 mm long, petals ca 4.5 mm long); Burtuk Basty, 22 Oct. 1980, *P. Chakraborty* 777-BSHC (gynophore up to 0.5 mm long, young portion sparsely hairy, Fig. 1, D1 & D2); Rhenock, 3390 ft. (1000 m), 7 Dec, 1980, *P. Chakraborty*, 888 – BSHC (gynophore 1 –1.5 mm long; young part sparsely hairy hairy); Tedong R.F. 17 Aug. 1985, *A. K. Verma* 3790- BSHC (gynophore 1.5-2 mm long; plant glabrous throughout; Fig. 1. G1 & G2); Kabi, 22 Aug, 1985, *D.C.S. Raju & S. Singh*, 4154-BSHC (fruits almost sessile; plant sparsely hairy throughout; fig. 1. A1 & A2); Pentong, 16 Sept., 1986, *A. K. Verma*, 6986- BSHC (gynophore ca 1 mm long; few hairs scattered all over the plant); Tendong R.F., 2250 m, Aug, 1991, *R. Gopalan*, 97525-BSHC (gynophore ca 1-5 mm long);

plant glabrous throughout; Fig. 1. F1 & F2); Okhrey to Hilley, 2400 – 2700 m, 21 Aug. 1994, *P. Singh*, 13961–BSHC (gynophore upto 2 mm long; plant glabrous throughout); Chongrang village 1500 m, 10 Dec. 1994, *G.P. Sinha & S. Pradhan*, 16551 – BSHC (gynophore up to 1.5 mm long; plant sparsely hairy; Fig. 1. C1 & C2); Namchi, Oct. 1997, *R.C. Srivastava*, 10991 – BSHC (gynophore up to 2 mm long; plant including leaflets pubescent); Yoksum, 1700 m, 2 Aug., 1999, *D. Maity*, 21260 – BSHC (gynophore upto 1 mm long, young stem with few hairs; Fig. 1. B1 & B2). Meghalaya : Khasi hill, *s.d. Herb. Sulp. Kurz*, 425-CAL (gynophore ca 1 mm long, petals ca 4.5 x 2 mm); Without any precise locality, 26 Dec., 1852. *B. Godfrey*, 440–CAL (gynophore up to 2 mm long).

Mizoram: Lushai hills, *s.d., Mrs. Parry s.n* – CAL (gynophore less than 1.5 mm long; petals ca 3.4 x 2 mm); Lushai hills, 6 Dec., 1902, *J.E. Leslie* 282 – CAL (gynophore up to 2mm long).

Nagaland : Naga hills, Kohima, 6000 ft, (1800 m), 21 Oct. 1885, *C. B. Clarke*, 40964 – CAL (gynophore upto 2 mm long); Naga hills, Ukhrul, 6000 ft. (1800 m), 27 July 1948, *S.K. Mukerjee*, 3259 – CAL (gynophore ca 1.5 mm long; petals ca 4.5 x 2 mm).

Arunachal Pradesh: Dum, Kameng district, 20 Sept., 1996, *J. Joseph*, 40102–CAL (gynophore upto 2 mm long).

NEPAL: Chusapani, 2 Dec., 1907, *I.H. Burkill*, 29595 – CAL (gynophore 2–2.5 mm long; petals ca 3 x 1.5 mm);

BHUTAN: Without any precise locality, *s.d., Ramesh Bedi*, 1140 – CAL (gynophore ca 2 mm long); Ranichamp to Tama, 14 Nov., 1964, *D.B. Deb*, 240 – CAL (gynophore 1.5–2 mm long).

CHINA: Yunnan, 12 July 1908, *Dwloux, s.n.* – CAL (gynophore less than 2 mm long);

JAPAN: Yokohana, 1862, without collectors's name, *s.n.*, acc. no. 72641 – CAL (gynophore 1.5 – 2 mm long).

TENASSERIM: Moolyet, 5000 ft. (1500 m), 27 Jan., 1877, *Geo Gallatly*, 1992 – CAL (gynophore 2 – 2.5 mm long).

PHILIPPINES: Mt. Tonglon, Dec., 1908, *Maximo Ramos*, 5419 – CAL (gynophore upto 1.5 mm long); Luzon Central, *s.d., A. Loher*, 191 – CAL (gynophore ca 1.5 mm long).

Specimens uncertain in position based on gynophore feature:

Bhutan: without any precise locality, *s.d., G. Sen Gupta*, 1605 – CAL (gynophore 1.5 – 3 mm long); **Nepal:** Chusapani, 2 Dec., 1907, *I.H. Burkill*, 29595 – CAL; West Bengal, Manebhanjan, on way to Dhotry, 3 Sept., 1985 *B. Krishna*, 4665- BSHC (gynophore 1 – 3 mm long; Fig. 1, H1 & H2); **Tenasserim:** Moolyet, 500 ft. (1500 m), 27 Jun., 1877, *Geo. Gallatley*, 192 – CAL (gynophore 2 mm long in dehiscent fruit).

Acknowledgement

The authors are thankful to Joint Director, Central National Herbarium (CAL), Botanical Survey of India and Sikkim Himalayan Circle (BSHC) for giving permission to study the herbarium.

LITERATURE CITED

Nair, K.N. & Nayar, M.P. 1997. Family Rutaceae in Hajra *et al.* (eds.), *Flora of India* 4: 356 – 359, BSI, Calcutta.