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INDIGOFERA TRITA L. f. (FABACEAE — PAPILIONOIDEAE) COMPLEX IN INDIA

M. SANJAPPA

Botanical Survey of India, Howrah

INTRODUCTION

Ali (1958) in his revision of the genus *Indigofera* L. from W. Pakistan and N. W. Himalayas made a statistical approach to study the taxa involved under *I. trita* L. f. and its closely related *I. subulata* Vahl ex Poir. The specimens of the above taxa were examined for the following three characters and their variations (symbols used are indicated) :

α = Length of the inflorescence.
α_1 = Less than or equal to 4.5 cm.
α_2 = More than 4.5 cm.
β = Number of leaflets per leaf.
β_1 = 3.
β_2 = More than 3.
γ = Condition of the fruit.
γ_1 = Fruits spreading, slightly curved at the base.
γ_2 = Fruits drooping deflexed, not curved at the base.

Based on statistical analysis (a method advocated by Bell, 1956) of these characters, Ali (*l. c.*) treated *I. trita* L. f. as a single species complex with 2 subspecies and 4 varieties as given below.

subsp. 1. *trita* (a) var. *trita*
(b) var. *maffeii* (Chiov.) Ali
subsp. 2. *subulata* (Vahl ex Poir.) Ali
(a) var. *subulata*
(b) var. *scabra* (Roth) Ali

Subsequently Gillett (1971) and Ali (1977) have merged the two subspecies and treated all varieties under *I. trita* L. f.

In view of the above observations, it was thought worthwhile to apply similar statistical method to analyse all Indian taxa under *I. trita* L. f. *viz.*, var. *trita*, var. *maffeii* (Chiov.) Ali and var. *scabra* (Roth) Ali and the closely allied *I. marginulata* Grah. ex Wt. & Arn. For the present work, the characters suggested by Ali (*l. c.*) were scored from specimens of above taxa available in almost all herbaria in India.

OBSERVATION AND TAXA DESCRIBED

A total of 278 specimens were examined for the analysis. The distribution frequency for each character is as given below :

α_1 = 135	β_1 = 179	γ_1 = 218
α_2 = 143	β_2 = 99	γ_2 = 60

The correlation of each 2 characters and a comparison of observed and expected frequency for each combination are presented in Table 1. The expected frequencies are calculated following Bell (1956) assuming the character to be independent. The expected frequencies are shown in parenthesis.

Date of receipt : 2.8.84. Date of acceptance : 7.4.85.

TABLE 1

	α_1	α_2	β_1	β_2	γ_1	γ_2
α_1	—	—	135** (86.92)	15* (68.07)	120** (105.86)	15* (29.13)
α_2	—	—	59* (92.07)	84** (50.92)	98* (112.13)	45** (30.86)
β_1	135** (86.92)	59* (92.07)	—	—	179** (140.36)	0* (38.63)
β_2	15* (48.07)	84 ** (50.92)	—	—	39* (77.63)	60** (21.36)
γ_1	120** (105.86)	98* (112.13)	179** (140.36)	39* (77.63)	—	—
γ_2	15* (29.13)	45** (30.86)	0* (38.63)	60** (21.36)	—	—

* = Under—representation of observed frequencies. ** = Over—representation of observed frequencies.

In Table 2 combination of 3 characters taken simultaneously are shown along with expected frequencies and Chi square (X^2) value for each combination.

TABLE 2

Combination	Observed frequencies	Expected frequencies	$X^2=[(0-E)-0.5]^2/E$
1. $\alpha_1\ \beta_1\ \gamma_1$	120	68.163	38.664
2. $\alpha_2\ \beta_1\ \gamma_1$	59	72.203	2.600
3. $\alpha_2\ \beta_1\ \gamma_2$	15	19.872	1.452
4. $\alpha_2\ \beta_2\ \gamma_2$	45	10.990	102.176
5. $\alpha_1\ \beta_1\ \gamma_2$	0	18.760	19.773
6. $\alpha_1\ \beta_2\ \gamma_1$	0	36.699	38.705
7. $\alpha_1\ \beta_1\ \gamma_2$	0	10.375	1.436
8. $\alpha_2\ \beta_2\ \gamma_1$	39	39.933	0.051
Degrees of freedom = 1, Probability $=< 0.001$.			204.857

The X^2 value in Table 2 indicate that it is unlikely that various grades of characters are associated at random. Among the 8 possible combinations 5 are represented in India. The combination of characters and taxa representing them are shown in Table 3.

TABLE 3

Combination of characters				Taxon
a.	α_1	β_1	γ_1	var. *trita*
b.	α_2	β_1	γ_1	var. *maffeii*
c.	α_2	β_2	γ_2	var. *scabra*
d.	α_2	β_2	γ_1	var. *marginulata*
e.	α_2	β_1	γ_2	var. *purandharensis*

Key to the varieties recognised

1a. Leaves 3-foliolate :
  2a. Racemes less than 4.5 cm long ; pods divaricate ... *trita*
  2b. Racemes more than 4.5 cm long ; pods not divaricate :
    3a. Pods 1 mm broad, up to 6 per peduncle ; lax, spreading ... *maffeii*
    3b. Pods more than 1 mm broad, more than 6 per peduncle ; compact, deflexed ... *purandharensis*
1b. Leaves 5-7-foliolate (basal leaves 3-foliolate) :
  4a. Pods less than 3 cm long, straight, spreading ... *marginulata*
  4b. Pods more than 3 cm long, curved, drooping ... *scabra*

Indigofera trita L. f. Suppl. Pl. 335. 1781 ; DC. Prodr. 2 : 232. 1825 ; Roxb. Fl. Ind. Carey ed. 3 : 371. 1832 ; Wt. & Arn. Prodr. 203. 1834 ; Dalz. & Gibs. Bombay Fl.

60. 1861 ; Baker in Hook. f. Fl. Brit. Ind. 2 : 96. 1876 ; Cooke, Fl. Pres. Bombay 1 : 315. 1902 ; Prain, Bengal Pl. 1 : 432. 1902 ; Haines, Bot. Bihar Orissa 2 : 249. 1922 ; Gamble, Fl. Pres. Madras 1 : 219. 1935 ; Kanjilal *et al.* Fl. Assam 2 : 22. 1938 ; Duthie, Fl. Upp. Gang. Plain 1 : 232. 1918 ; Gillett in Kew Bull. Add. Ser. 1 : 101. 1958 ; Ali in Bot. Notis. 111 : 553. 1958 et Fl. W. Pakistan Fasc. 100 : 78. 1977 ; Santapau, Fl. Saurashtra 128. 1968 ; Maheshwari, Fl. Delhi 118. 1963 ; Gandhi in Saldanha & Nicolson, Fl. Hassan Dist. 258. 1976 ; Shah, Fl. Gujarat State 1 : 225. 1978. *Type* : INDIA, *Unknown Collector*, Herb. Linn. no. 925.9 (LINN., Microfische CAL !). Figure : Wight, Icones t. 315, 386. 1840-43 ; Roxb. Icones (Ined.) t. 379 (CAL ! K) ; *I. canascens* Lamk. Encyc. 3 : 251. 1789 ; *I. hedysaroides* Lamk. Encyc. 3 : 250. 1789 ; *I. cinera* Willd. Sp. Pl. 1225. 1803 ; *I. rigidula* Willd. Enum. 2 : 780. 1809 ; *I. timorensis* DC. Prodr. 2 : 223. 1825 ; *I. leschenaultii* DC. Prodr. 2 : 223. 1825 ; *I. virgata* DC. Prodr. 2 : 224. 1825. *non* Roxb. 1832 ; *I. arcuata* Willd. Sp. Pl. 3 : 1228. 1803.

var. **trita** (Fig. 1).

Erect undershrub, 50-150 cm tall, branches angular, adpressed white canascent. Leaves 2.5-5 cm long with a petiole of 1.2-2.5 cm long ; pinnately trifoliolate, side ones opposite, 1.0-3.5 × 0.5-2 cm, obovate or oblong, sometimes ovate or elliptic rounded at base and apex, sometimes emarginate at apex, fine adpressed grey pubescent on both surfaces ; stipules small setaceous ; stipels absent. Racemes 1.5-4.5 cm long, a sessile or subsessile, axillary, 10-20-flowered, upper flowers sterile. Flowers 5 mm long, pink ; pedicels short ; bracts small, caducous. Calyx 2-2.5 mm long, adpressed white pubescent without, teeth linear, acute. Standard 5 × 1.5-2 mm, orbicular or obovate, fine adpressed white pubescent without ; wings 3.5-4 mm long, glabrous ; keels 4-4.5 mm long, white pubescent without, spurred on sides. Ovary 3 mm long, glabrous initially, 4-8-ovuled, style 1.5-2 mm long, bent, glabrous ; stigma capitate. Pods 2.5-3 × 0.3 cm, divaricate, very rarely deflexed, rigid, straight, tetragonous, spine-pointed, fine adpressed white pubescent, up to 10-seeded ; seeds 1.5-2 × 1 mm, oblong, subtetragonous, truncate at both ends or rounded at one end, smooth, yellow or reddish-brown.

Fls. : Sept.-Oct. *Frts.* : Nov.-Dec.

Distribution : Throughout INDIA, BURMA, SRI LANKA, PAKISTAN, INDONESIA, AUSTRALIA.

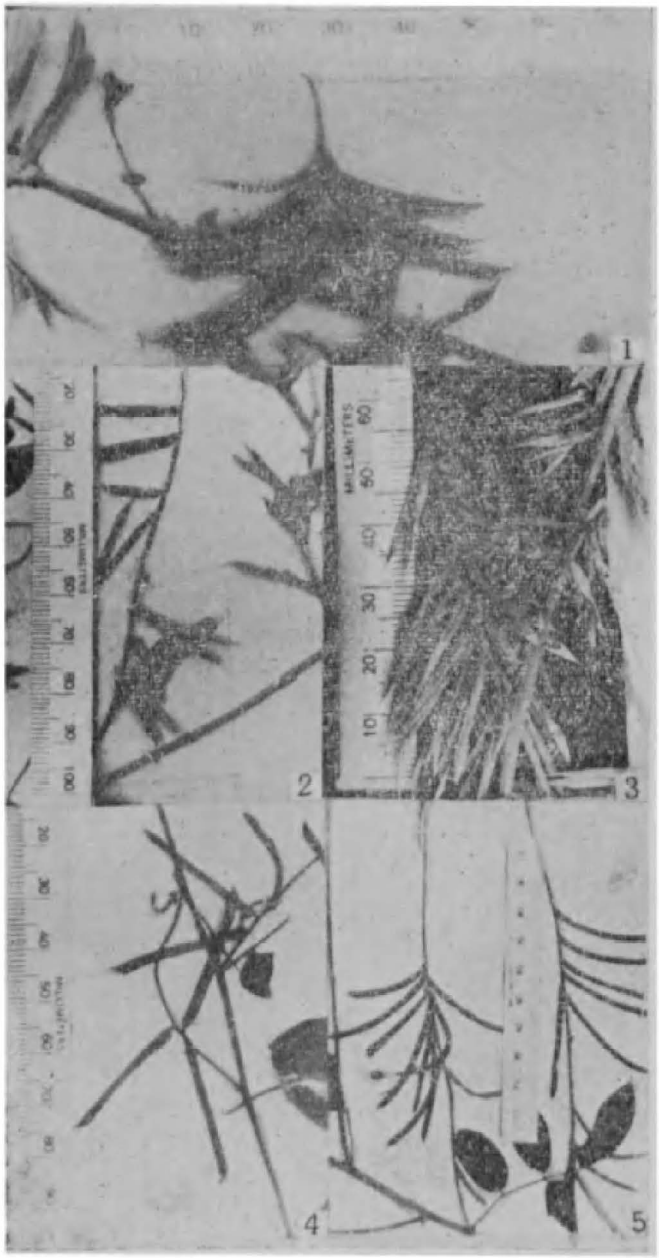
Specimens examined for this variety are not cited, as it is a long list. However, the list of specimens examined in various herbaria is preserved in CAL.

var. **maffeii** (Chiov.) Ali, in Bot. Notis. 111 : 559. 1958 et in Nasir & Ali, Fl. W. Pakistan Fasc. 100 : 79. 1979 ; Gillett in Milne-Redhead & Polhill, Fl. Trop. E. Africa 3 : 304. 1971 ; Nair in Rec. Bot. Surv. India 21 : 90. 1978 ; Shah, Fl. Gujarat St. 1 : 225. 1978. *I. maffeii* Chiov. in Atti Ist. Bot. Univ. Pavia Ser. 4, 7 : 128. t. 5. 1936 ; *I. subulata* Vahl ex Poir. var. *maffeii* (Chiov.) Gillett in Kew Bull. Add. Ser. 1 : 101. 1958. *Type* : Somalia, Genale, *Pollacci & Maffei* 124 (FI). *I. marginulata* auct. non Grah. ex Wt. & Arn. 1834 ; Baker in Hook. f. Fl. Brit. Ind. 2 : 97. 1876 *pro parte* (excl. spec. cited *Wight*) ; Cooke, Fl. Pres. Bombay 1 : 336. 1902 ; *I. oreophila* Sant. & Panth. in J. Bombay Nat. Hist. Soc. 54 : 221. 1956 ; Sant. Fl. Purandhar : 39. 1957. *Type* : Gujarat, Waghai, Dangs forest, 23 Sept. 1955, *D. P. Panthaki* 2350 (Holo, BLAT !). Fig. 2.

Differs from var. *trita* in having more than 4.5 cm long distinctly pedunculate racemes ; narrow and spreading pods.

Fls. : Sept.-Nov. *Frts.* : Oct.-Dec.

Specimens examined : GUJARAT : Dangs forest, Waghai to Pimpri, alt. 500', Nov.



Figs. 1-5 : Fruiting peduncles of *Indigofera trita* L.f. 1. var. *trita* (*C.E.C. Fischer* 2439). 2. var. *maffeii* (Chiov.) Ali. (*B. M. Wadhwa* 60931). 3. var. *purandharensis* Sanjappa (*H. Santapau* 11398). 4. var. *marginulata* (Grah. ex Wt. & Arn.) Sanjappa (*M. Sanjappa* 702). 5. var. *scabra* (Roth) Ali (*E. Vajravelu* 22462) respectively.

1921, *W. T Saxton* 2635 (CAL) ; Dangs forest, 23 Oct. 1919, *R. H. Dastur* 141 (CAL) ; Waghai, along Nasik Road, 23 Oct. 1955, *D. P. Panthaki* 2350 (BLAT, Holotype of *I. oreophila*) ; Pimpri, Dangs forest, 26 Oct. 1955, *D. P. Panthaki* 2415 (BLAT) ; Waghai, alongside Pimpri road, 22 Oct. 1955, *H. Santapau* 19995 (BLAT) ; Alongside Nasik road, 23 Oct. 1955, *H. Santapau* 20080 (DD), 20081 (BLAT). There are several collections made from Dangs forest and are deposited in BLAT—19 Oct. 1954, *D. P. Panthaki* 1734, 1735 ; 4 Sept. 1954, *H. Santapau* 19235, 19236 ; 19 Oct. 1954, *H. Santapau* 19637, 20 Oct. 1955, *H. Santapau* 19994 ; 22 Oct. 1955, *H. Santapau* 19996, 19997 ; 22 Oct. 1955, *D. P. Panthaki* 2341b ; 26 Oct. 1955, *D. P. Panthaki* 2415 ; 11 Feb. 1956, *D. P. Panthaki* 2529 and in HSPU—18 Sept. 1966, *B. Suryanarayana* 1607 ; 21 Sept. 1966, *B. Suryanarayana* 711 ; 22 Oct. 1966, *B. Suryanarayana* 2172. Vyars forest, Mirapur, 3 Oct. 1968, *A. I. Patel* s. n. MAHARASHTRA : Concan, *Stocks* s. n. (CAL) ; Matheran, Neral, Thaburwadi, 29 Oct. 1959, *N. A. Irani* 4724 (BLAT) ; 24 Jan. 1959, *N. A. Irani* 2824 (BLAT) ; National Park, Borivile, Bombay ; 25 Oct. 1954, *P. S. Herbert* 239 ; 29 Oct. 1955, *Herbert* 862 ; 11 Dec. 1955, *Herbert* 1139, 11340 ; 2 Oct. 1956, *Herbert* 2480, 2481, 2482, 2483 (BLAT) ; Khandesh, E. slope of Turanmal, Dec. 1918, *E. Blatter* 1256, 12438 (BLAT) ; Deodongra, Nasik Dist., 29 Sept. 1967, *J. Cherian* 112676 (BSI). NAGAR HAVELI : Dongerpad-Umberkoi, 7 Nov. 1970, *M. Y. Ansari* 122008 (BSI).

Distribution : INDIA (Gujarat, Maharashtra, Nagar-Haveli) ; ETHIOPIA, ERITREA, KENYA, MOZAMBIQUE, PAKISTAN, TANGANYIKA, SOMALI REPUBLIC, SUDAN, UGANDA.

var. **purandharensis** Sanjappa, var. *nov.* (Figs. 3).

A varietate *trita*, racemis floribusque longioribus, leguminibus brevioribus latioribus, compactis, deflexisque. Holotypus lectus ad locum Purandhar, Poona, Maharashtra, die 9 Oct. 1950, *H. Santapau*, sub numero 11398, et positus in herbario BLAT.

Differs from var. *trita* in having longer racemes and flowers ; shorter, broader, compact and deflexed pods.

Holotype : Purandhar, Poona, Maharashtra, 9 Oct. 1950, *H. Santapau* 11398 (BLAT).

Fls. : Sept.-Oct. *Frts.* : Nov.-Dec.

Specimens examined : INDIA : Maharashtra, Poona Dist., Vazirghad, Purandhar, 9 Oct. 1950, *H. Santapau* 11399 ; 20-30 Sept. 1945, *H. Santapau* 8368 ; Slopes below Vazirghad fort, 29 Dec. 1945, *H. Santapau* 8326, 8327 ; 13 Oct. 1957, *H. Santapau* 22021 ; 13 Oct. 1957, *G. L. Shah* 9259, 9260. All specimens cited are in BLAT.

Note : This variety is apparently restricted to Purandhar. The medifixed hairs on leaflets, calyx and corolla have black spot at their point of attachment.

Among the varieties of *Indigofera trita* L. f., this new variety shows more affinities with var. *maffeii* (Chiov.) Ali but differs from it in having subcoriaceous leaflets ; shorter racemes ; broader, compact and deflexed pods.

var. **marginulata** (Grah. ex Wt. & Arn.) Sanjappa, *comb. et stat. nov. I. marginulata* Grah. ex Wt. & Arn. Prodr. : 204. 1834 ; Drury, Handb. Indian Fl. 1 : 281. 1864 ; Baker in Hook. f. Fl. Brit. Ind. 2 : 97. 1876 *pro parte* (excl. spec. cited *Stocks*) ; Gamble, Fl. Pres. Madras 1 : 220. 1935. *Type* : Penin. India, *Wall. Cat. no.* 5467 (CAL ! K, Photo CAL !). (Fig. 4).

Differs from var. *trita* in having generally 5-foliolate leaves (except for basal leaves on branches which are 3-foliolate), more than 4.5 cm long racemes, and spreading pods with rounded valves.

Fls. : Sept.-Oct. *Frts.* : Nov.-Jan.

Specimens examined : TAMIL NADU : Dindygul, *Wall. Cat. no.* 5467 (CAL) ; Herb.-Wight, Royal Garden, Kew Dist. no. 666 (CAL) ; Nilgiri Dist., Kullar, alt. 2000′, *J. S. Gamble* 16993 (CAL) ; Adderly, alt. 750 m, *N. C. Rathakrishnan* 39155 (MH) ; Tirunelveli Dist., Naterikal, 12 Feb. 1913, *D. Hooper & M. S. Ramaswamy* 38390 (CAL, MH) ; Coimbatore Dist., Thekkumalai, alt. 662 m, 19 Nov. 1956, *K. M. Sebastine* 1388 (CAL, MH) ; Marudhamalai, near temple, 6 Dec. 1980, *M. Sanjappa* 702 (CAL) ; Ramnad Dist., Aiynarkoil forest, alt. 425 m, 13 March 1970, *E. Vajravelu* 33709 (CAL, MH) ; Madurai Dist., on way to Sirumalai, alt. 900 m, 27 Feb. 1978, *M. Chandrabose* 53402 (CAL, MH).

Distribution : Endemic to India (Tamil Nadu).

var. **scabra** (Roth) Ali in Bot. Notis. 111 : 558. 1958 ; Gillett in Milne-Redhead & Polhill, Fl. Trop. E. Africa 3 : 304 : 1971. *I. scabra* Roth, Nov. Pl. Sp. 359. 1821 ; DC. Prodr. 2 : 229. 1825. *I. subulata* Vahl ex Poir. var. *scabra* (Roth) Meikle in Kew Bull. 5 : 352. 1951 ; Gillett in Fl. W. Trop. Afr. ed. 2, 1 : 541. 1958, in Kew Bull. Add. Ser. 1 : 100. 1958. *Type* : Penin. India, Madras Province *Wall. Cat. no.* 5475 *ex Herb. Heyne* (K, CAL !) ; *I. flaccida* Koenig ex Roxb. Fl. Ind. 3 : 375. 1832 ; Wt. & Arn. Prodr. : 204. 1834 ; Drury Handb. Indian Pl. 1 : 281. 1864. *Type* : INDIA, Galicondah, *Roxburgh* s. n. (CAL !). Figure : Roxb. Icones (ined.) t. 384 (CAL !) ; *I. mucronata* Spreng. ex DC. Prodr. 2 : 227. 1825. *Type* : *Herb. DC.* 2 : 227.54 (G, Microfische CAL !) ; *I. subulata* auct. non Vahl ex Poir. 1789 ; Baker in Hook. f. Fl. Brit. Ind. 2 : 96. 1876 ; Gamble, Fl. Pres. Madras 1 : 219. 1935 ; Duthie, Fl. Upper Gang. Plain 1 : 232. (Fig. 5).

Differs from var. *trita* in having longer, 5-7-foliolate leaves ; 5-15 cm long racemes (much longer in fruits), 3-4 cm long curved pods hanging alongside inflorescence axis.

Fls. : Sept.-Oct. *Frts.* : Oct.-Dec.

Specimens examined : ANDHRA PRADESH : Kistna Uplands, Nov. 1902, *C. A. Barber* 4576 (CAL) ; 17 Oct. 1902, *C. A. Barber* 4624, 4626 (CAL) ; Simhachalam 13 July 1958, *S. K. Wagh* 8416, 8417 (BLAT) ; Vishakhapatnam, Dolphins nose, 17 Oct. 1956, *S. K. Wagh* 4598, 4599 (BLAT) ; Palasa, 20 Nov. 1955, *G. H. Maduram* 197

(CAL) ; Hyderabad, Osmania University Campus, 6 Nov. 1970, *B. K. Vijay Kumar* 1268 (CAL, MH, BSI, BSD) ; Galicondah, *Roxburgh* s. n. (Type of *I. flaccida* Koen. ex Roxb.—CAL). KARNATAKA : Ranganathittu near Srirangapatna, Mandya Dist., *H. Shekar Shetty* 39, 40, 41. 42 (MGM). MAHARASHTRA : Concan, *Stocks* s. n. (CAL) ; Khandesh, Dec. 1918, *E. Blatter* 12463 (BLAT). TAMIL NADU : Coimbatore Dist., Anamalai Hills, alt. 3000′, Sept. 1884, *J. S. Gamble* 14592 (CAL) ; Udonthorai, alt. 1000′, 5 Aug. 1910, *C. E. C. Fischer* 2069 (CAL) ; *C. E. C. Fischer* 1260 (CAL) ; alt. 1300′, 16 July 1905, *C. E. C. Fischer* 8 (CAL) ; Kuradimalai, alt. 653 m, 7 Nov. 1956, *K. Subramanyam* 1216 (CAL, MH) ; Murthamalai, alt. 653 m, 23 Nov. 1956, *K. Subramanyam* 1430 (CAL, MH) ; Thekkumalai, alt. 653 m, *K. M. Sebastine* 1496 (CAL, MH) ; Aliyar submergible area, alt. 350 m, 24 Nov. 1962, *K. M. Sebastine* 15336 (CAL, MH) ; Vadakumalai, alt. 750 m, 22 Dec. 1970, *M. V. Vishwanathan* 857 (MH) ; Marudhamalai, near temple, 6 Dec. 1981, *M. Sanjappa* 701 (CAL) ; Tirunelveli Dist., Courtallam, Ilengi Tank, 25 July 1957, *K. Subramanyam* 3915 (CAL, MH) ; Nilgiri Dist., Kotaigiri, Mamaram, alt. 766 m, 6 Jan. 1957, *K. Subramanyam* 1981 (CAL, MH) ; Salem Dist., Pennagaram Reserve Forest, 4 Dec. 1964, *E. Vajravelu* 22462 (CAL, MH) ; Thruchirappaly Dist., Changalpatti, on way to top, alt. 700 m, 28 Oct. 1958, *K. M. Sebastine* 7106 (CAL, MH) ; Ramanathapuram Dist., Periyar river bank, near Periyar Dam, alt. ± 275 m, 16 Feb. 1979, *N. C. Nair* 60863 (CAL, MH) ; *Herb. Wight*, Royal Garden, Kew distribution no. 667 (CAL) ; *Wall. Cat. no.* 5475, 5475B (K-W Microfisce CAL !) ; *Wall. Cat. no.* 5475C (CAL, K-W Microfisce CAL !).

Distribution : INDIA (Andhra Pradesh, Karnataka, Maharashtra, Tamil Nadu) ; CONGO ; CENTRAL AMERICA ; ETHIOPIA ; KENYA ; MADAGASCAR ; MALAWI ; MOZAMBIQUE ; NIGERIA ; RHODESIA ; S. AFRICA ; TANGANYIKA ; UGANDA ; ZAMBIA ; ZANZIBAR.

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