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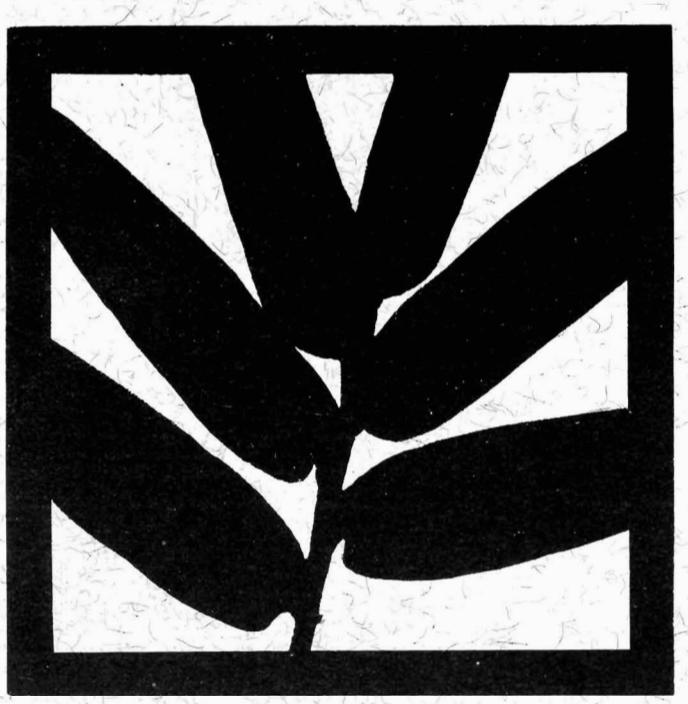

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CONTENTS

D. Ohrnberger and J. Goerrings: The Bamboos of the World - A Preliminary Study of the Names and Distribution of the Herbaceous and Woody Bamboos (Bambusoideae Nees v. Esenb.) - Documented in Lists and Maps. Genus Chusquea. 1

Stephen M. Young: The Flowering of *Bambusa paniculata* (Poaceae: Bambusoideae) in Southern Mexico 47

D. Ohrnberger: Errata 54

D. Ohrnberger* and J. Goerrings**: **The Bamboos of the World - A Preliminary Study of the Names and Distribution of the Herbaceous and Woody Bamboos (Bambusoideae Nees v. Esenb.) - Documented in Lists and Maps**

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GENUS CHUSQUEA

Chapter 1: Nomenclature (by D. Ohrnberger)

Chusquea has more species than any other genus of American bamboos. The species have solid culms and more than one bud at a node. The genus includes morphologically heterogeneous species and a revision is deemed necessary. At present, the genus contains about 90 generally recognized species and several not yet described. A total of 92 species are listed in the present work, of which about 8 are questionable and 2 are fossil species. The list also contains 6 varieties and 1 form. The references cited here are abbreviated; full references will be found in a bibliography to appear in a later number of this journal. The publication year of a given reference is followed by its page numbers. An asterisk, *, indicates that the work contains one or more figures of the taxon concerned, these being helpful for identification in many ways.

The Genus

Chusquea Kunth, 1822:151 - Kunth, 1822:254 - Kunth, 1829:138 - Kunth, 1833:427 - Nees v. Esenb., 1834:467,484,486 - Endlicher 1836-1840:102,1354 - Ruprecht,1839:30, and 1840:120 - Steudel, 1854:336 - Miquel, 1857:414 - Grisebach, 1864:529 - Munro, 1868:52 - Doell in Martius, 1880:194 - Bentham in Bentham and Hooker, 1883:1095,1209 - Hackel in Engler and Prantl, 1887:93 - Baillon, 1894:253 - Arechavaleta, 1897:542 - E.G. Camus, 1913:78 - Hitchcock, 1927:308 - Hitchcock 1936:22 - Parodi, 1941:331-333 - Parodi, 1945:61-64 - McClure in Swallen, 1955:86 - cf. McClure, 1957:202 - McClure and Smith in Reitz, 1967:19 - McClure, 1973:69 - Nicora in Correa, 1978:16 - cf. Soderstrom and Calderón, 1978:154.- cf. Calderón and Soderstrom, 1980:16,19 - Pohl in W. Burger, 1980:127 - cf. P.C. Keng, 1982:179
(tribe CHUSQUEEAE - cf. Soderstrom and Calderón, 1978:154 - cf. Calderón and Soderstrom, 1980:16,18)
type: *Chusquea scandens* Kunth - cf. Calderón and Soderstrom, 1980:19

Coliquea Steudel ex Bibra, 1853:115, without description - cf. McClure, 1957:202

Chusquea subgenus *Dendragrostis* Nees v. Esenb., 1834:467,487 - cf. McClure, 1973:69

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Dendragrostis Nees v. Esenb. ex Munro, 1868:52, as a synonym - Nees v. Esenb. ex Jackson, 1893:727, not validly published - cf. McClure, 1957:202 - cf. P.C. Keng, 1983:11

Mustelia Cavanilles ex Steudel, 1841:168, without description; not Sprengel, 1801 - cf. McClure, 1957:205 - cf. P.C. Keng, 1983:143

Rettbergia Raddi, 1823:17 - Nees v. Esenb., 1829:535 - cf. McClure, 1957:207
Chusquea subgenus *Rettbergia* (Raddi) Nees v. Esenb., 1834:467,489

The Species

Chusquea abietifolia Grisebach, 1864:529 - Munro, 1868:55 - J.D. Hooker, 1885:tab. 6811,* - E.G. Camus, 1913:80 - Hitchcock and Chase, 1917:400 - Hitchcock, 1936:22,* - McClure, 1966:272 - McClure, 1973:74

Arundinaria microclada Pilger in Urban, 1907:289 - E.G. Camus, 1913:49 - Hitchcock and Chase, 1917:400, as a synonym under *Chusquea abietifolia* - Urban, 1920:52

Species not well known.

Chusquea acuminata Doell in Martius, 1880:204 - Dutra, 1938:146 - McClure, 1973:74

Chusquea tenuis Glaziou ex E.G. Camus, 1913:90,* - McClure,1973:74, as a synonym

Chusquea affinis Munro ex E.G. Camus, 1913:80,* - McClure, 1973:74

Chusquea andina Philippi, 1858:103 - Munro,1868:58 - E.G. Camus, 1913:86 - Parodi, 1945:64, as a synonym under *C. culeou* - McClure, 1973:74 - Nicora in Correa, 1978:19, as a synonym under *C. culeou*

According to Munro, 1868:58, *C. andina* is probably an alpine form of *C. culeou*.

Chusquea anelythra Nees v. Esenb., 1834:491 - Ruprecht 1839:30,* and 1840:120 - Steudel, 1854:336, as *C.* "*anelytra*" - Munro, 1868:63 - Doell in Martius 1880:205, as *C.* "*anelytra*" - E.G. Camus, 1913:93,* - McClure and Smith in Reitz, 1967:35,*, as *C.* "*anelytra*" - McClure, 1973:74
Dendragrostis anelythra Nees v. Esenb. ex Munro, 1868:63, as a synonym

Chusquea anelytroides Ruprecht ex Doell in Martius, 1880:206 - E.G. Camus, 1913:93,*, as *C.* "*anelythroides*" - McClure, 1973:74

Chusquea argentina Parodi, 1941:339,* - Parodi, 1945:64 - McClure, 1973:74 - Nicora in Correa, 1978:18,17*

Quila (Argentina)

Chusquea bambusoides (Raddi) Hackel in Wettstein, 1908:81 - McClure and Smith in Reitz, 1967:24 - McClure, 1973:74,69,73

Rettbergia bambusoides Raddi, 1823:18,* as *R.* "*bambusaeoides*" - Nees v. Esenb., 1829:536

Nastus bruneus A.N. Desvaux, 1831:107,[err.211]

Chusquea gaudichaudii Kunth, 1829:138, without description, and 1830:331,*, based on *Rettbergia bambusoides* Raddi - Kunth, 1833:428 - Kunth, 1834:467-468 - Kunth, 1834:610 - Kunth, 1835:352 - Trinius, 1835:616 - Ruprecht, 1839:34,*, and 1840:124,* - Steudel, 1854:337 - Munro, 1868:67 - Doell in Martius, 1880:197 - E.G. Camus, 1913:98,* - McClure, 1973:74,71

Chusquea quila cv. Bambusaeoides (Hackel ex Brennecke, 1980:5, without description)

Chusquea bambusoides var. ***minor*** McClure and Smith in Reitz, 1967:25,* - McClure, 1973:74

Chusquea bilimekii Fournier, 1881/1886:132, as *C.* "*bilimeki*" - Fournier ex Hemsley, 1885:587, without description? - Hitchcock, 1913:387 - E.G. Camus, 1913:82,* - McClure, 1973:74 - not? Beetle, 1977:340 - Martinez and Matuda, 1979:429

Chusquea breviglumis Philippi, 1858:103 - Munro, 1868:58, as a synonym under *C. culeou* - cf. Parodi, 1945:66,70

Chusquea capitata Nees v. Esenb., 1834:489 - Ruprecht, 1839:35,*, and 1840:125,* - Steudel, 1854:338 - Munro, 1868:69 - Doell in Martius, 1880:195 - Ekman, 1913:65 - E.G. Camus, 1913:99,* - McClure and Smith in Reitz, 1967:22,* - McClure, 1973:74,71,73

Rettbergia capitata Nees v. Esenb. ex Munro, 1868:69, as a synonym

Chusquea capituliflora Trinius, 1835:613,617 - Trinius, 1836:339 - Ruprecht, 1839:35,*, and 1840:125,* - Steudel, 1854:337 - Munro, 1868:68 - Doell in Martius, 1880:196 - Arechavaleta, 1897:544-546,* - E.G. Camus, 1913:98,* - McClure and Smith in Reitz, 1967:26-28,* - McClure, 1973:74,73

Chusquea capituliflora var. ***pubescens*** McClure and Smith in Reitz, 1967:28,* - McClure, 1973:74

Chusquea carinata Fournier, 1881/1886:132 - E.G. Camus, 1913:89 - McClure, 1973:74 - Beetle, 1977:340

Chusquea circinata Soderstrom and Calderón, 1978:156,* - McVaugh, 1983:120-121,*

Chusquea coronalis Soderstrom and Calderón, 1978:158,* - Pohl in W. Burger, 1980:129,* - Haubrich, 1980:28-29,36 - Stover, 1983:38,*

Chusquea machrisii hort. ex Soderstrom and Calderón, 1978:160, as a synonym

Chusquea culeou E. Desvaux in Gay, 1854:450,* - Philippi, 1864:299 - Munro, 1868:58 - Philippi, 1873:578, as *C. "coleou"* - O. Kuntze 1898:348, as *C. "culeu"* - E.G. Camus, 1913:87,* - Parodi, 1941:342,* - Parodi, 1945:64 - Lawson, 1968:148-151,* - McClure, 1973:74 - Nicora in Correa, 1978:19,18,17* - Stover, 1983:38 - Feesey, 1983:38

Culeú, Colihue, Coligüe (Argentina)

Chusquea culeou f. ***longiramea*** Parodi, 1941:343 - Parodi, 1945:64 - McClure, 1973:75 - Nicora in Correa, 1978:19, as a synonym under *C. culeou*

Chusquea culeou var. ***tenuis*** D. McClintock, 1983:486

Chusquea breviglumis hort.

culms: thinner and shorter.

Chusquea cumingii Nees v. Esenb., 1834:487 - Ruprecht, 1839:*, and 1840:122 - Steudel, 1854:336 - Munro, 1868:56 - E.G. Camus, 1913:86,* - Parodi, 1945:65 - McClure, 1973:75 - cf. D. McClintock, 1983:486

Arundo canila Molina ex Steudel, 1854:336, as a synonym

Chusquea parvifolia Philippi, 1864:299 - Philippi,1873:578 - Munro, 1868:56, as a synonym under *C. cumingii*

Arundo quillinga Molina ex Munro, 1868:56, as a synonym under *C. cumingii*

Chusquea decolorata Munro ex Parodi, 1945:65-66 - McClure, 1973:75

Chusquea deficiens Parodi, 1941:335-338,* - McClure, 1973:75

Chusquea delicatula Hitchcock, 1927:309-310 - McClure, 1973:75

Chusquea discolor Hackel, 1903:155-156 - E.G. Camus, 1913:90,* - McClure and Smith in Reitz, 1967:31,* - McClure, 1973:75

Chusquea dombeyana Kunth, 1832:553,* - Kunth, 1833:428 - Kunth, 1834:610 - Kunth, 1835:350 - Trinius, 1835:616 - Ruprecht, 1839:*, and 1840:123,* - Steudel, 1854:337 - Munro, 1868:62 - E.G. Camus, 1913:92,* - Hitchcock, 1927:311 - McClure, 1973:75

Chusquea fasciculata Doell in Martius, 1880:202,* - E.G. Camus, 1913:81,* - McClure, 1973:75

Chusquea fendleri Munro, 1868:61 - Doell in Martius, 1880:205 - E.G. Camus, 1913:92,* - McClure, 1966:28,33,* - McClure, 1973:75,69,73

Chusquea fernandeziana Philippi, 1873:577-578 - Johow, 1896:141 - Parodi, 1945:67 - McClure, 1973:75

? *Arundo quila* Molina, 1782:279; cf. Johow, 1896:141

Chusquea ligulata Munro, 1868, partly; cf. Johow, 1896:141

Chusquea galeottiana Ruprecht ex Munro, 1868:59 - Ruprecht in Galeotti, 1842:246, without description - Steudel, 1854:338, without description - E.G. Camus, 1913:89,* - McClure, 1973:75

Chusquea gracilis McClure and Smith in Reitz, 1967:43-44,* - McClure, 1973:75

Chusquea huantensis Pilger, 1920:29-30 - Hitchcock, 1927:310 - McClure, 1973:75

Chusquea ibiramae McClure and Smith in Reitz, 1967:40-42,* - McClure, 1973:75

Chusquea inamoena Pilger, 1905:150-151 - Weberbauer, 1911:250 - E.G. Camus, 1913:83, as *C.* "*inamaena*" - Hitchcock, 1927:312 - McClure, 1973:75

Chusquea juergensii Hackel, 1909:325-326, as *C.* "*Jürgensii*" - E.G. Camus, 1913:82, as *C.* "*jurgensii*" - McClure, 1973:75

Chusquea lanceolata Hitchcock in Morton, 1935:145 - McClure in Swallen, 1955:87 - McClure, 1973:75,69

Chusquea lehmannii Pilger, 1899:35-36 - E.G. Camus, 1913:83,205, as *C.* "*Leibmanni*" and *C.* "*Liebmanni*", as synonyms; not *Chusquea liebmannii* Fournier, 1886 - Hitchcock, 1930:571 - McClure, 1973:75

Chusquea pilgeri E.G. Camus, 1913:83, based on *C. lehmannii* Pilger

Chusquea leptophylla Nees v. Esenb., 1834:489 - Ruprecht, 1840:119,163 - Steudel, 1854:336 - Munro, 1868:69 - E.G. Camus, 1913:72,99,* - McClure and Smith in Reitz, 1967:42,* - McClure, 1973:75

Arthrostylidium leptophyllum (Nees v. Esenb.) Doell in Martius, 1880:175 - Hackel in Wettstein, 1908:81

Arundinaria leptophylla (Nees v. Esenb.) Hackel, 1903:69 - Hackel, 1903:518

Arthrostylidium trinii (not Ruprecht, 1839) in the sense of Steudel, 1854:336, partly - cf. Munro, 1868:69 - cf. McClure, 1973:75

Chusquea liebmannii Fournier, 1881/1886:132, as *C.* "*Liebmanni*" - E.G. Camus, 1913:96 - McClure, 1973:75 - Beetle, 1977:340 - Soderstrom and Calderón, 1978:161,*

Chusquea heydei Hitchcock, 1927:80 - Hitchcock, 1930:570 - McClure in Swallen, 1955:87 - McClure, 1973:75 - Beetle, 1977:340 - Soderstrom and Calderón, 1978:161, as a synonym under *C. liebmannii* Fournier

Chusquea ligulata Munro, 1868:62 - E.G. Camus, 1913:93 - McClure, 1973:75

Chusquea linearis N.E. Brown, 1901:76 - Hitchcock, 1922:452 - McClure, 1973:75

According to McClure, 1973:75, *Chusquea linearis* probably equals *C. pinifolia*.

Chusquea longifolia Swallen, 1940:210 - McClure in Swallen, 1955:88 - McClure, 1973:75 - Beetle, 1977:340 - Pohl in W. Burger, 1980:131 - Haubrich, 1980:36,42*, as *C.* "*longifolium*" - Stover, 1983:38

Chusquea longipendula O. Kuntze, 1898:348 - E.G. Camus, 1913:92 - Hitchcock, 1927:309 - McClure, 1973:75

Chusquea lorentziana Grisebach, 1874:249-250 - Parodi, 1941:338,* - McClure, 1973:75

Chusquea macrostachya Philippi, 1896:350-351 - E.G. Camus, 1913:99 - Parodi, 1945:68 - McClure, 1973:75

Chusquea mexicana Hackel, 1902:256 - E.G. Camus, 1913:87 - McClure, 1973:75

Chusquea meyeriana Ruprecht ex Doell in Martius, 1880:203 - Lindman, 1900:23,* - E.G. Camus, 1913:94,* - Ekman, 1913:68 - Dutra, 1938:147 - McClure and Smith in Reitz, 1967:34,* - McClure, 1973:75 - not Pohl in W. Burger, 1980:132,*

Chusquea mimosa McClure and Smith in Reitz, 1967:37,* - McClure, 1973:75

Chusquea montana Philippi, 1864:298-299 - Munro, 1868:59 - E.G. Camus, 1913:89 - Parodi, 1945:66 - McClure, 1973:75 - Nicora in Correa, 1978:21,18,17*

Tihuen (Argentina)

Chusquea mulleri Munro, 1868:65 - E.G. Camus, 1913:96, as *C.* "*Muelleri*" - McClure, 1973:75, as *C.* "*muelleri*" - Beetle, 1977:340, as *C.* "*muelleri*"

Chusquea nelsonii Lamson-Scribner and J.G. Smith, 1897:16, as *C.* "*nelsoni*" - Hitchcock, 1913:387 - McClure, 1973:75 - Beetle, 1977:340

Chusquea nigricans Philippi, 1865:323 - Philippi, 1896:351-352 - E.G. Camus, 1913:90,* - Parodi, 1945:66, as a synonym under *C. montana* - McClure, 1973:75 - Nicora in Correa, 1978:21, as a synonym under *C. montana*

Chusquea oligophylla Ruprecht, 1839:34,*, and 1840:124,* - Steudel, 1854:337 - Munro, 1868:60 - Doell in Martius, 1880:198 - E.G. Camus, 1913:89,* - McClure, 1973:75

Chusquea oxylepis (Hackel) Ekman, 1913:65,* - McClure and Smith in Reitz, 1967:25,* - McClure, 1973:75,69,*
Chusquea bambusoides subsp. *oxylepis* Hackel in Wettstein, 1908:81-82

"***Chusquea oxyphylla***" Frenguelli and Parodi, 1941:236,* - cf. Janaki Ammal, 1959:78

Fossil species of the Tertiary from Argentina.

Chusquea palenae Philippi, 1896:350 - E.G. Camus, 1913:99 - Parodi, 1945:69 - McClure, 1973:75

Chusquea pallida Munro, 1868:65 - E.G. Camus, 1913:96 - McClure, 1973:75

Chusquea parviflora Philippi, 1896:349-350 - Parodi, 1945:70 - McClure, 1973:75

Chusquea perligulata (Pilger) McClure, 1973:75
Guadua perligulata Pilger in Diels, 1937:57-58,*

Chusquea peruviana E.G. Camus, 1913:88,*, based on *C. ramosissima* Pilger - Hitchcock, 1927:311 - McClure and Smith in Reitz, 1967:36,* - McClure, 1973:75

Chusquea ramosissima Pilger, 1905:149-150; not Lindman, 1900

Chusquea sandiensis Pilger, 1920:29, based on *C. ramosissima* Pilger

Chusquea picta Pilger, 1905:151-152 - E.G. Camus, 1913:85-86 - Hitchcock, 1927:311 - McClure, 1973:75

Chusquea pinifolia (Nees v. Esenb.) Nees v. Esenb., 1834:490 - Trinius, 1835:614,616 - Trinius, 1836:340,* - Ruprecht, 1839:31,*, and 1840:121,* - Steudel, 1854:336 - Munro, 1868:55 - Doell in Martius, 1880:201 - Hackel in Wettstein, 1908:82 - E.G. Camus, 1913:84,* - McClure, 1973:75,69,71,73,74
Arundinaria pinifolia Nees v. Esenb., 1829:525,527 - Kunth, 1833:427 - Kunth, 1834:610
Ludolfia pinifolia (Nees v. Esenb.) Dietrich, 1833:25
Dendragrostis pinifolia Nees v. Esenb. ex Munro, 1868:55, as a synonym

Chusquea baculifera Alvaro da Silveira, 1919:99 - cf. McClure, 1973:73

Chusquea heterophylla var. *elongata* Doell in Martius, 1880:207 - McClure,

1973:75, as a synonym under *C. pinifolia*

Chusquea heterophylla Nees v. Esenb., 1834:488 - Ruprecht, 1839:32, and 1840:122 - Steudel, 1854:336 - Munro, 1868:69 - Doell in Martius, 1880:207 - E.G. Camus, 1913:84,* - McClure, 1973:75,73, as a synonym under *C. pinifolia*

Chusquea pinifolia var. *heterophylla* (Nees v. Esenb.) Hackel in Wettstein, 1906:21, and 1908:82

Chusquea heterophylla var. *microphylla* Doell in Martius, 1880:207 - McClure, 1973:75, as a synonym under *C. pinifolia*

Chusquea heterophylla var. *squamosa* Doell in Martius, 1880:207 - McClure, 1973:75, as a synonym under *C. pinifolia*

Chusquea pittieri Hackel, 1903:153-154 - E.G. Camus, 1913:82 - Hitchcock, 1930:571 - McClure in Swallen, 1955:89 - McClure, 1973:75,69 - Soderstrom and Calderón, 1978:163 - Pohl in Burger, 1980:134,* - Haubrich, 1980:36 - Stover, 1983:38

Chusquea maurofernandeziana Hackel ex E.G. Camus, 1913:86,* - Hackel ex Pittier, 1892:61, without description - McClure, 1973:76, as a synonym under *C. pittieri*

Chusquea polyclados Pilger, 1905:147 - Weberbauer, 1911:261 - E.G. Camus, 1913:91 - Hitchcock, 1927:312 - McClure, 1973:76

Chusquea pubescens Steudel, 1854:337 - Munro, 1868:66, as a synonym under *C. quila* - E.G. Camus, 1913:96, as a synonym under *C. quila* - Parodi, 1945:69, as a synonym under *C. quila* - McClure, 1973:76

Chusquea pubispicula Pilger, 1905:148-149 - Weberbauer, 1911:239-240 - E.G. Camus, 1913:95 - Hitchcock, 1927:311, as a synonym under *C. dombeyana* - McClure, 1973:76

Chusquea purdieana Munro, 1868:56 - E.G. Camus, 1913:84,* - McClure, 1973:76

Chusquea quila (Molina) Kunth, 1829:138, and 1830:329,* - Kunth, 1833:428 - Kunth, 1835:351 - Trinius, 1835:616 - Ruprecht, 1839:*, and 1840:123 - Steudel, 1854:336 - Munro, 1868:65 - E.G. Camus, 1913:96,* - Parodi, 1945:69 - McClure, 1973:76 - Nicora in Correa, 1978:21,18,20* - cf. P.C. Keng, 1982:180

Arundo quila Molina, 1782:279 - Poiret, 1804:274 - Roemer and Schultes, 1817:512

Nastus quila (Molina) Schultes in Roemer and Schultes, 1830:1361
Coliquea quila (Molina) Steudel ex Bibra, 1853:115, not validly published - cf. McClure, 1957:202

Chusquea intermedia Steudel in Lechler, 1857:52, without description - Munro, 1868:66, as a synonym

Chusquea quila var. *laxiflora* E. Desvaux in Gay, 1854:447 - Parodi, 1945:69, as a synonym under *C. quila*

Chusquea quila var. *longipila* E.G. Camus, 1913:198, invalid name - McClure, 1973:76, as a synonym under *C. quila*

Nastus prolifer N.A. Desvaux, 1831:211 - McClure, 1973:76, as a synonym under *C. quila*

Chusquea quila cv. Longiramea (Parodi ex Brennecke, 1980:5, without description)

Quila (Argentina)

Chusquea ramosissima Lindman, 1900:24,* - Hackel in Wettstein, 1908:82 - Weberbauer, 1911:239-240 - E.G. Camus, 1913:92 - Parodi, 1936:240 - Dutra, 1938:146 - Parodi, 1941:335 - McClure and Smith in Reitz, 1967:30,* - McClure, 1973:76 - Dimitri, 1974:39,*

Chusquea phacellophora Pilger, 1923:456 - McClure, 1973:76 as a synonym

Tacuarembó (Argentina)

"***Chusquea rollotii***" Berry, 1929:2-3 - McClure, 1973:76

Fossil species of the late Tertiary from Colombia.

Chusquea scabra Soderstrom and Calderón, 1978:300,* - Pohl in W. Burger, 1980:136 - Haubrich, 1980:36-37

Chusquea scandens Kunth, 1822:254, based on *Nastus chusque* H.B.K. - Kunth, 1829:138 - Kunth, 1833:428, - Kunth, 1835:350 - Trinius, 1835:616 - Ruprecht, 1839:*, and 1840:123,* - Steudel, 1854:337 - Munro, 1868:64-65 - E.G. Camus, 1913:94-95,* - Hitchcock, 1927:311-312 - Pilger in Diels, 1937:58 - McClure in Sohns and Swallen, 1955:133 - McClure, 1973:76,69,71,73,*

Mustelia arundinacea Cavanilles ex Trinius ex Steudel, 1840:361, as a synonym - Steudel, 1841:168, as a synonym - Munro, 1868:64, as a synonym - cf. McClure, 1957:205

Nastus chusque Humboldt, Bonpland and Kunth, 1816:201 - Sprengel, 1825:113 -

Schultes, 1830:1360

Bambusa chusque (Humboldt, Bonpland and Kunth) Poiret, 1817:494, as "*Bambos chusque*"?

Nastus chusquea (Humboldt, Bonpland and Kunth) Raspail, 1825:442

Chusquea jamesonii Steudel, 1854:337, as *C.* "*Jamesoni*" - Munro, 1868:64, as a synonym - McClure, 1973:76, as a synonym, and 75

Chusquea quitensis var. *patentissima* Hackel, 1908:161 - E.G. Camus, 1913:95 - Henrard in Herzog, 1921:77 - Hitchcock, 1927:312, as a synonym under *C. scandens*

Chusquea meyeriana var. *patentissima* (Hackel) E.G. Camus, 1913:94

Chusquea quitensis Hackel in Sodiro, 1889:484, without description - Hackel, 1903:154 - E.G. Camus, 1913:95 - Hitchcock, 1927:312, as a synonym under *C. scandens*

Chusquea sclerophylla Doell in Martius, 1880:200 - E.G. Camus, 1913:88,* - McClure, 1973:76

Chusquea sellowii Ruprecht, 1839:35,*, and 1840:125,* - Steudel, 1854:337 - Munro, 1868:67, as *C.* "*Sellovii*" - Doell in Martius, 1880:197, as *C.* "*sellol*" - E.G. Camus, 1913:98,* - McClure and Smith in Reitz, 1967:29,* - McClure, 1973:76,73

Chusquea serrulata Pilger, 1898:719-720 - E.G. Camus, 1913:88-89 - Hitchcock, 1927:311, - ?Hitchcock, 1930:571 - McClure in Sohns and Swallen, 1955:134 - McClure, 1973:76 - ?Beetle, 1977:341

Chusquea simpliciflora Munro, 1868:54,* - E.G. Camus, 1913:80,* - Hitchcock, 1930:570 - McClure in Swallen, 1955:91,* - McClure, 1973:76,69 - Beetle, 1977:341 - Pohl in W. Burger, 1980:137 - Haubrich, 1980:37, as *C.* "*simpliciflorum*"

Chusquea simplicifolia Munro ex Hemsley in Godman and Salvin, 1885:587, error for *C. simpliciflora*

Chusquea sneidernii Asplund, 1939:797-799,* - McClure, 1973:76

Chusquea spadicea Pilger, 1899:35 - E.G. Camus, 1913:91 - Hitchcock, 1927:311, as a synonym under *C. serrulata* - McClure, 1973:76

Chusquea spencei Ernst, 1872:262, - Ernst, 1887:132 - E.G. Camus, 1913:99 - McClure, 1973:76

Chusquea straminea Pilger, 1905:147-148 - Weberbauer, 1911:263 - E.G. Camus, 1913:95-96 - Hitchcock, 1927:312 - McClure, 1973:76

Chusquea sulcata Swallen, 1940:209 - McClure, 1973:76 - Beetle, 1977:341

Chusquea swallenii McClure and Smith in Reitz, 1967:44-45,* - McClure, 1973:76

Chusquea tarmensis Pilger, 1905:151 - E.G. Camus, 1913:85 - Hitchcock, 1927:312 - McClure, 1973:76

Chusquea tenella Nees v. Esenb., 1834:492 - Ruprecht, 1839:31,*, and 1840:121,* - Steudel, 1854:336 - Munro, 1868:54 - Doell in Martius, 1880:200 - E.G. Camus, 1913:79,* - Dutra, 1938:146 - McClure and Smith in Reitz, 1967:32 - McClure, 1973:76,69

Dendragrostis tenella Nees v. Esenb. ex Doell in Martius, 1880:201, as a synonym

Chusquea tenella var. ***latifolia*** Dutra, 1938:146 - McClure, 1973:76

Chusquea tenuiflora Philippi, 1859:206 - Munro, 1868:66 - E.G. Camus, 1913:97,* - Parodi, 1945:68, as a synonym under *C. uliginosa* - McClure, 1973:76

Chusquea ciliata Philippi, 1864:299 - Munro, 1868:66, as a synonym - Parodi, 1945:68, as a synonym under *C. uliginosa* - McClure, 1973:76, as a synonym

Chusquea quila (not Kunth, 1830) in the sense of E. Desvaux in Gay, 1854:447; cf. Munro, 1868:66

Chusquea tenuiglumis Doell in Martius, 1880:199-200 - E.G. Camus, 1913:79,* - McClure, 1973:76

Chusquea tenuiglumis var. ***laxiuscula*** Doell in Martius, 1880:200 - E.G. Camus, 1913:80 - McClure, 1973:76

Chusquea tenuiglumis var. ***subcylindrica*** Doell in Martius, 1880:199-200 - E.G. Camus, 1913:80 - McClure, 1973:76

Chusquea tonduzii Hackel, 1903:155 - E.G. Camus, 1913:87 - Hitchcock, 1930:571 - McClure, 1973:76 - Pohl in W. Burger, 1980:138,* - Haubrich,

1980:37

Chusquea tuberculosa Swallen, 1931:14 - McClure, 1973:76

Chusquea hispida McClure, 1942:179,* - McClure, 1973:76, as a synonym

Chusquea uliginosa Philippi, 1859:207, as *C. "nliginosa"* - Munro, 1868:57-58 - E.G. Camus, 1913:86 - Parodi, 1945:68 - McClure, 1973:76

Chusquea uniflora Steudel, 1854:337 - Munro, 1868:59 - E.G. Camus, 1913:88,* - Hitchcock, 1927:309 - McClure, 1973:76

Chusquea urelytra Hackel, 1903:158-159 - E.G. Camus, 1913:97,* - McClure, 1973:76

Chusquea uruguayensis Arechavaleta, 1897:546-547 - Parodi, 1941:333,* - McClure, 1973:76,69

Chusquea valdiviensis E. Desvaux in Gay, 1854:446 - Philippi, 1864:299 - Munro, 1868:66, as a synonym under *C. quila* - Parodi, 1945:69, as a synonym under *C. quila* - McClure, 1973:76 - Nicora in Correa, 1978:21, as a synonym under *C. quila*

Chusquea virgata Hackel, 1903:156-157 - E.G. Camus, 1913:85 - Hitchcock, 1930:570-571 - McClure, 1973:76 - Pohl, in W. Burger, 1980:43,*

Chusquea wettsteinii Hackel in Wettstein, 1906:21-22, and 1908:82-83 - Ekman, 1913:67,* - McClure, 1973:76

Chusquea wilkesii Munro, 1868:63 - E.G. Camus, 1913:94 - McClure, 1973:76

Invalid Species Names

Chusquea caamanoi Sodiro, 1881/1889:11, invalid name - E.G. Camus, 1913:99, invalid name - cf. McClure, 1973:77

Chusquea longipila E.G. Camus, 1913:pl.61,fig.A*, invalid name

Chusquea macahensis Glaziou ex E.G. Camus, 1913:97, invalid name under *C. urelytra* Hackel

Chapter 2: Distribution (by J. Goerrings and D. Ohrnberger)

Following the Central and South American mountain range (Andes), the genus *Chusquea* is distributed from Mexico to Chile and Argentina. *Chusquea* occurs moreover in the eastern South America and on Caribbean islands.

The habitat of most species of *Chusquea* is the understory of forests in the cool and temperate climate at high altitudes. A few species are found in forests on slopes at low elevations. *Chusquea* is the genus with the southernmost latitudinal extension among the bamboos. Some species reach to about 47° South.

The genus has an altitude range from slightly above sea level to the lower limit of perpetual snow. In the midtropics *Chusquea* is usually found between 1500 and 3000 m altitude.

A few species have been introduced into the USA, Mexico, Cuba and Europe as ornamental plants.

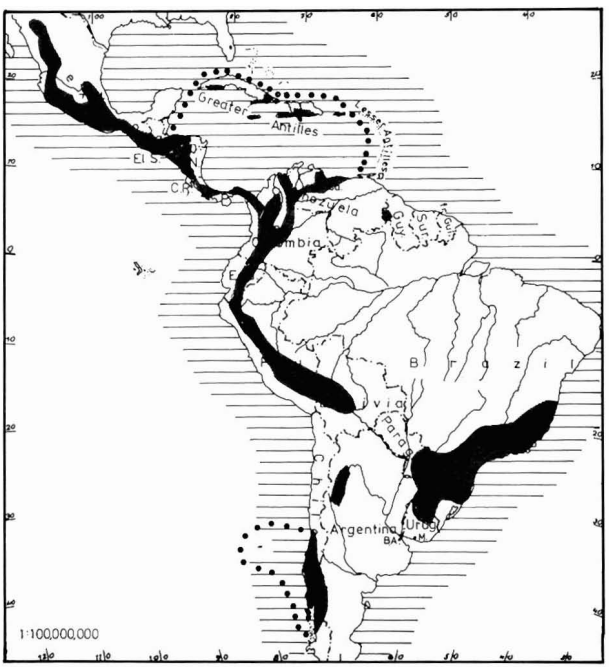

Figure 1. ***Chusquea***
Central America and Caribbean Islands:
Mexico, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama.
Greater Antilles:
Cuba, Jamaica, Haiti, Dominican Republic, Puerto Rico (USA).
South America:
Guyana, Venezuela, Colombia, Ecuador, Peru, Bolivia, Chile, Archipélago Juan Fernández (Chile), Argentina, Brazil, Paraguay, Uruguay.

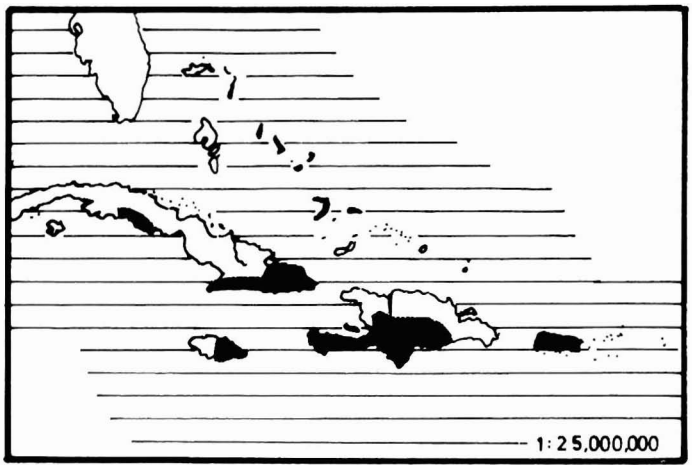

Figure 2.
Chusquea abietifolia
Greater Antilles: Cuba, Jamaica, Haiti, Dominican Republic, Puerto Rico (USA).
Wet woods, mostly above 1000 m altitude.

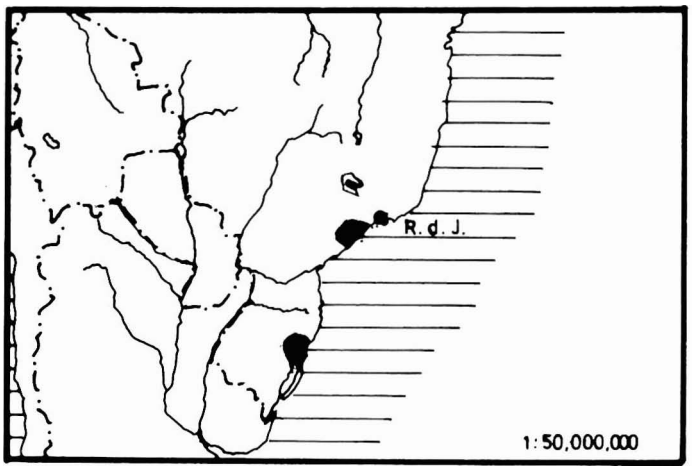

Figure 3.
Chusquea acuminata
Brazil: Rio de Janeiro: Itatiaia.
Rio Grande do Sul: São Francisco de Paula.

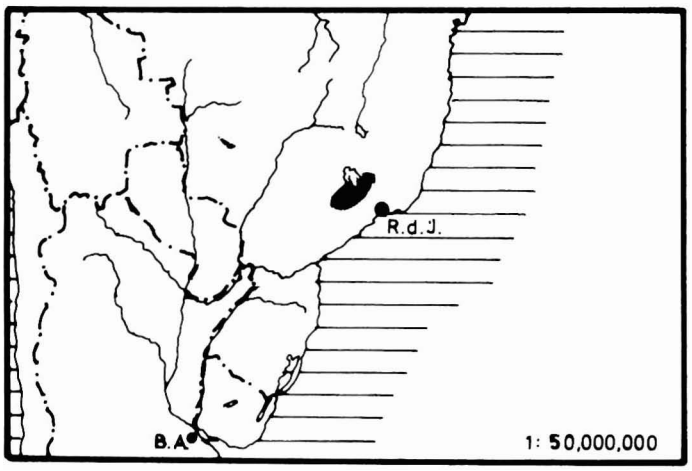

Figure 4.
Chusquea affinis
Brazil: Minas Gerais.

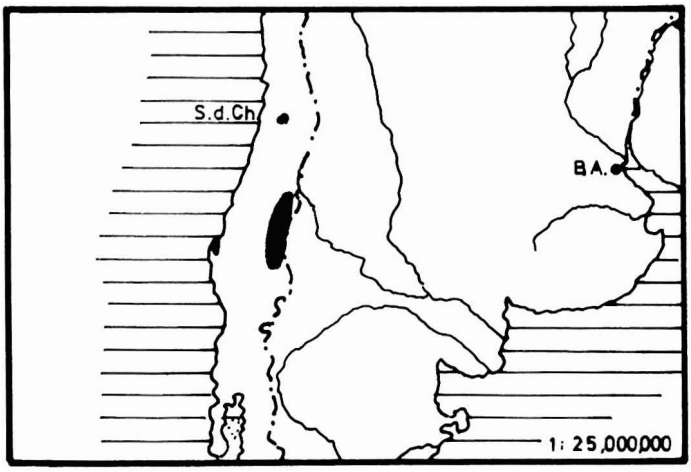

Figure 5.
Chusquea andina
Chile: Biobío: Chillán, almost up to elevations of perpetual snow.

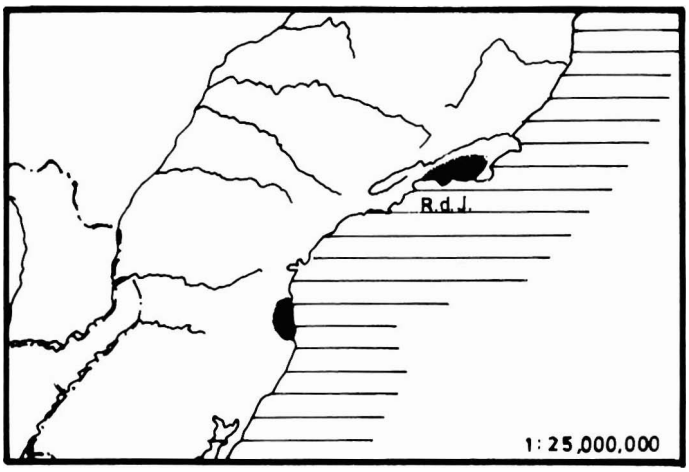

Figure 6.
Chusquea anelythra
Brazil: Rio de Janeiro: Alto Macahé. Santa Catarina: Campo Alegre, Garuva.

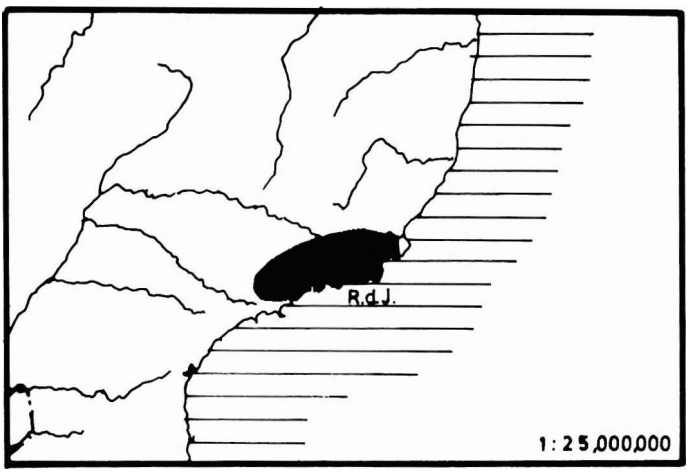

Figure 7.
Chusquea anelytroides
Brazil: São Paulo, Rio de Janeiro.

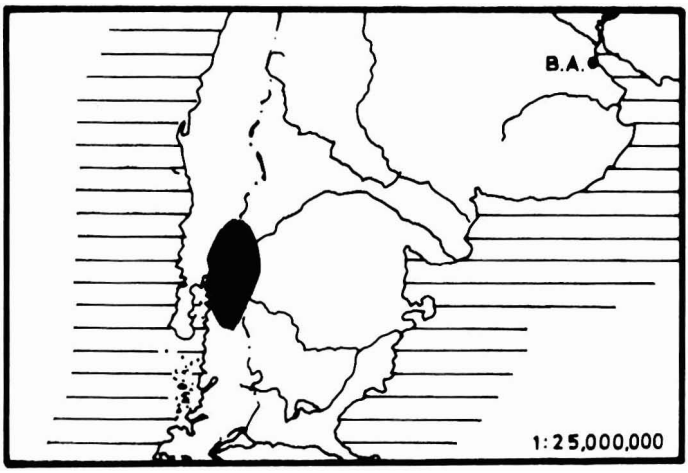

Figure 8.
Chusquea argentina
Argentina: Río Negro.
Chile: Valdivia.

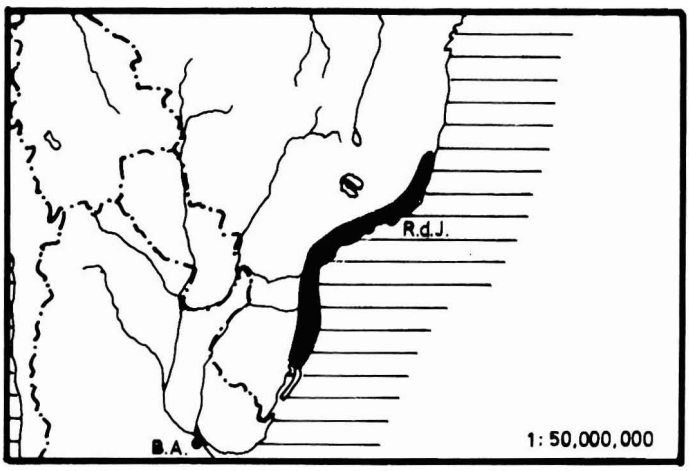

Figure 9.
Chusquea bambusoides
var. ***bambusoides***
Brazil: from Espirito Santo across Rio de Janeiro to Santa Catarina.

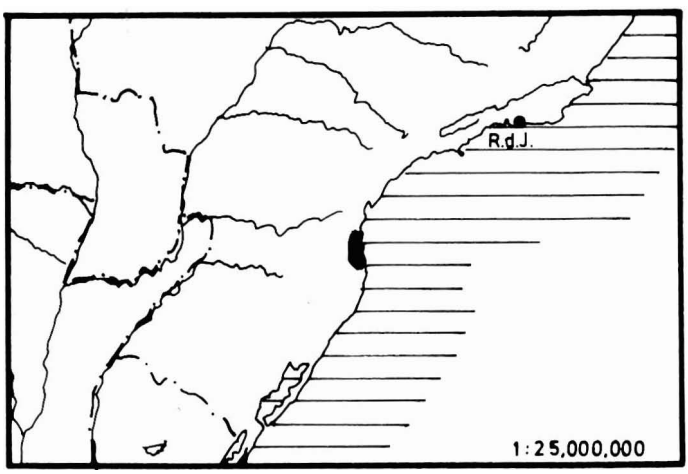

Figure 10.
Chusquea bambusoides
var. ***minor***
Brazil: Santa Catarina: Itajaí.

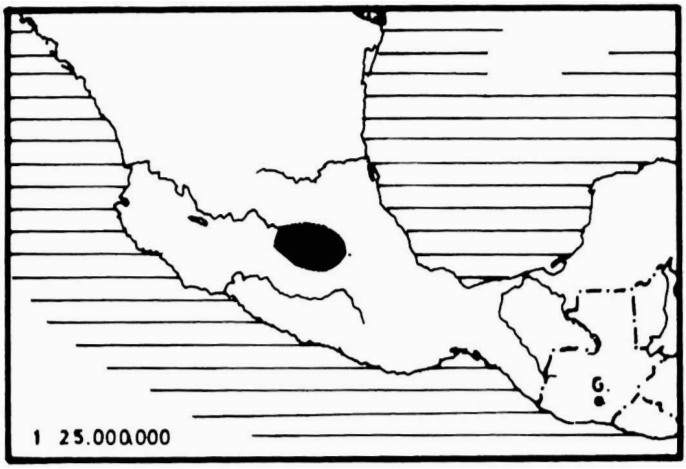

Figure 11.
Chusquea bilimekii
Mexico: State of Mexico.

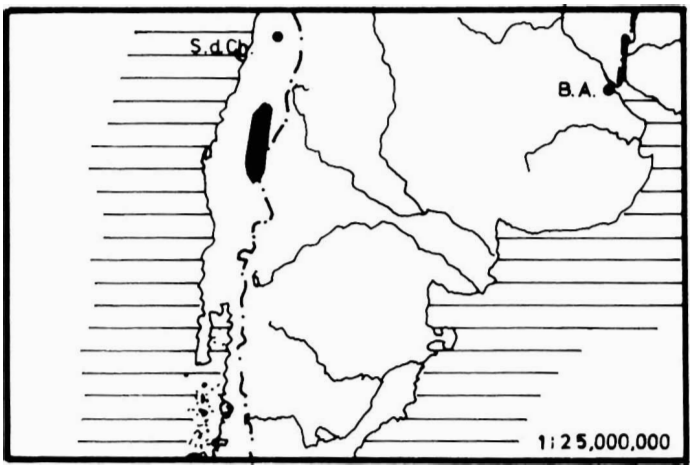

Figure 12.
Chusquea breviglumis
Chile: Biobío: Cordillera de Chillán.

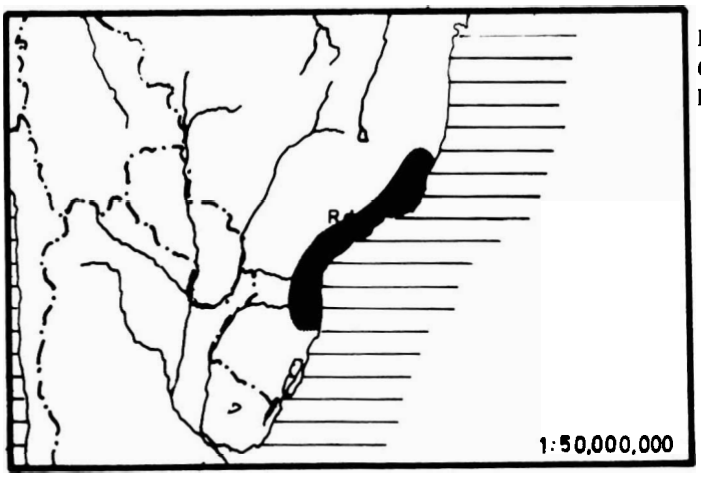

Figure 13.
Chusquea capitata
Brazil: from Minas Gerais and Espirito Santo to Santa Catarina.

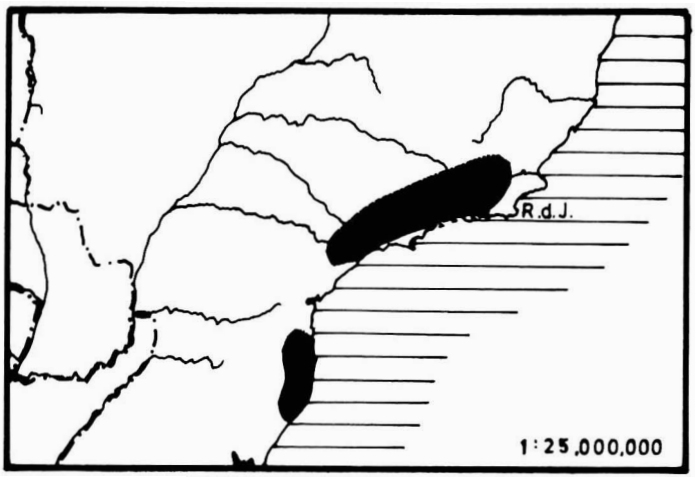

Figure 14.
Chusquea capituliflora
var. ***capituliflora***
Brazil: Minas Gerais, Rio de Janeiro, São Paulo, Santa Catarina.

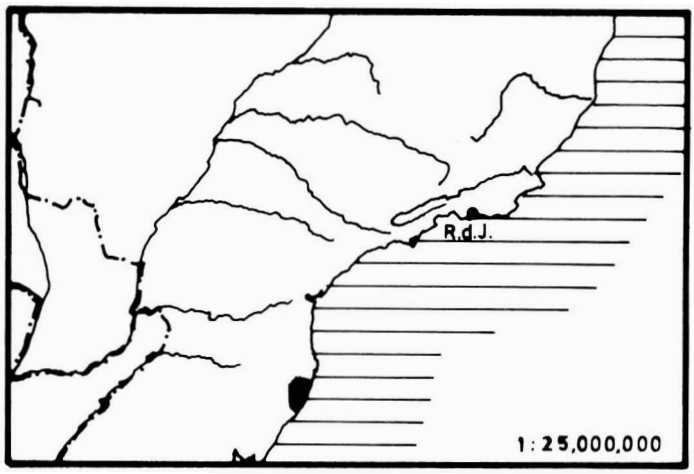

Figure 15.
Chusquea capituliflora
var. ***pubescens***
Brazil: Santa Catarina: Brusque, Corupá.

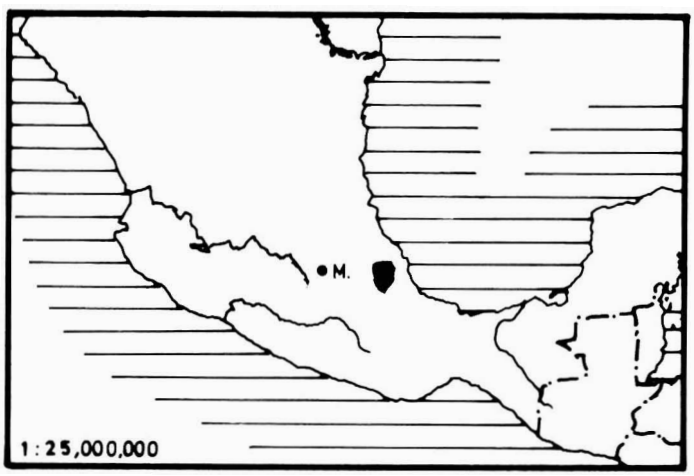

Figure 16.
Chusquea carinata
Mexico: Veracruz: Orizaba, in thickets.

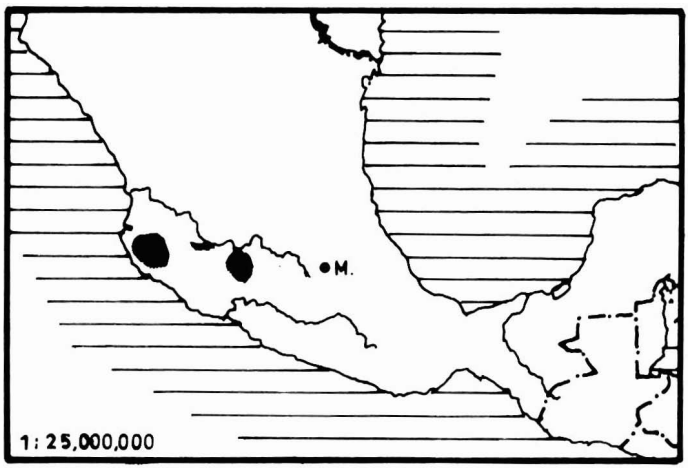

Figure 17.
Chusquea circinata
Mexico: Michoacán: near Uruapan.
Jalisco: near Autlán.
On mountain slopes between 1000 and 1600 m altitude.

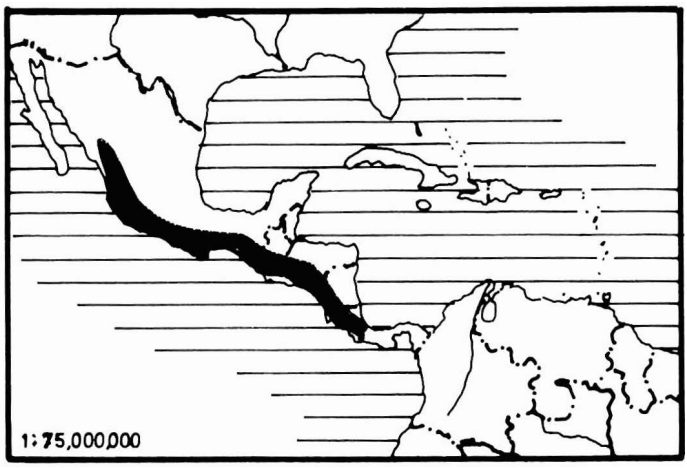

Figure 18.
Chusquea coronalis
From Mexico (Sinaloa, Colima, Chiapas), Guatemala, El Salvador to Costa Rica.
Inhabits forested river valleys and slopes of ravines (barrancas), between 65 and 1800 m altitude.
Cultivated in Cuba and the USA.

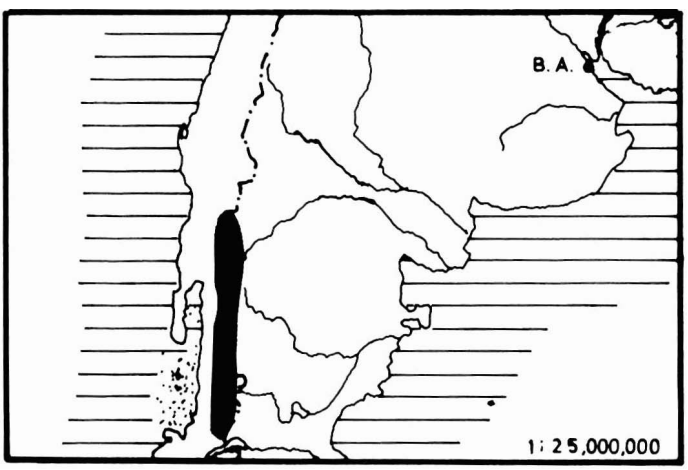

Figure 19.
Chusquea culeou f. ***culeou***
Chile: Valdivia.
Argentina: Nequén, Río Negro, Chubut.
In humid deciduous forest. *C. culeou* is the southernmost species among the bamboos, extending to about 47° south latitude at Lago Buenos Aires between Chile and Argentina.

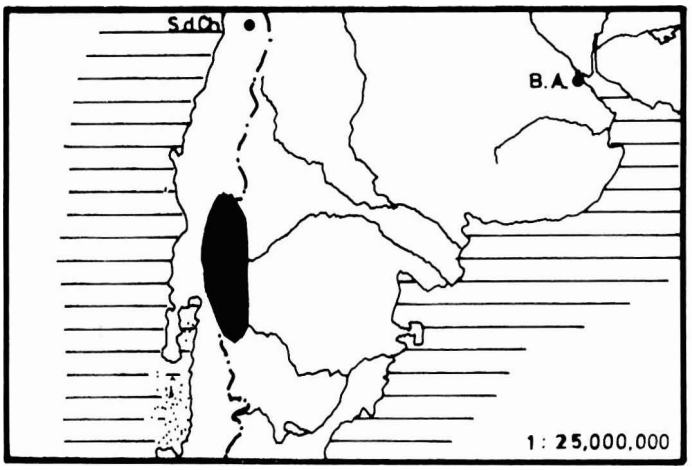

Figure 20.
Chusquea culeou
f. ***longiramea***
Argentina: Río Negro.
Chile: Araucanía.

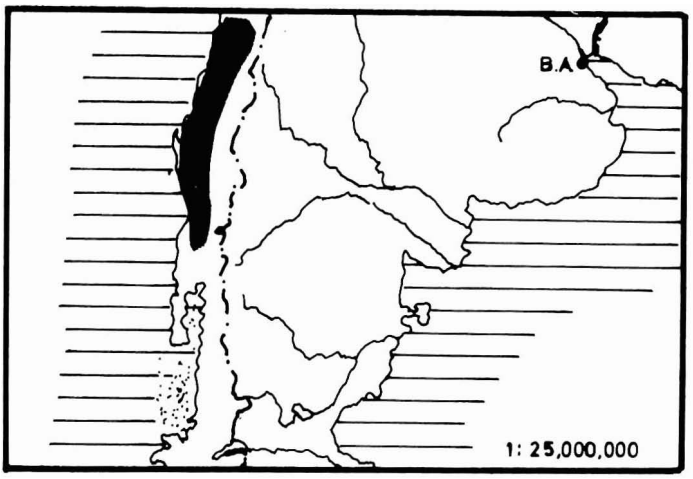

Figure 21.
Chusquea cumingii
Chile: Valparaiso, Concepción, Cordillera de Ranco, Aconcagua, Cauquenes.

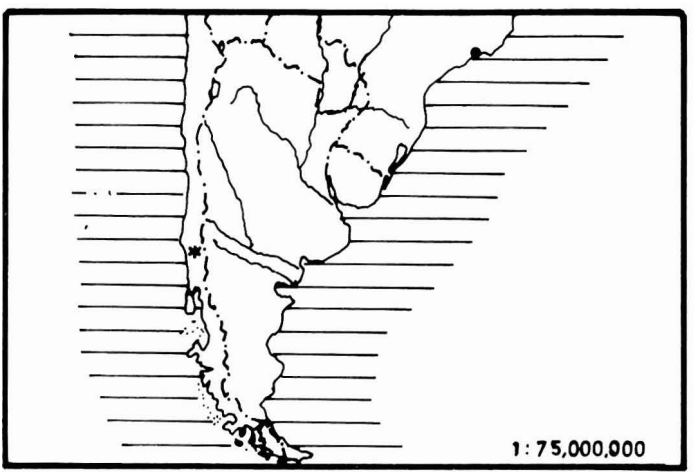

Figure 22.
Chusquea decolorata
Chile.

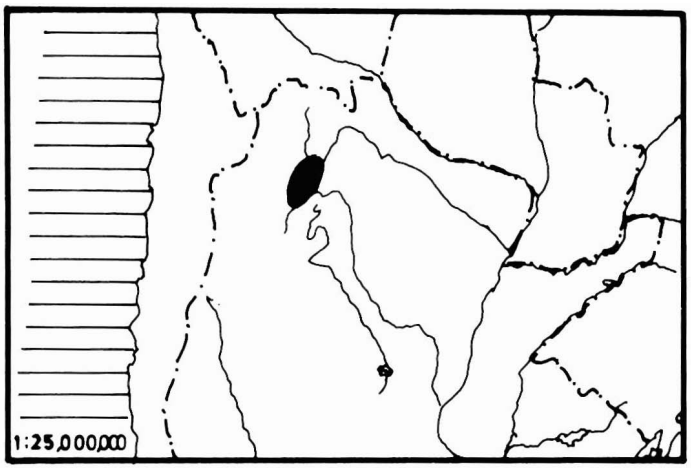

Figure 23.
Chusquea deficiens
Argentina: Salta: Cerros de Maíz Gordo, at about 1800 m altitude.

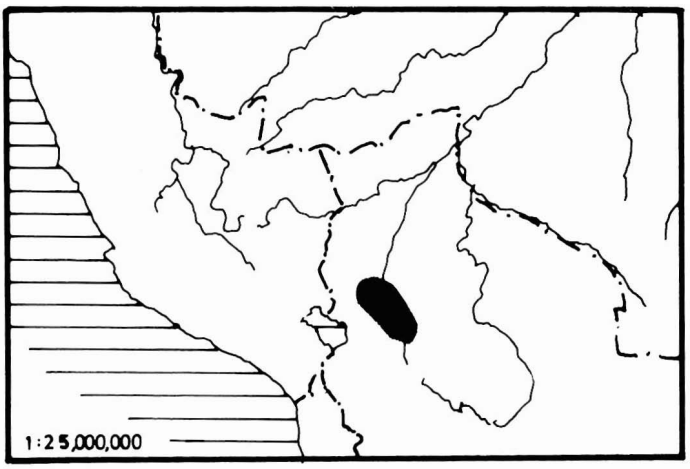

Figure 24.
Chusquea delicatula
Bolivia: Yungas.

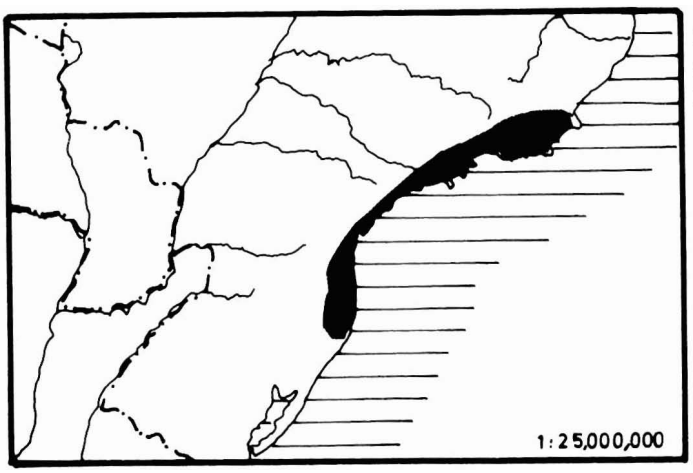

Figure 25.
Chusquea discolor
Brazil: from Rio de Janeiro to Santa Catarina.

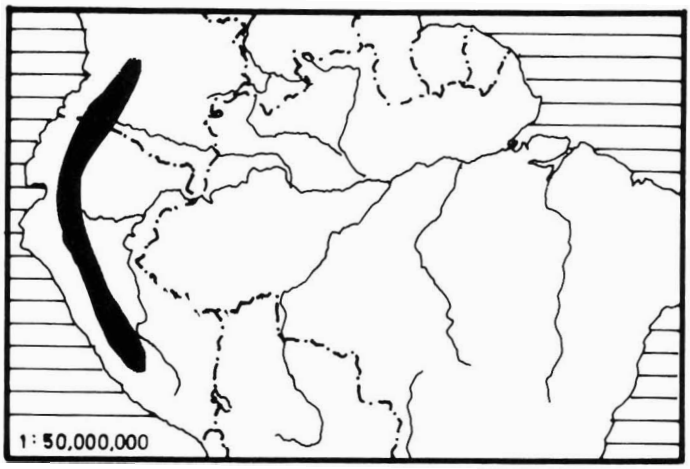

Figure 26.
Chusquea dombeyana
Peru: mountain thickets.
Colombia: Bogotá, Tolima, at 2800 m altitude.
Ecuador: at 1200 - 1800 m altitude.

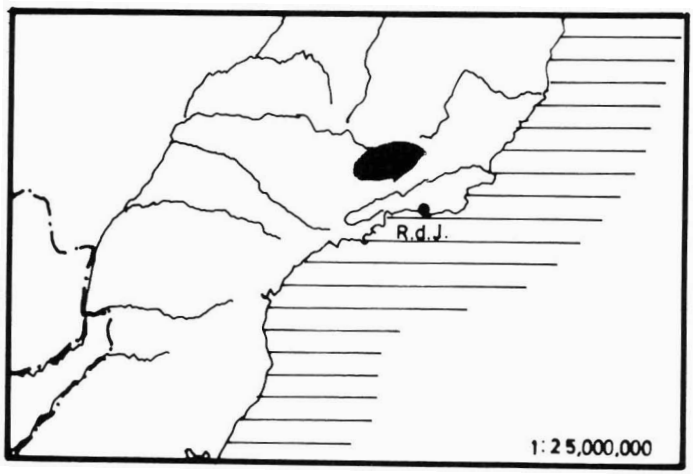

Figure 27.
Chusquea fasciculata
Brazil: Minas Gerais.

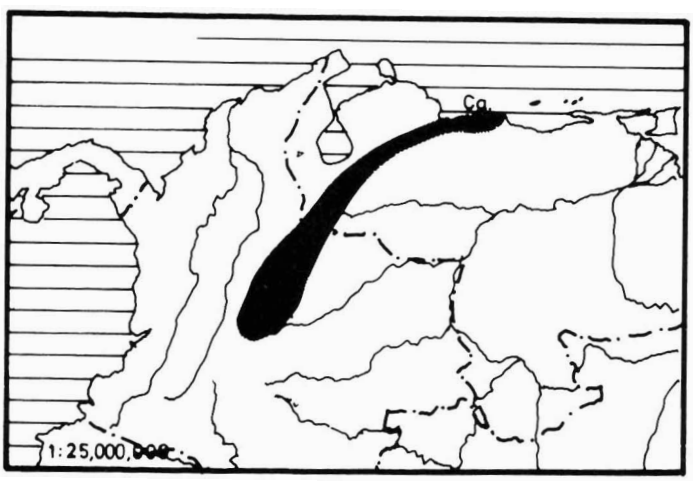

Figure 28.
Chusquea fendleri
Colombia and Venezuela, altitude range ca. 1800-2800 m.

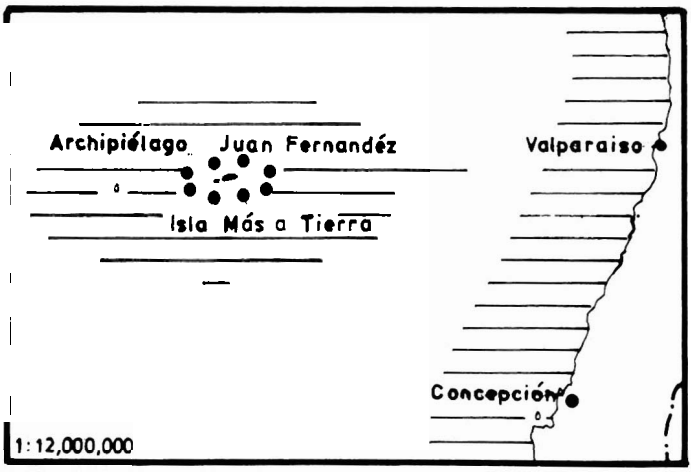

Figure 29.
Chusquea fernandeziana
Chile: endemic to Más a Tierra, island of the Juan Fernández archipelago.

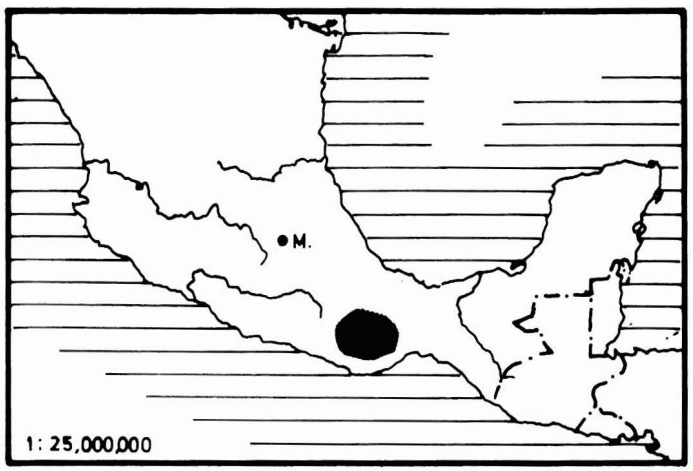

Figure 30.
Chusquea galeottiana
Mexico: Guerrero, Oaxaca, Chiapas, up to 2700 m altitude.

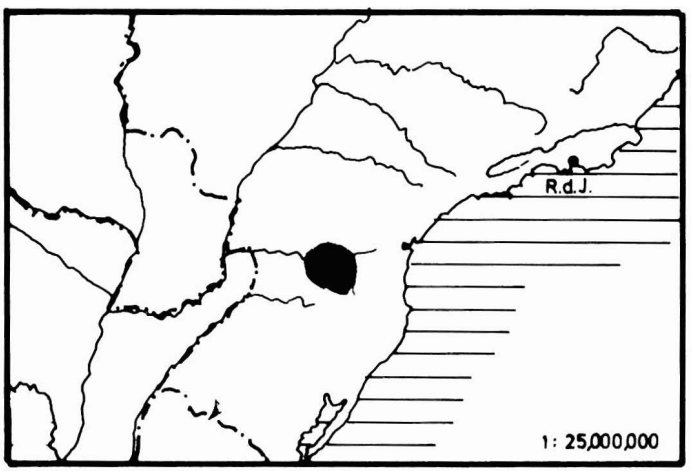

Figure 31.
Chusquea gracilis
Brazil: Santa Catarina: Cacador

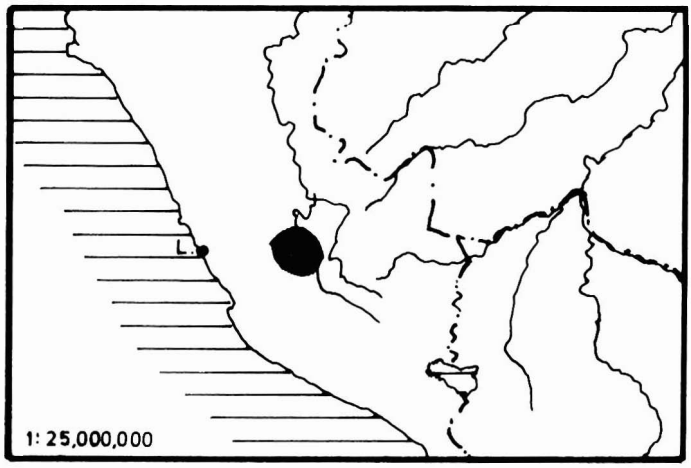

Figure 32.
Chusquea huantensis
Peru: Dept. Ayacucho: Huanta, San Miguel, at about 3000 m altitude.

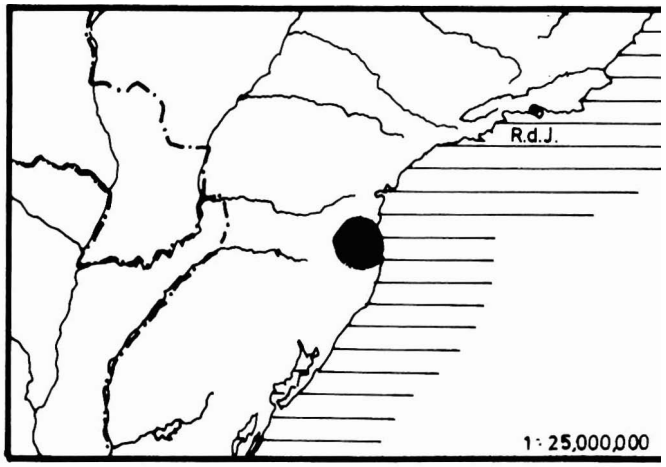

Figure 33.
Chusquea ibiramae
Brazil: Santa Catarina: Brusque and Ibirama.

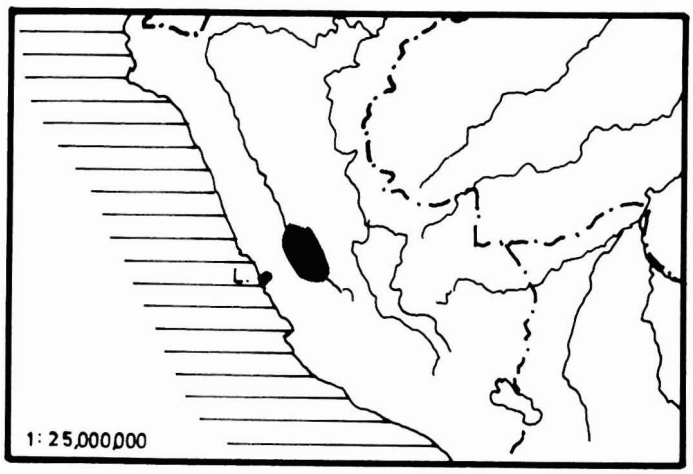

Figure 34.
Chusquea inamoena
Peru: Tunín: Tarma, at 2700 m altitude.

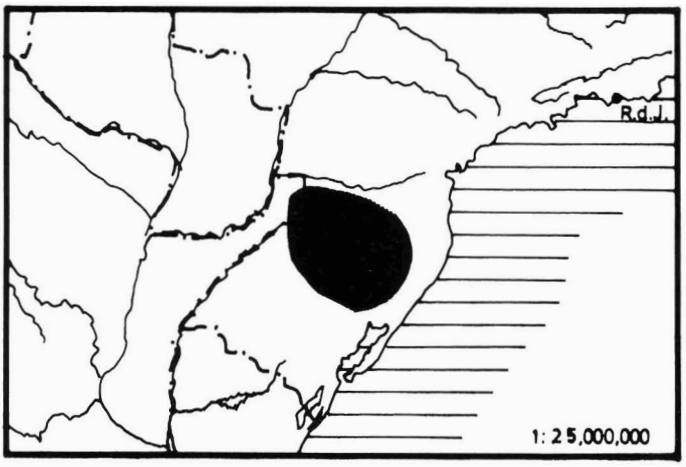

Figure 35.
Chusquea juergensii
Brazil: Rio Grande do Sul, in the plains at 400 - 600 m altitude.

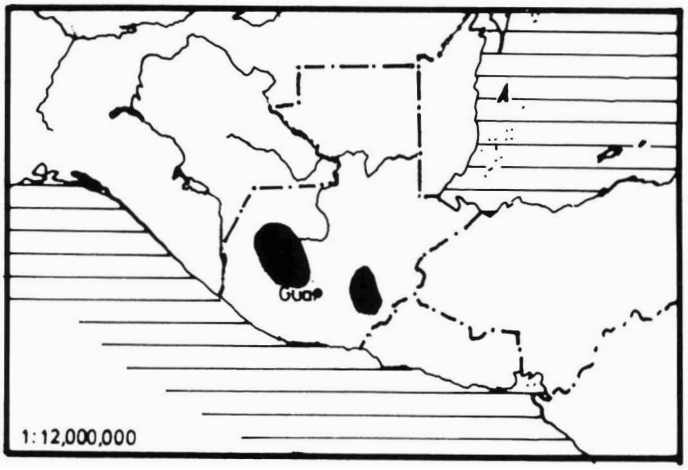

Figure 36.
Chusquea lanceolata
Guatemala: Chimaltenango, El Progreso, Sololá, Quezaltenango, between 2000 and 3300 m altitude.

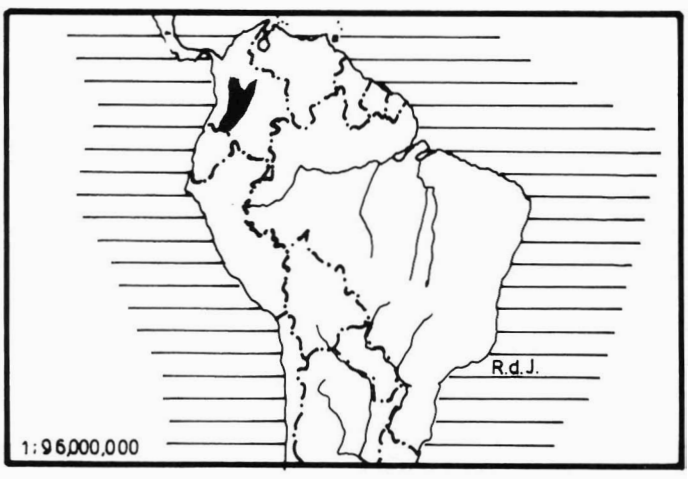

Figure 37.
Chusquea lehmannii
Colombia: in dense forests at 2500 - 3000 m altitude.

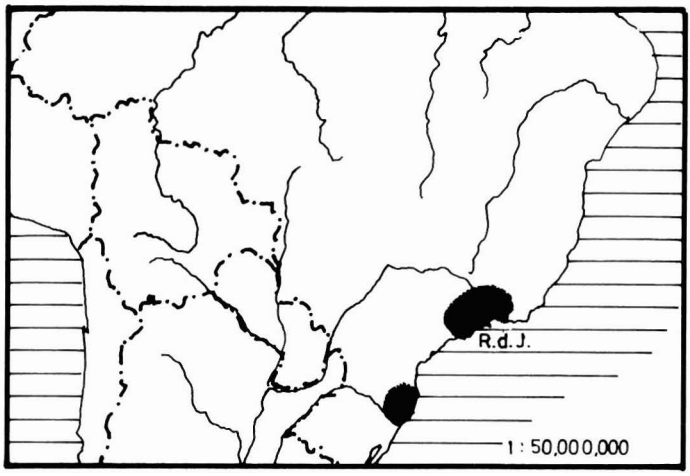

Figure 38.
Chusquea leptophylla
Brazil: Rio de Janeiro, Minas Gerais, at 1400 - 2000 m altitude.
Santa Catarina, at about 1000 m altitude.

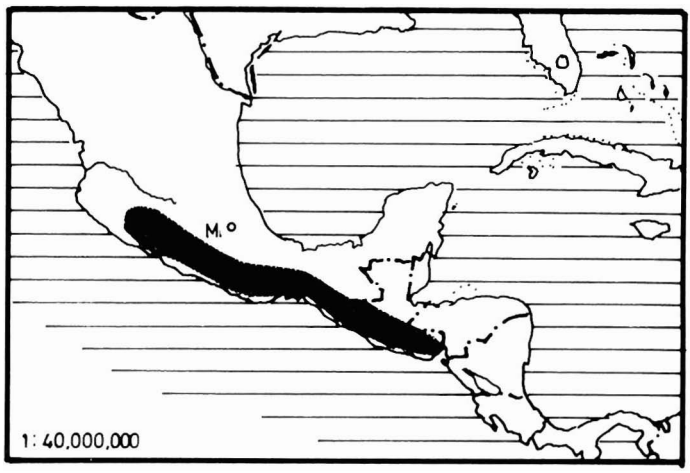

Figure 39.
Chusquea liebmannii
Mexico: Sinaloa, Jalisco to Chiapas. Guatemala. El Salvador.
On steep slopes between 375 and 1400 m altitude in the tropical deciduous forest and in thickets.

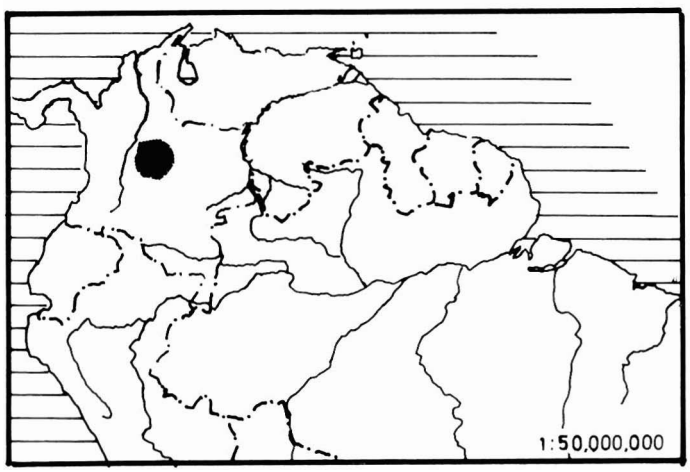

Figure 40.
Chusquea ligulata
Colombia: Bogotá.

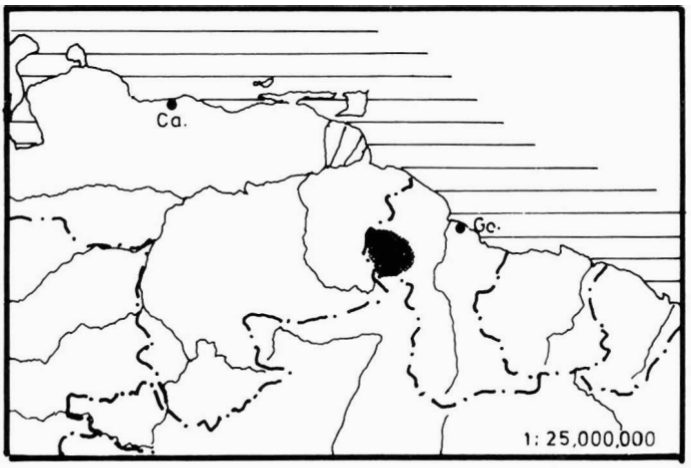

Figure 41.
Chusquea linearis
Guyana: only known from the summit of Mount Roraima.

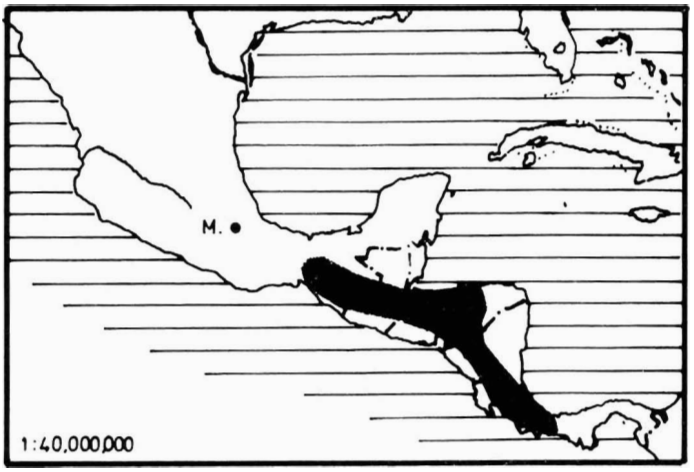

Figure 42.
Chusquea longifolia
From southern Mexico (Chiapas) to Panama (Chiriquí), between 1700 and 4100 m altitude. Common in Costa Rica above 2000 m altitude.

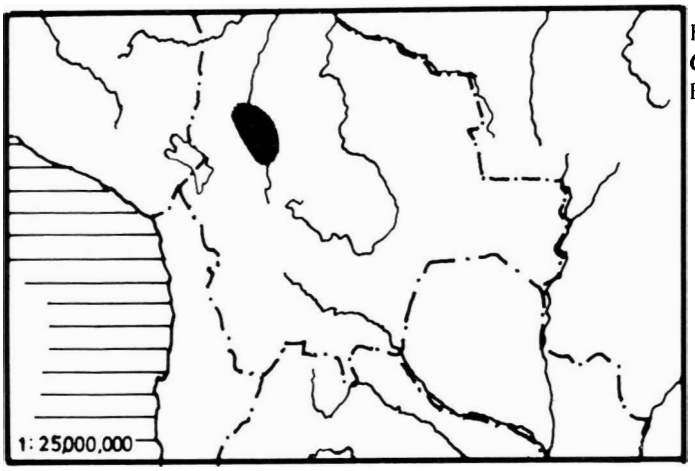

Figure 43.
Chusquea longipendula
Bolivia: Nor-Yungas, on moist shady banks.
Cochabamba, in forests at 2000 m altitude.

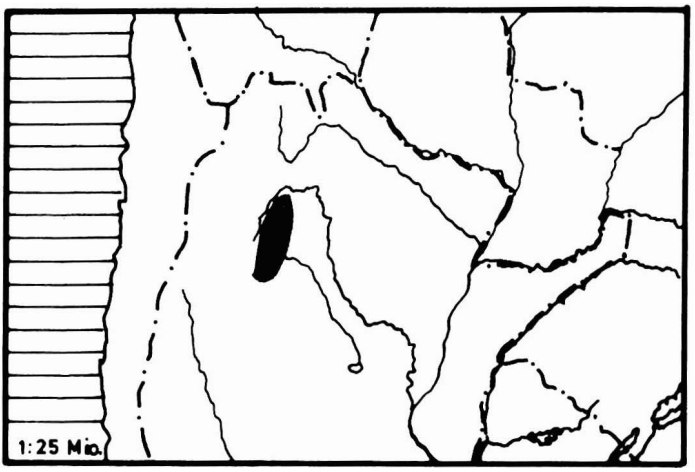

Figure 44.
Chusquea lorentziana
Argentina: Salta, Tucumán, Catamarca.
Between 1000 and 1500 m altitude.

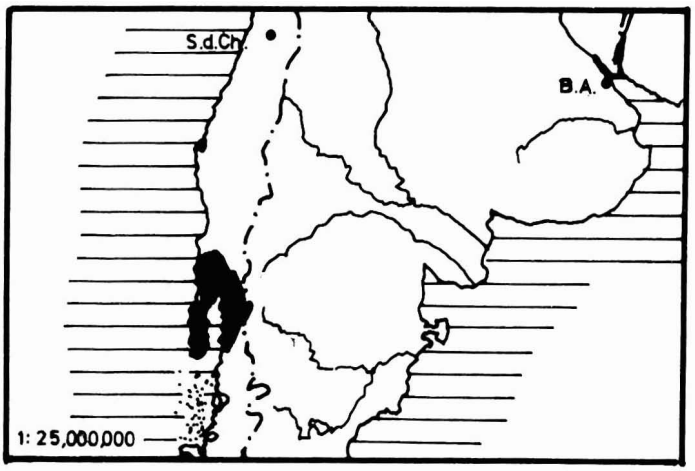

Figure 45.
Chusquea macrostachya
Chile: Valdivia, Los Lagos, and Chiloé Island.

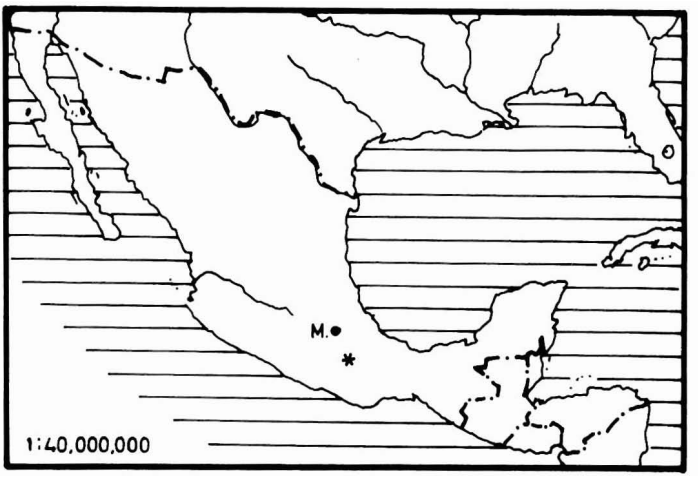

Figure 46.
Chusquea mexicana
Mexico.

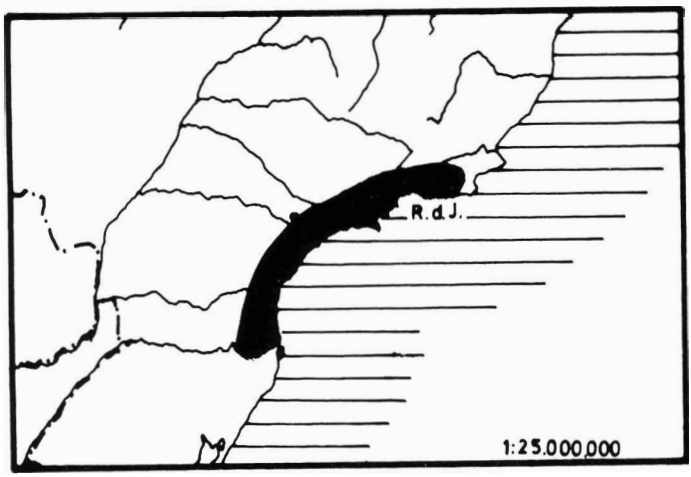

Figure 47.
Chusquea meyeriana
Brazil: from Minas Gerais and Rio de Janeiro to Rio Grande do Sul.

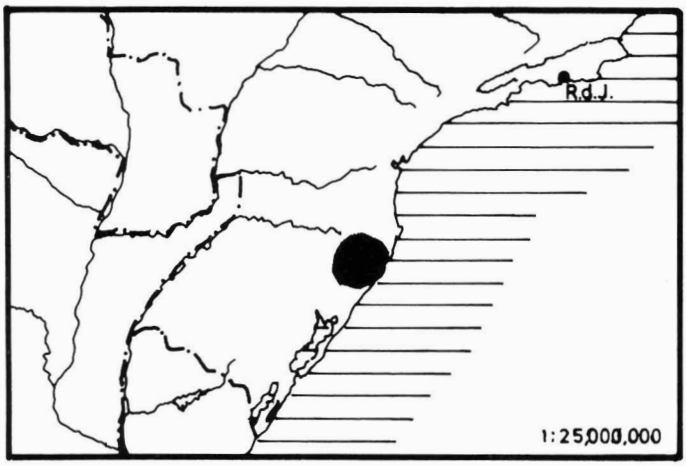

Figure 48.
Chusquea mimosa
Brazil: Santa Catarina: Bom Retiro, Campo Alegre and São Joaquim.

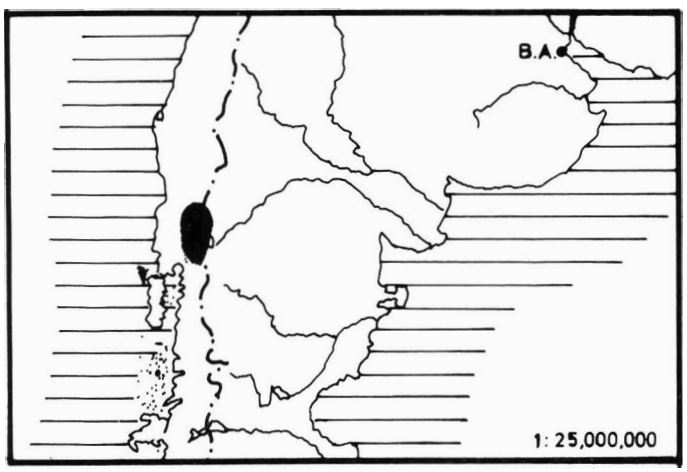

Figure 49.
Chusquea montana
Chile: Valdivia.
Argentina: Neuquén, Río Negro.

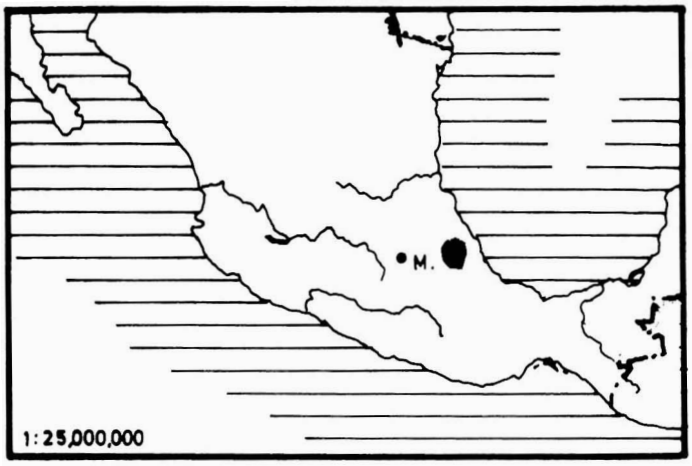

Figure 50.
Chusquea mulleri
Mexico: Veracruz: Orizaba, in thickets.

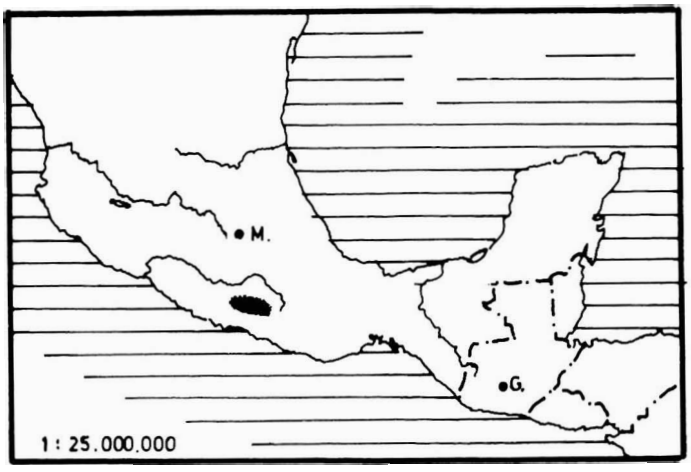

Figure 51.
Chusquea nelsonii
Mexico: Guerrero: between Tixtla and Chilapa de Alvarez at 1500 - 2100 m altitude.
Chiapas: in thickets.

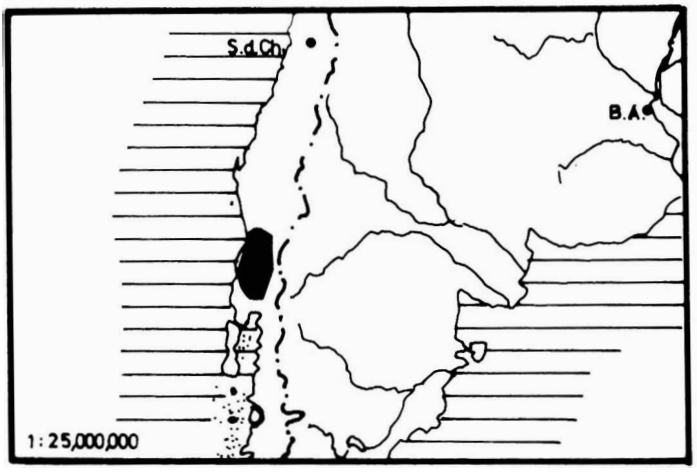

Figure 52.
Chusquea nigricans
Chile: Valdivia, 800 m altitude.

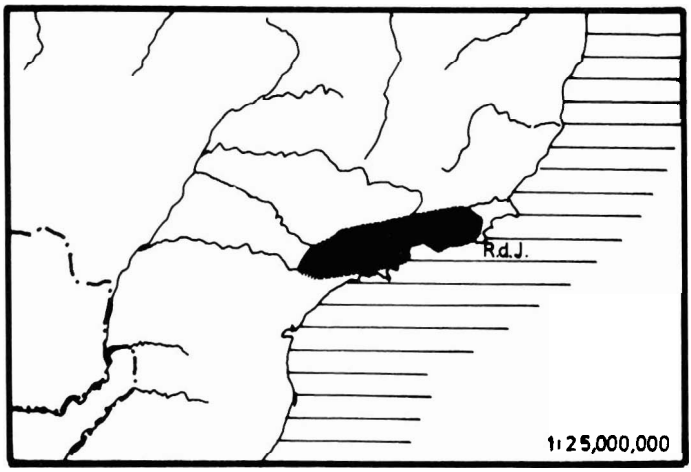

Figure 53.
Chusquea oligophylla
Brazil: São Paulo, Rio de Janeiro.

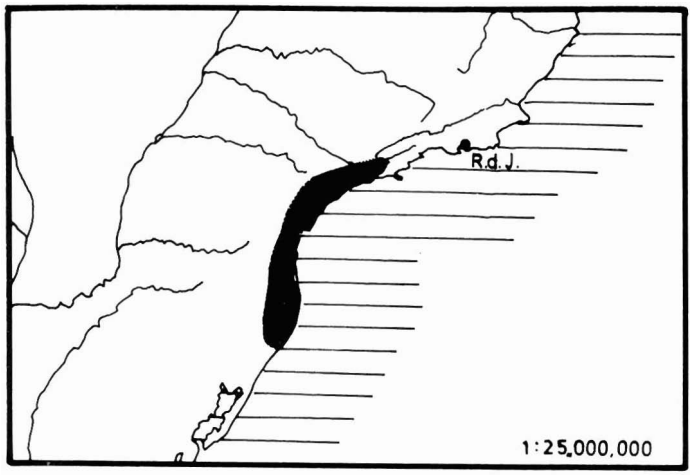

Figure 54.
Chusquea oxylepis
Brazil: São Paulo, Paraná, Santa Catarina.

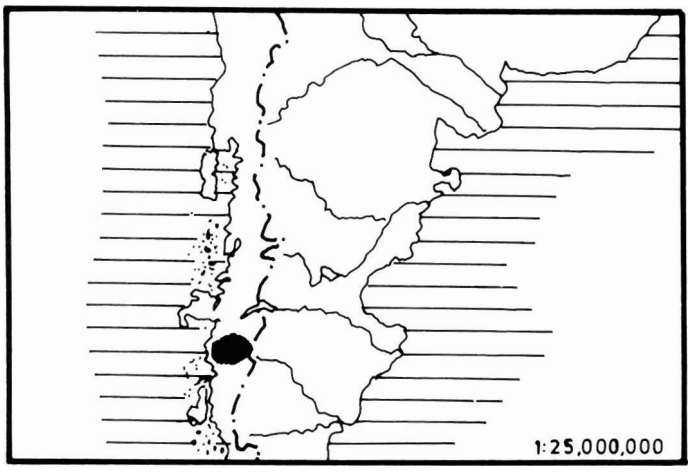

Figure 55.
Chusquea palenae
Chile: Valley of Río Palena

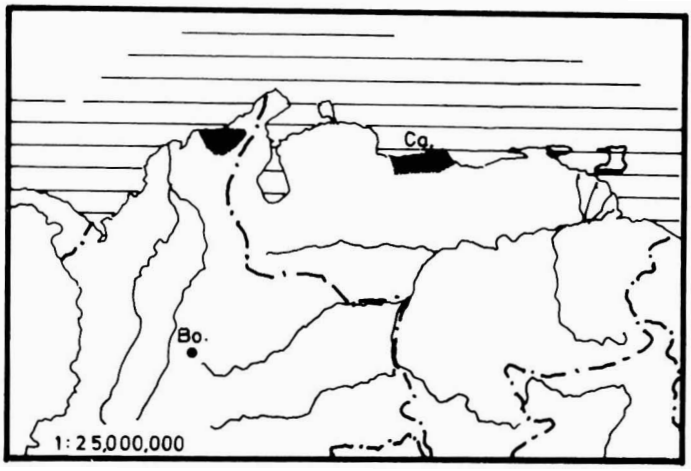

Figure 56.
Chusquea pallida
Colombia: Santa Marta.
Venezuela: near Caracas at 450 m altitude.

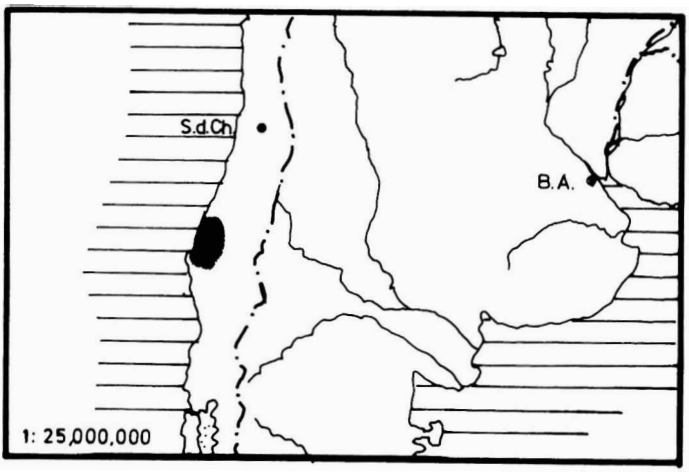

Figure 57.
Chusquea parviflora
Chile: Concepción: Lota, Tomé.

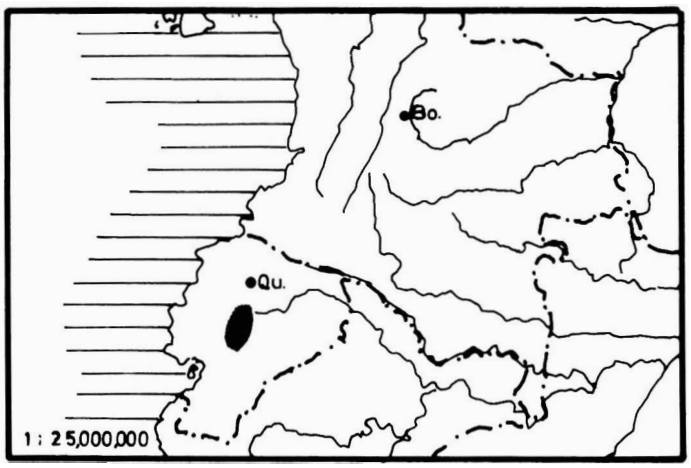

Figure 58.
Chusquea perligulata
Ecuador: Chimborazo, at moist sites in mountain forest, about 3200 m altitude.

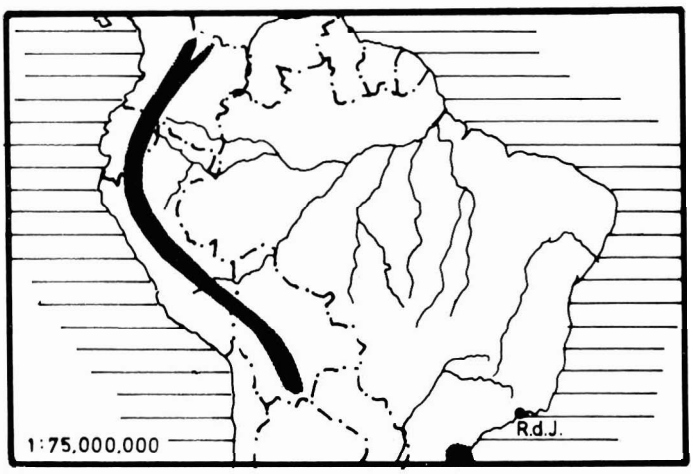

Figure 59.
Chusquea peruviana
From Colombia to Bolivia, in mountain thickets at 2800 - 3000 m altitude.
Brazil: Santa Catarina.

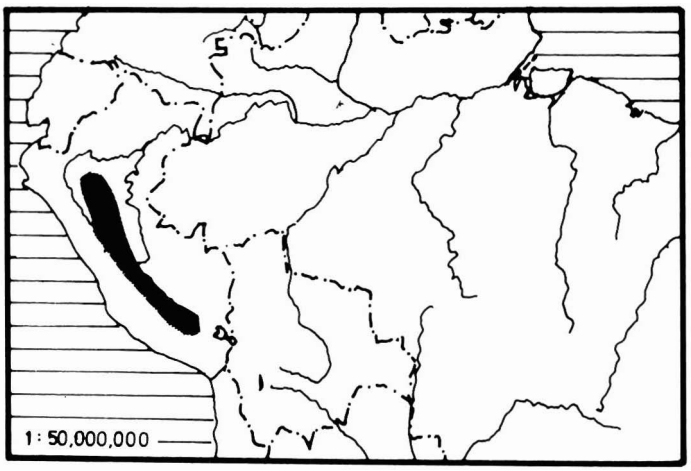

Figure 60.
Chusquea picta
Peru: in forests of the Andes.

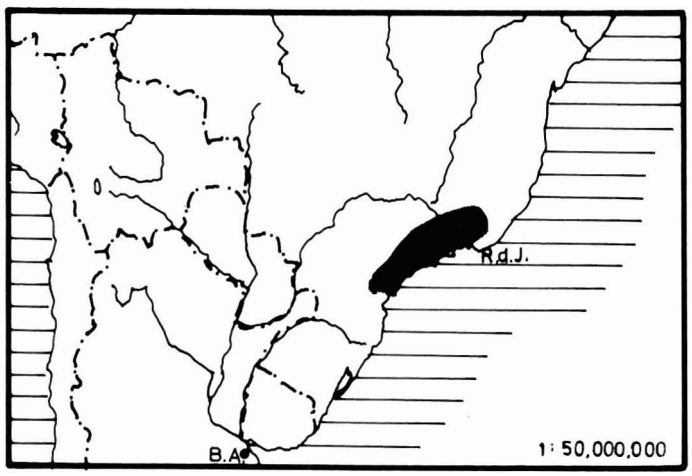

Figure 61.
Chusquea pinifolia
Brazil: São Paulo, Minas Gerais, Rio de Janeiro, between 1300 and 2750 m altitude.

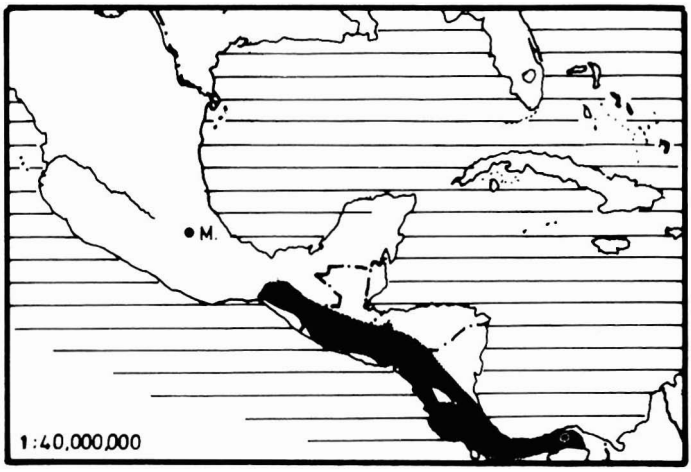

Figure 62.
Chusquea pittieri
From southern Mexico (Chiapas) throughout Central America to Panama, in forest between 1400 and 2700 m altitude, preferring slopes. Large populations on the slopes of some volcanos in Cost Rica.

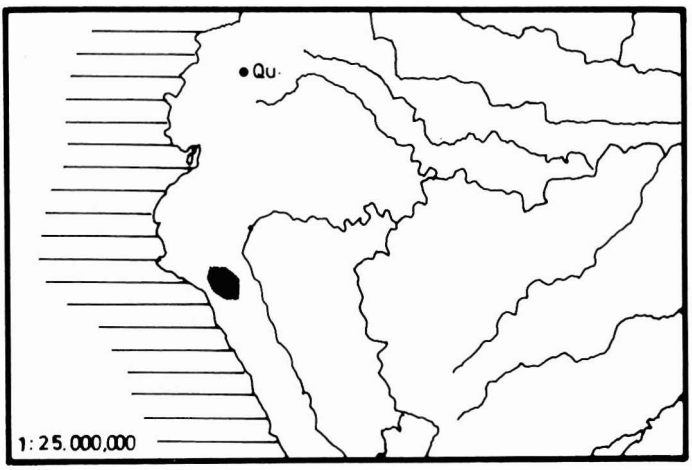

Figure 63.
Chusquea polyclados
Peru: Cajamarca: Hualgayoc, 3100 - 3300 m altitude.

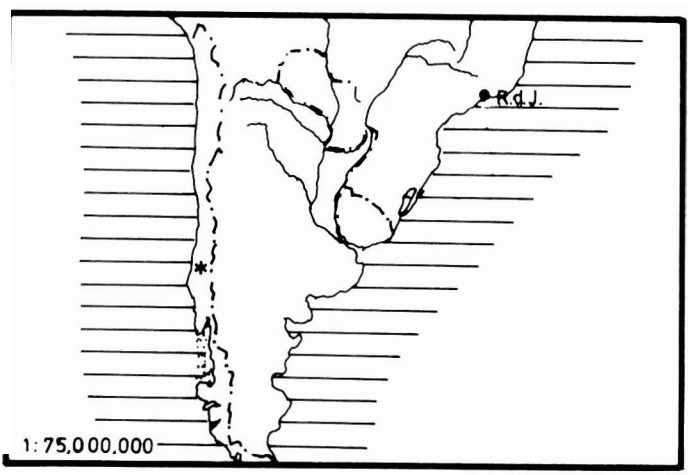

Figure 64.
Chusquea pubescens
Chile.

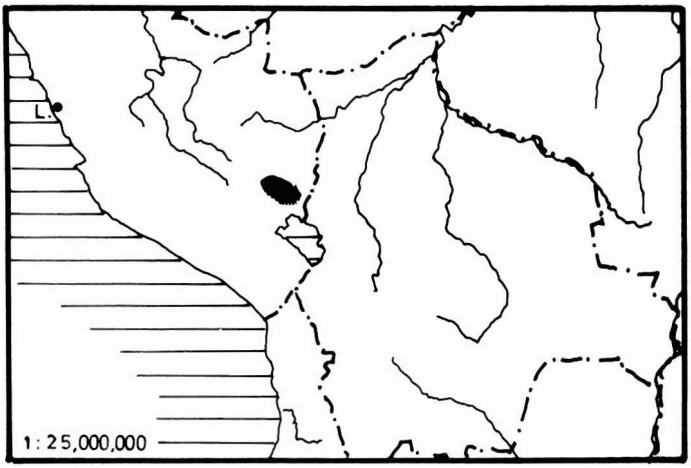

Figure 65.
Chusquea pubispicula
Peru: Puno: Sandía, frequently between 2600 and 2800 m altitude.

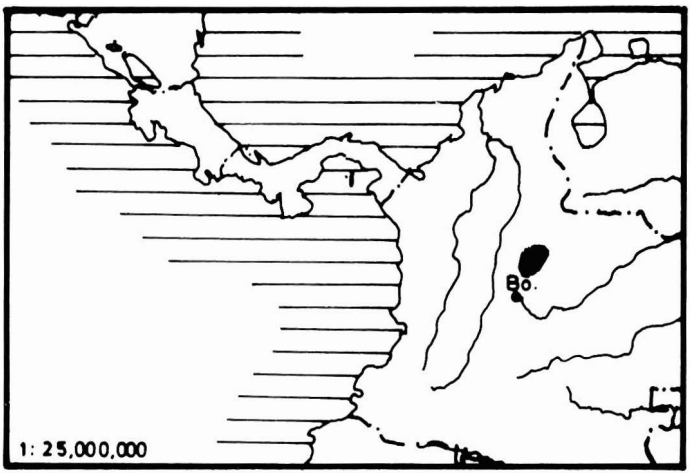

Figure 66.
Chusquea purdieana
Colombia: Vélez: Monte del Moro in humid areas.

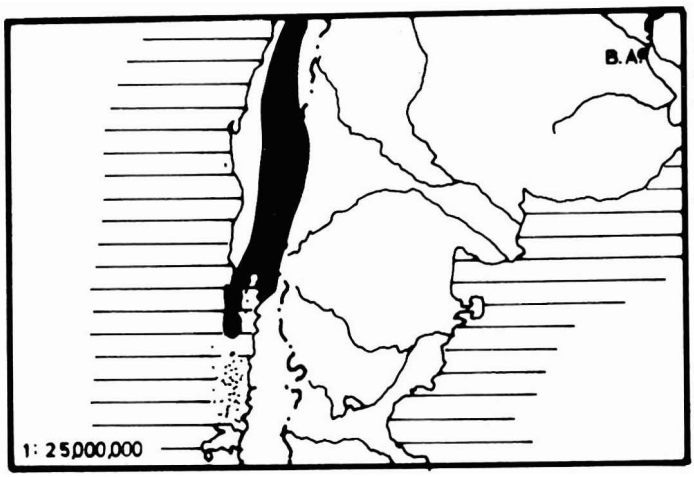

Figure 67.
Chusquea quila
Chile: Andes: Valparaiso, Valdivia, Cautin, Llanquihue, and Isla Chiloé.
Argentina: Neuquén.

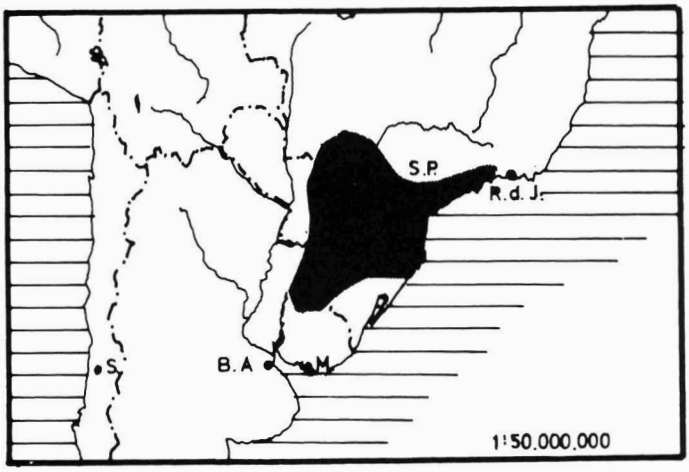

Figure 68.
Chusquea ramosissima
Tropical and subtropical South America from eastern Paraguay, eastern Argentina (Missiones, Corrientes) and southern Brazil (São Paulo, Santa Catarina, Rio Grande do Sul), to northern Uruguay. At about 500 m altitude. Peru: Sandía.

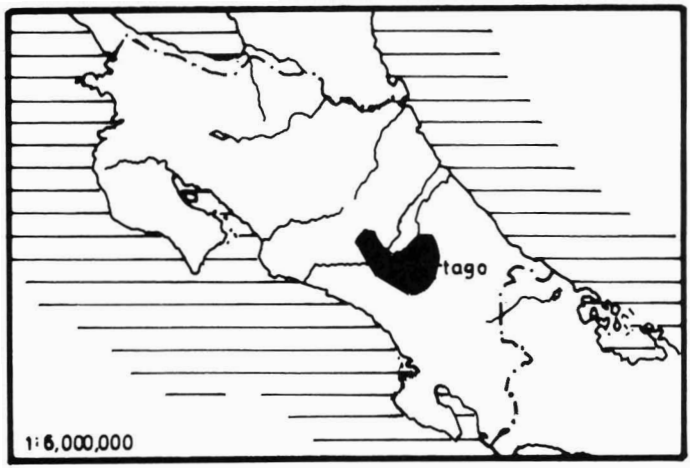

Figure 69.
Chusquea scabra
Only known from Costa Rica: Cartago: on moist mountain slopes at 1200 - 1630 m altitude.

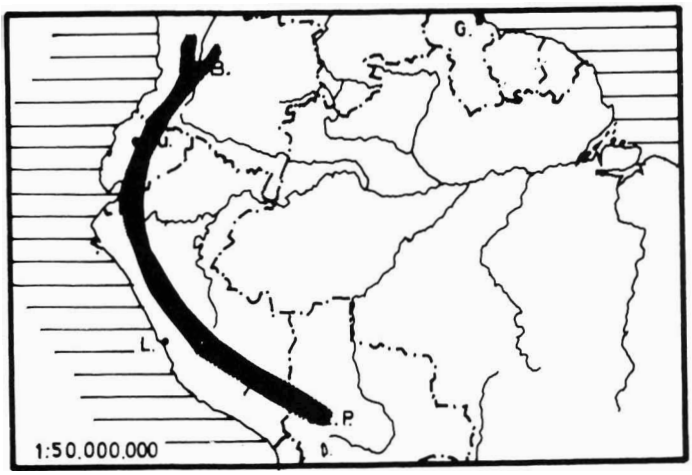

Figure 70.
Chusquea scandens
In forests from Colombia to Bolivia, up to 3300 m altitude.

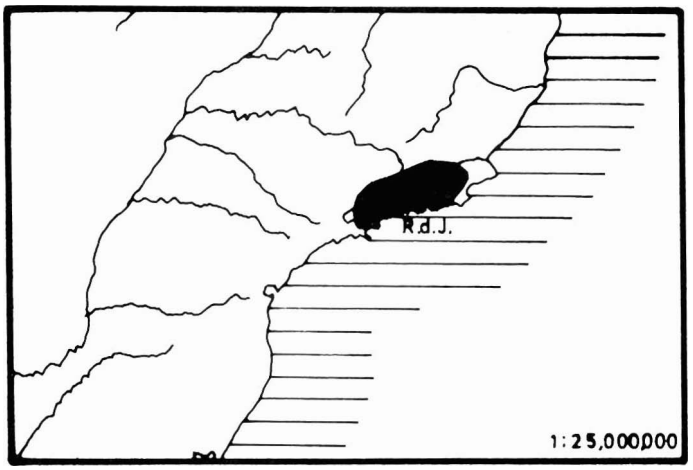

Figure 71.
Chusquea sclerophylla
Brazil: Rio de Janeiro.

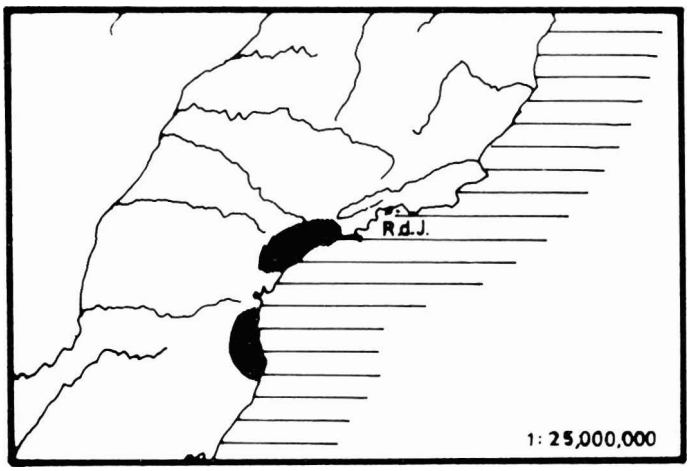

Figure 72.
Chusquea sellowii
Brazil: São Paulo, Santa Catarina.

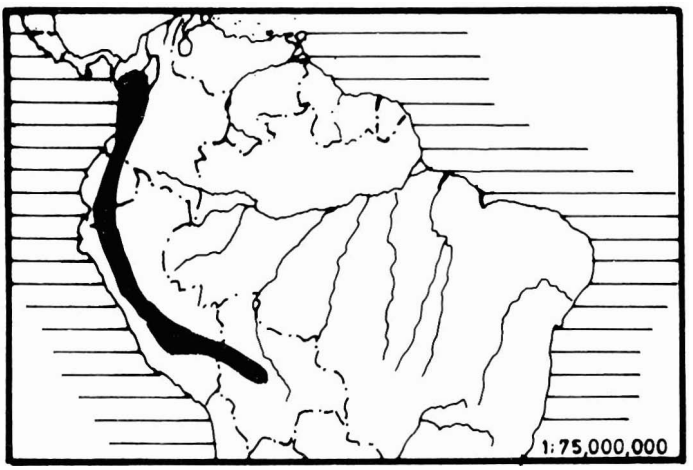

Figure 73.
Chusquea serrulata
Colombia, Ecuador, Peru to Bolivia, in forest between 1300 and 3000 m altitude.

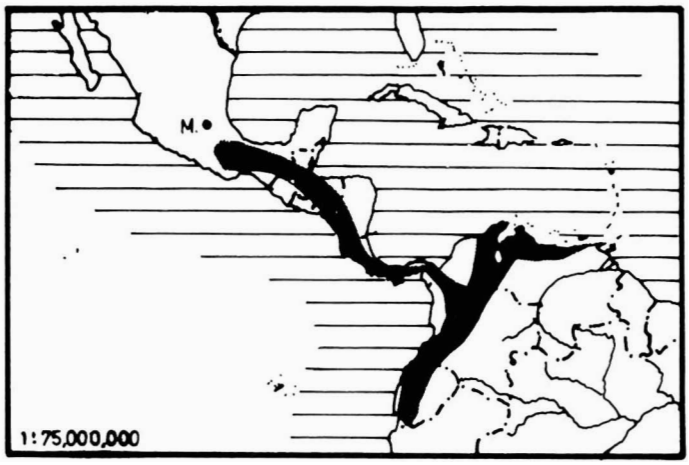

Figure 74.
Chusquea simpliciflora
From Mexico to Venezuela and Ecuador, in dense wet forest at low altitudes between about 50 and 800 m.

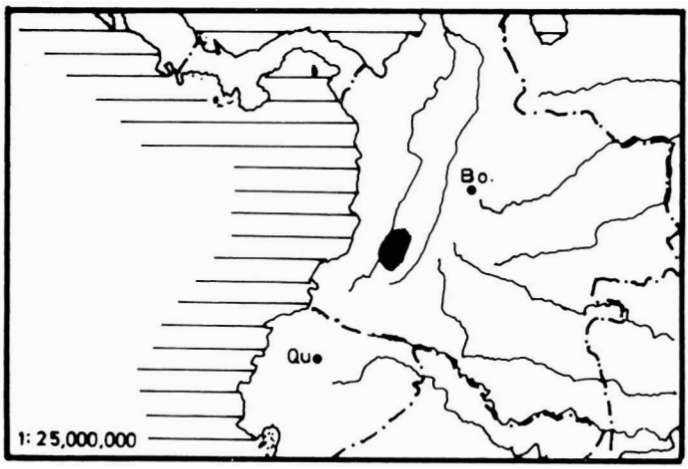

Figure 75.
Chusquea sneidernii
Colombia: Province Popayán, at 2700 m.

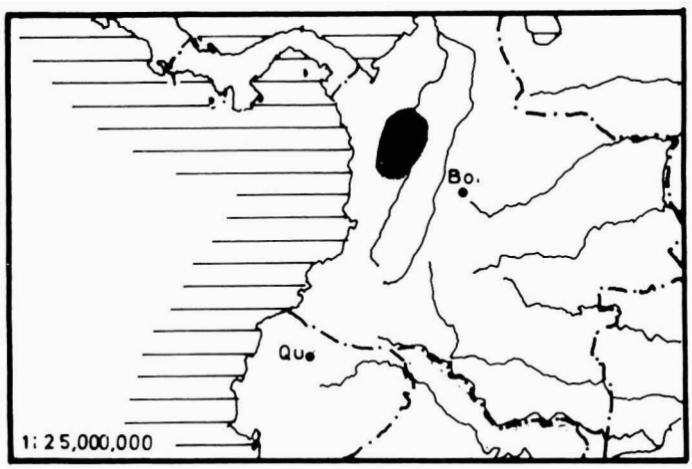

Figure 76.
Chusquea spadicea
Colombia: Antioquia.

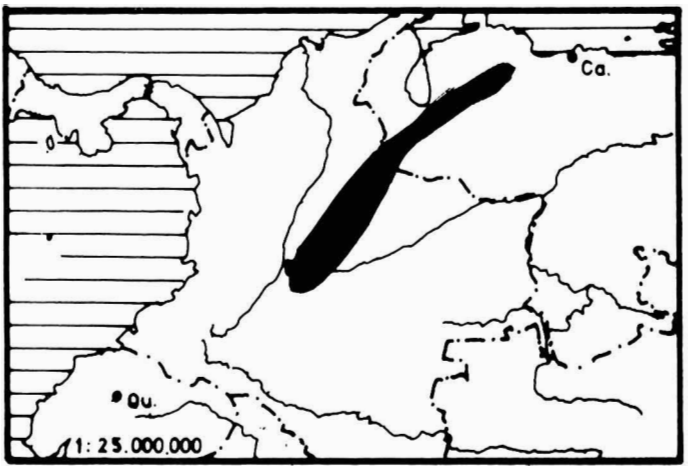

Figure 77.
Chusquea spencei
Venezuela: Corillera del Litoral near Caracas: Pico Naiguatá.
Colombia: along the Cordillera Oriental.

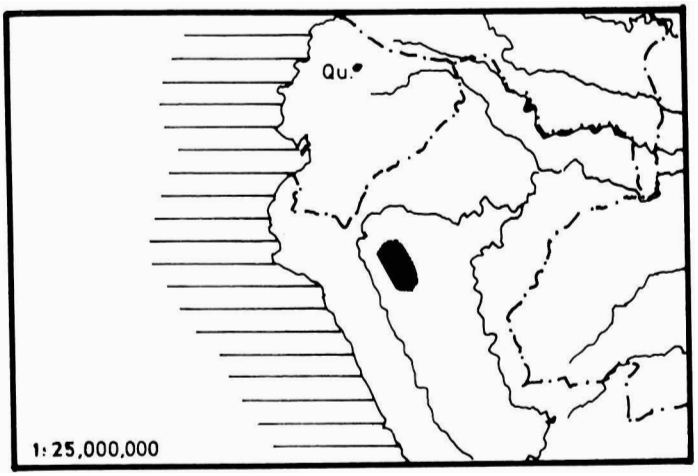

Figure 78.
Chusquea straminea
Peru: Amazonas: Chachapoyas, 2400 - 2600 m altitude.

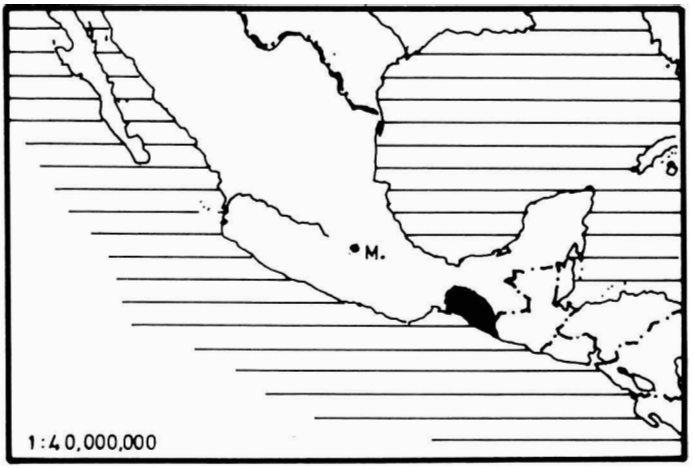

Figure 79.
Chusquea sulcata
Mexico: Chiapas: Mount Orando.

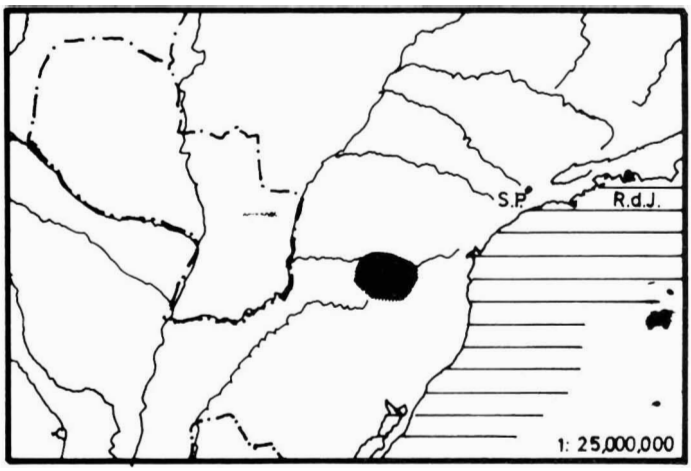

Figure 80.
Chusquea swallenii
Brazil: Santa Catarina: Caçador.

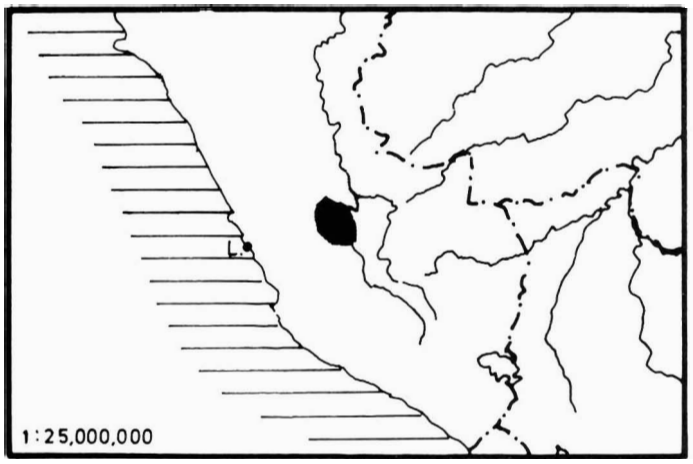

Figure 81.
Chusquea tarmensis
Peru: Junín: Tarma, 2100 - 2600 m altitude.

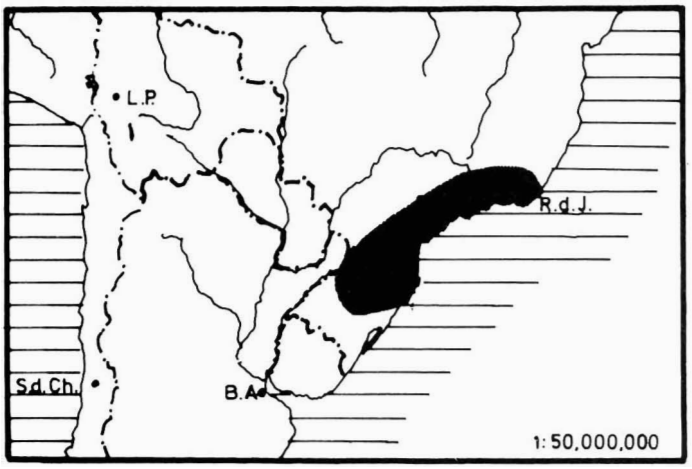

Figure 82.
Chusquea tenella
var. ***tenella***
Brazil: from Minas Gerais to Rio Grande do Sul.

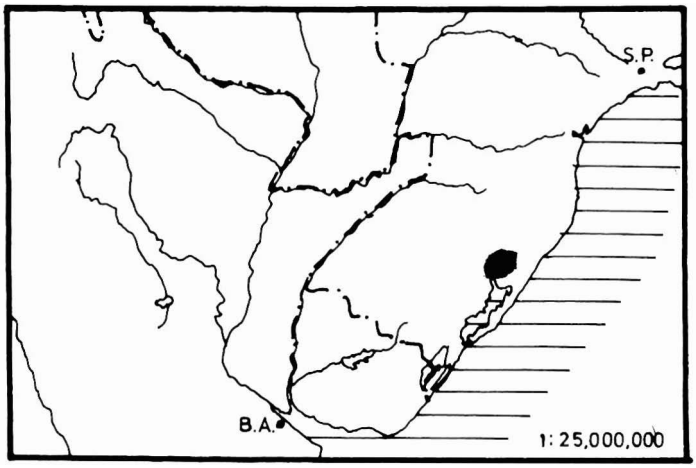

Figure 83.
Chusquea tenella
var. ***latifolia***
Brazil: Rio Grande do Sul: São Leopoldo.

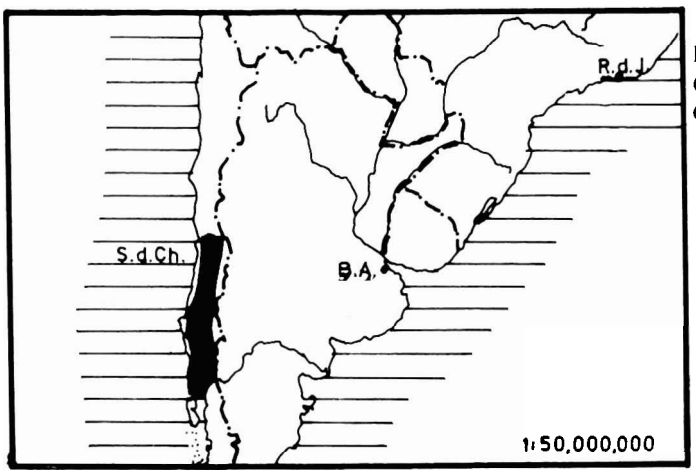

Figure 84.
Chusquea tenuiflora
Chile: Santiago, Biobío (Lota), Valdivia, Isla de Chiloé.

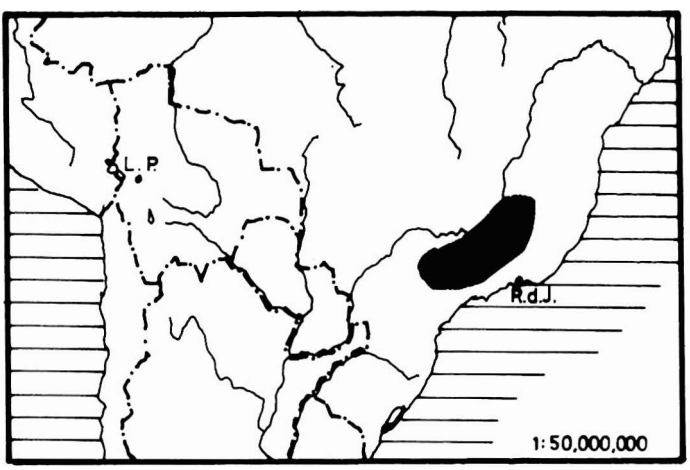

Figure 85.
Chusquea tenuiglumis
var. ***tenuiglumis***
Brazil: Minas Gerais.

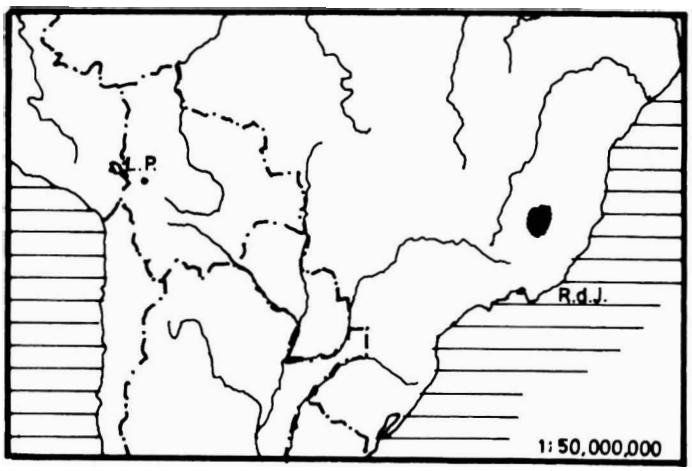

Figure 86.
Chusquea tenuiglumis var. ***laxiuscula***
Brazil: Lagoa Santa.

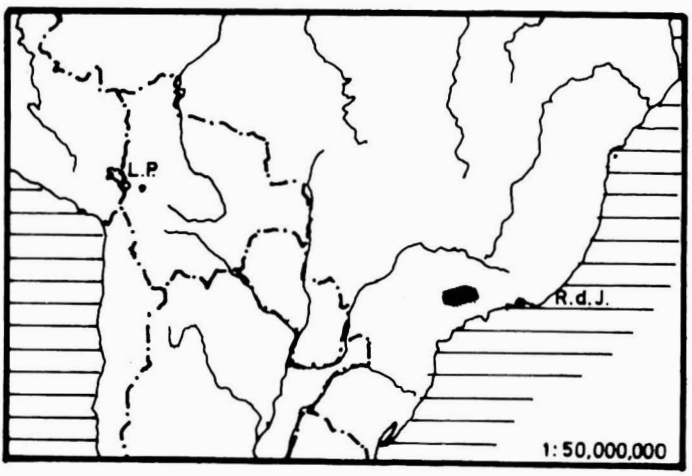

Figure 87.
Chusquea tenuiglumis var. ***subcylindrica***
Brazil: Caldas.

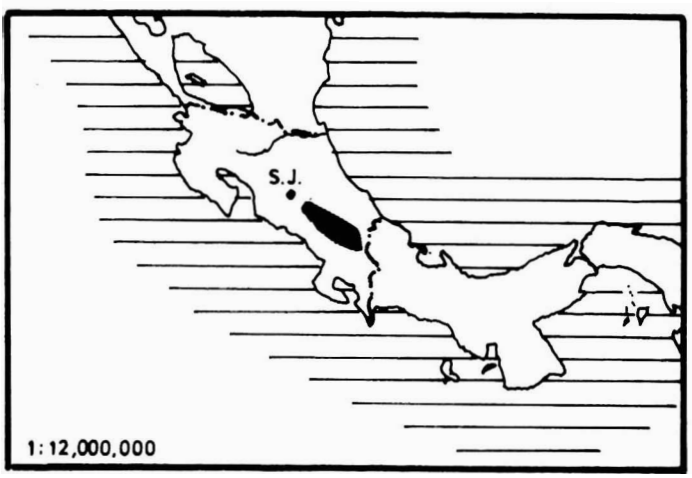

Figure 88.
Chusquea tonduzii
Costa Rica: endemic. Common in the Cordillera de Talamanca between 2400 and 3140 m altitude, below the páramo.

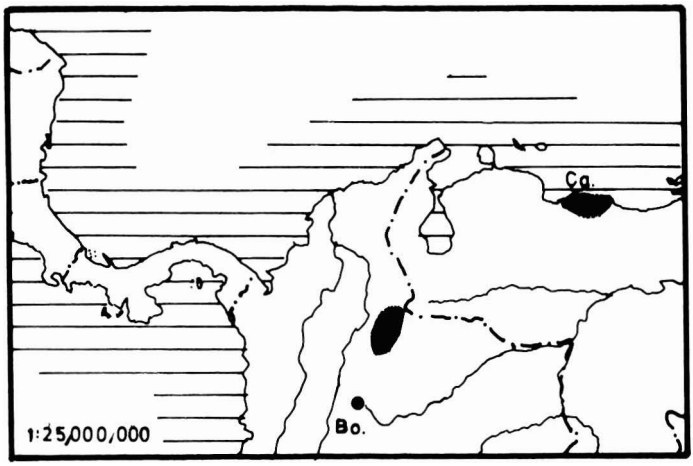

Figure 89.
Chusquea tuberculosa
Venezuela: Distrito Federal: Upper Catuche wood near Caracas.
Colombia: Dept. Santander: at 2500 m altitude.

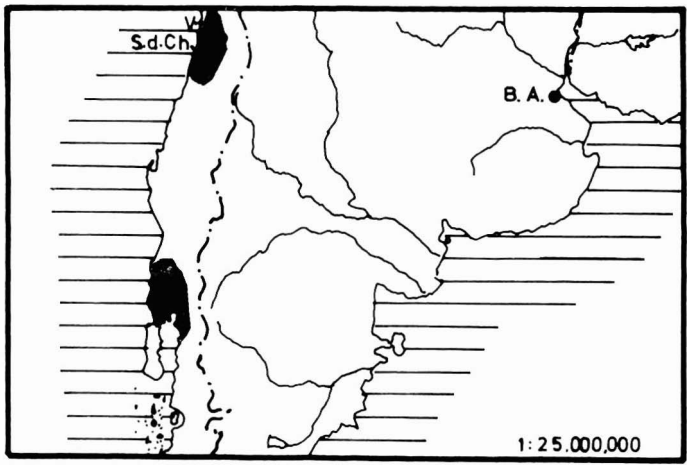

Figure 90.
Chusquea uliginosa
Chile: Valparaiso, Puerto Montt, Valdivia, in humid areas.

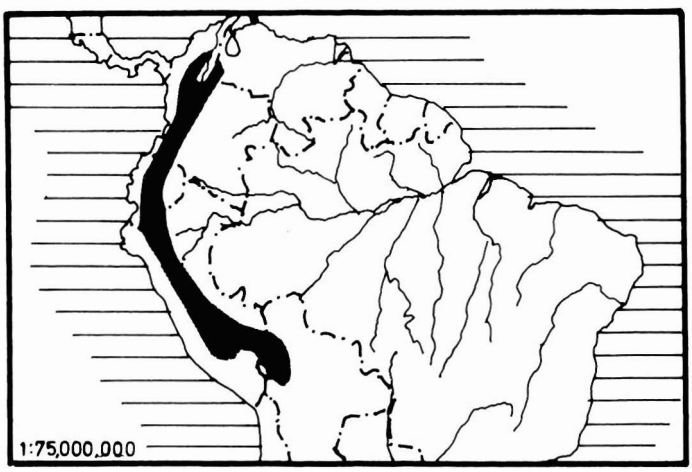

Figure 91.
Chusquea uniflora
In the Andes from Colombia to Bolivia.

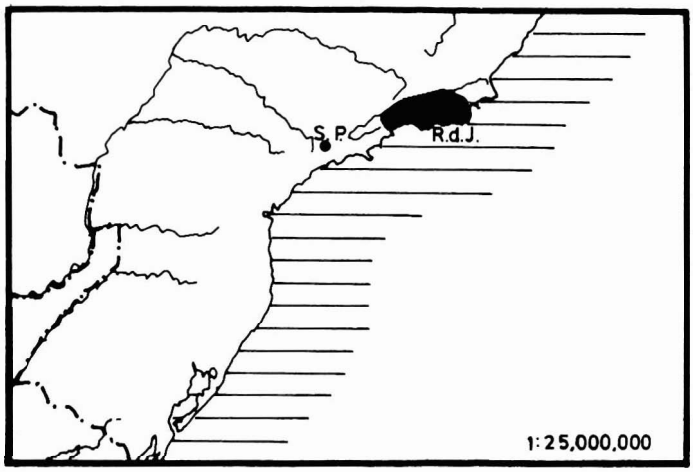

Figure 92.
Chusquea urelytra
Brazil: Province Rio de Janeiro: Nova Friburgo.

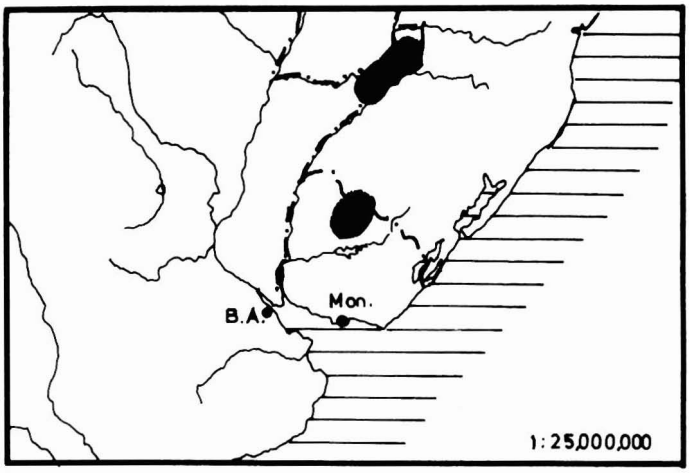

Figure 93.
Chusquea uruguayensis
Uruguay: Tacuarembó.
Argentina: Misiones.

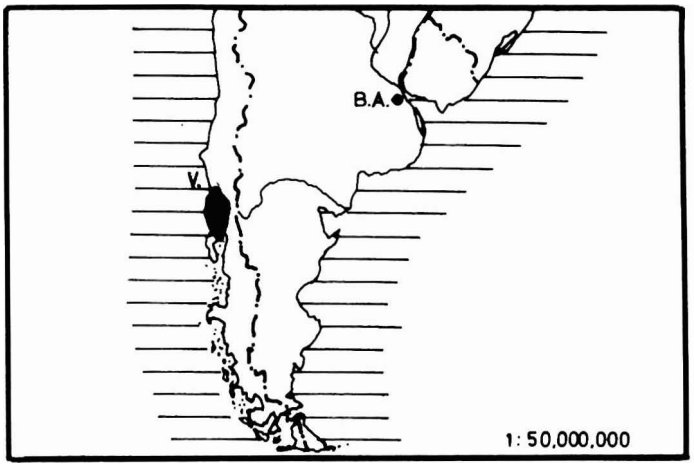

Figure 94.
Chusquea valdiviensis
Chile: Valdivia.

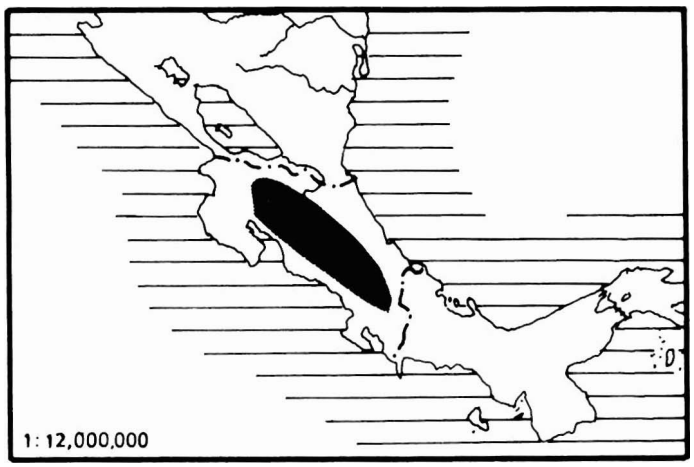

Figure 95.
Chusquea virgata
Costa Rica: apparently endemic; widely distributed in central parts at about 1300 m altitude, but rare.

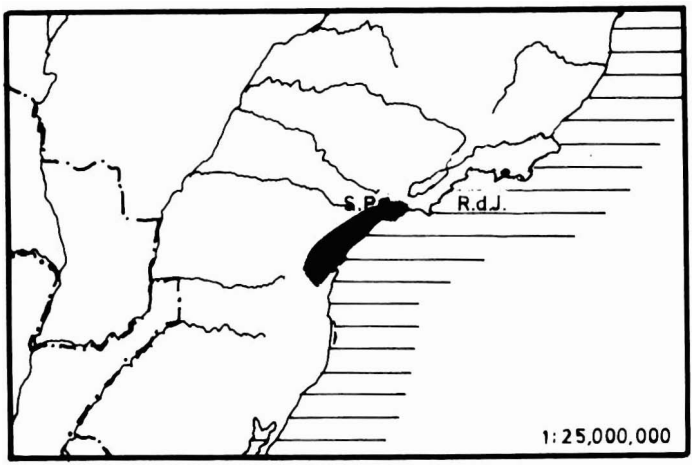

Figure 96.
Chusquea wettsteinii
Brazil: São Paulo (?): Itapecirica, in forest at about 1000 m. Paraná: Serra do Mar.

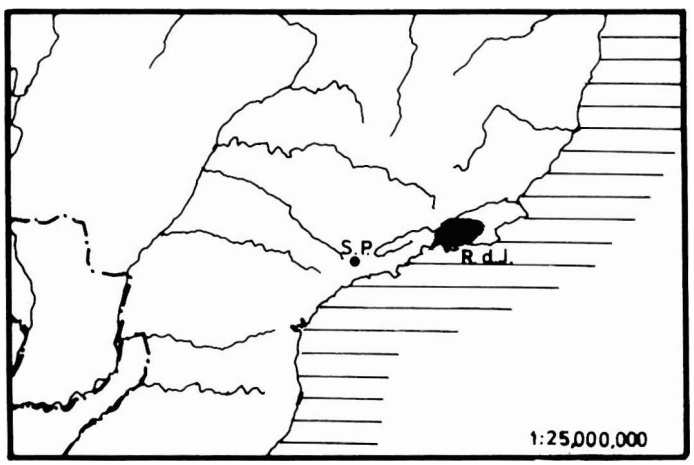

Figure 97.
Chusquea wilkesii
Brazil: Province Rio de Janeiro: Serra dos Órgãos.

Stephen M. Young*: **The Flowering of *Bambusa paniculata* (Poaceae: Bambusoideae) in Southern Mexico**

Revised manuscript received September 20, 1985.

Bambusa paniculata (Munro) Hackel is a widely-distributed yet uncommon bamboo of *Bambusa* subgenus *Guadua*. It was first described by Munro (1868) from Brazilian specimens collected in the states of Goiás and Pernambuco.

This interesting bamboo is not large, rarely measuring over ten meters tall and seven centimeters in diameter. It exhibits a number of distinctive characteristics which distinguish it from other bamboos of subgenus *Guadua*. Weakly erect and often scrambling culms turn noticeably yellow with age, and cascades of narrow, pendant branch leaves are readily visible among surrounding vegetation (Fig. 1). Culm leaves are rather stiff; and the blades, one half to one third as long as the entire culm leaf, are deciduous from the sheaths (Fig. 2). Culm leaves on new shoots are a beautiful yellow-green color covered by purple horizontal stripes (Fig. 3). These colors gradually fade to light yellow with age. There is one main branch with few to numerous subsidiary branches at each node, and each branch is armed with slender, very sharp thorns which make entrance to a clump difficult. The spikelets are usually few-flowered, pubescent, flattened, and usually occur in clusters of three or more (Fig. 4). One side of the spikelet is often purple and the other side green.

For a more detailed description of the morphological features of *Bambusa paniculata* see Doell in Martius (1880), McClure (1955) and Pohl (1980).

B. paniculata grows in a wide range of ecological conditions, but is often found in drier areas such as deciduous forest and savannah that other species of subgenus *Guadua* will not tolerate. It is rarely found above 1300 meters elevations.

B. paniculata also has a wide geographic distribution. It has been recorded from every country in Central America except Belize and from the South American countries of Venezuela, Brazil, and Paraguay. Besides *B. paniculata*, only two species of *Bambusa* subgenus *Guadua*, *B. amplexifolia* and *B. guadua*, have been recorded from both North and South America.

In Mexico, *B. paniculata* has rarely been collected, and appears to be rare. Its northernmost locality was recorded from the state of Nayarit (30 miles south of Acaponeta, H.S. Gentry 6808, 15 Jan 1943, F). I have seen only two additional collections from Mexico, both from the state of Oaxaca (Between La Galera and Pochutla, Liebmann 130, Oct 1842, US and Loma Bonita, E. Hernandez 620, 5 Apr 1945, TEX). Liebmann's collection was originally used to describe *Chusquea spinosa* by Fournier (1886), but additional study has determined that it is indeed *B. paniculata*.

During July 1984, I visited southern Mexico to collect bamboos as part of my research on *Bambusa guadua*. In the states of Chiapas and Oaxaca, I was fortunate enough to observe and collect flowering specimens of *B. paniculata*.

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In Chiapas, I collected from a small clump one kilometer south of the Rio Margaritas (22 km south of Pijijiapan), elevation 50 meters, along the Pacific coastal road. When I first drove by this clump, which was growing on a small hillside and partially covered by tall grass, I mistook it for a clump of *Chusquea* because of its clambering habit and narrow branch leaves. The presence of many dead culms in the clump may have been the result of a partial flowering, but I did not observe any spikelets.

Four days later, I found a few clumps of *B. paniculata* along the transisthmus highway seven kilometers north of Matias Romero, elevation 150 meters, in the state of Oaxaca. None of these culms were discovered to be in flower. Here, as in many parts of southern Mexico, *B. paniculata* is known by the common name "Otate" and is used to some extent for fences, gates, and roof supports. I was told that it is fairly common in the area around Matias Romero.

My next and last encounter with *B. paniculata* occurred north of Pochutla in southern Oaxaca. I arrived in Pochutla from the East on the road from Salina Cruz, and I noticed that a species of small diameter *Bambusa* was being used quite extensively for fences and roof supports. I visited a small warehouse where bundles of this bamboo were being sold (Fig. 5) and learned that north of the city grew large groves of the same bamboo that were presently flowering and dying.

I later found these masses of dead and dying culms twelve kilometers north of Pochutla on the road to Oaxaca. They were covering many hectares of rolling terrain, at approximately 200 meters elevation (Fig. 6). There was no doubt these were culms of *B. paniculata*. Flowering was said to have begun in June, and local farmers could not remember the last time it had occurred. New shoots were present in some clumps, and seedlings were seen growing in others. Unfortunately, many dead clumps were being cleared for cornfields. I did not have ample time in the area to determine population sizes, but I did not observe any further clumps along the road north or south of the one-kilometer-wide zone of flowering. A thorough search of the areas around Pochutla and along the newly opened coastal road at similar elevations would probably reveal additional populations.

I travelled north from Pochutla to the city of Oaxaca, on to Jalapa, Veracruz and west to Merida, Yucatan, but I was unable to locate another clump of *B. paniculata*.

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Figure 1. Narrow, pendant branch leaves.

Figure 2. Culm leaf sheaths with detached or deciduous blades.

Figure 3. Culm leaf sheath and blade of new shoot.

Figure 4. Spikelets.

Figure 5. Bundles of culms at bamboo warehouse, Pochutla, Mexico.

Figure 6. Hillside near Pochutla covered with flowering culms.

Errata

to *J. American Bamboo Soc.*, Vol. 4, No. 3&4, 1983 (1985)

Page 43, footnote 2, b), 2nd sentence, beginning with "**Their different circumspections of the genera ...**". My intention was to say as follows: The genera of the *Thamnocalamus* complex were differently defined and circumscribed by Chinese authors, partly leading to changes in nomenclature that causes confusion of the (species) names.

Page 44, section "The Genera", line beginning with "*Ampelocalamus*":
For "**C.Y. Sheng**" read "**G.Y. Sheng**".

Page 45, line beginning with "*Chimonobambusa*":
For "**3 sp.**" read "**9 sp.**".

Page 47, line beginning with "*Mustelia*":
For "**1840**" read "**1841**".

Page 48, line beginning with "*Qiongzhuea*":
For "**W.T. Yi**" read "**T.P. Yi**".

Page 50, Table 1, line beginning with "ATOMOCHLOEAE":
For "**ATOMOCHLOEAE**" read "**ANOMOCHLOEAE**".

Page 50, Table 1, line beginning with "OLYREAE":
For "***Alberella***" read "***Arberella***".

Page 51, Table 1 Continued, line beginning with "MELOCANNEAE":
For "***Thyrostachys***" read "***Thyrsostachys***".

Page 54, section "The Species", line beginning with synonym "*Sasa bitchuensis*" under "*Sasaella bitchuensis*":
For "**Nakai, 1925:143**" read "**Nakai, 1925:149**".

Page 61, line beginning with synonym "*Arundinaria hashimotoi* f. *minaguchii*" under "*Sasaella masamuneana*" (on page 60):
For "**(Makino and Koidzumi ex Koidzumi) Murata in Kitamura and Murata**" read "**(Makino and Koidzumi) Murata in Kitamura and Murata**".

Page 64, line beginning with synonym "*Pleioblastus viridistriatus* var. *agrestis*" under "*Sasaella ramosa*" (on page 63):
For "**as "*viridi-striatus*"**" read "**as P. "*viridi-striatus* β *agrestis*"**".

Page 64, line beginning with synonym "*Sasaella dimorpha*" under "*Sasaella ramosa*" (on page 63):
For "**(Hackel ex Nakai) Nakai ex Koidzumi**" read "**(Hackel ex Nakai) Koidzumi**".

Page 65, line beginning with synonym "*Pleioblastus kongosanensis* cv. *vagans*" under "*Sasaella ramosa*" (on page 63):
For "***Pleioblastus kongosanensis* cv. *vagans***" read "***Pleioblastus kongosanensis* cv. Vagans**".

Page 67, line beginning with species "*Sasaella sadoensis*":
For "**Makino ex Koidzumi, 1935:13**" read "**Makino ex Koidzumi, 1935:19**"

Page 80, Figure 21:
For scale "**1:12,000,000**" read "**1:25,000,000**".

Dieter Ohrnberger
Mannheim, 14 June 1985

INFORMATION TO CONTRIBUTORS

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References should cite the author and date first, followed by (for journals), the article name, journal name, volume number (in boldface), issue number, and pages; and followed by (for books), the book title, publisher, and pages.

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CONTENTS

Elizabeth A. Widjaja: Ethnobotanical Notes on *Gigantochloa* in Indonesia with Special Reference to *G. apus*..... 57

L.G. Clark: Notes on Two Viny West Indian Bamboos..... 69

Wen Yue Hsiung: Growth Pattern of Monopodial Rhizomes of Bamboo Plants..... 73

Y.Y. Cheung, S.G. Cooper, T.J. Hansken and Y.C. Cheung: Research on the Raising of *Phyllostachys pubescens* Seedlings..... 79

Elizabeth A. Widjaja*: **Ethnobotanical Notes on *Gigantochloa* in Indonesia with Special Reference to *G. apus***

Revised manuscript received January 18, 1986

Abstract

The traditional uses of various species of the giant bamboo genus *Gigantochloa* found in Indonesia are described. Special reference is given to *Gigantochloa apus* with regards to its wide uses for building material, furniture, food resources, packaging and basketry, handicrafts, musical instruments, fishing implements and weaponry. The area of distribution and the respective local uses are tabulated. Methods of cultivation of these bamboos are presented.

Introduction

Gigantochloa Kurz ex Munro is a genus of giant bamboos growing widely in tropical Asia. In Indonesia the genus plays a very important role in the daily life of the people. This is evident from the fact that the bamboos are extensively used for village houses, furniture, handicrafts, and musical instruments. Locally they also feature prominently in fishing implements and cooking utensils; they are also used extensively as food. Therefore, it is not surprising that many species of *Gigantochloa* are cultivated so that they are a common sight in the Indonesia rural countryside.

The purpose of this study is to identify the established uses of species of *Gigantochloa* as they are known and practiced today in many areas of Indonesia. The opportunity is also used to compare the folk nomenclature and classification of the species with those produced by professional plant taxonomists. The traditional practices of the people in cultivating these species and the possible scientific explanation of these practices will also be elaborated.

Materials and Methods

The data presented here have been accumulated during the course of a taxonomic study of Malesian species of *Gigantochloa*. Field work was undertaken in many areas of Indonesia in 1982-1984; the specimens collected were deposited in the Herbarium Bogoriense (BO), the Herbarium of the Royal Botanic Gardens, Kew (K), and the Rijksherbarium at Leiden (L). Notes recorded on specimens available in those as well as in other herbaria were also incorporated in this study. Ethnobotanical information has mostly been obtained by interviewing the local people; it is supported by direct observation. The nomenclature used is that adopted by Widjaja (1985).

* Herbarium Bogoriense - Lembaga Biologi Nasional, Bogor, Indonesia.

Useful Species of *Gigantochloa* in Indonesia

Of the 19 accepted species of *Gigantochloa* for Malesia (Widjaja, 1985), 13 occur in Indonesia. Among these, the Indonesians are known to use as many as 12 species for various purposes. The species (Table 1) vary in the size, strength and color of their culms; these features have determined the uses of each species.

As shown in Table 1, the use of a particular species is not the same in all areas of its distribution, because there seems to be a good correlation between the species and the local tribe's degree of cultural development. To illustrate this, one may look at the use and the pattern of distribution of *G. apus* (Schultes and Schultes) Kurz which seems to follow the migrations of the Javanese. It is well known that this species has been used in Java for ages. When the Javanese migrate to other islands, they always try to bring living rhizomes of this species with them. Consequently in new resettlement areas such as Central Sulawesi, Central Kalimantan and Riau Island, people will not use a local or unfamiliar species straight away because they are very strict to their traditional habits. Some migrating people correctly assert that the local bamboos are not as good as *G. apus* for building materials and handicrafts so they bring this species with them from their native villages in Java. It is only after a considerable period of time and only if the familiar species is not available then they experiment with local species.

It is estimated that approximately 60% of all bamboos consumed in Java are *G. apus*; the rest are *G. pseudoarundinacea* (Steudel) Widjaja, *G. atter* (Hasskarl) Kurz, *G. atroviolacea* Widjaja and bamboos belonging to other genera. *G. apus* has been used for a long time by the Javanese for building material, packaging, handicrafts, and furniture due to the strength and pliability of its culms. It is also cheaper than other bamboos due to its abundance.

One factor that contributes to the popularity of *G. apus* is the fact that it is resistant to borer attacks. In spite of the fact that the starch content of *G. apus* depends on the habitat, the accepted view that the higher the starch content of the culms the more they are susceptible to borer attacks does not appear to apply to this species. Whether there is a physical or anatomical explanation for this phenomenon requires further careful study (Sulthoni, 1983).

Uses of *Gigantochloa*

As stated above the tribes that make up the Indonesian people have used bamboos in many different ways from time immemorial. The more important uses still practiced today are elaborated below.

Building Materials

Monroy (1955) estimated that 80% of the bamboos consumed in Indonesia are used for building materials, 10% for packaging, 5% for fencing and 5% for other purposes. It is a fact that a house can be constructed solely out of bamboos, including its pillars, floors, walls, doors, windows, rafters and roof-laths as well as its ceilings and roofs (Felix, no date; Soedarmadi, 1972). It is therefore clear that the most important use of bamboo in Indonesia is for building purposes.

Sindoesoewarno (1963) reported that 35% of the houses in Indonesia were entirely made of bamboo and that another 35% used bamboo in one way or another. Understandably, the use of bamboo in rural area housing is greater than in urban areas. In recent years the use of bamboo for housing tended to decrease, because according to Sulthoni (1983) bamboo consumption in 1976 for building construction in Central Java was less than timber but greater than non teak timber; the figure for East Java and Bali was almost the same as that of Central Java. According to him more than 50% of the bamboo used in building rural houses were employed for walls, roof-laths, rafters and ceilings. The greatest demand is for roof-laths and rafters which in 1980 amounted to more than 400,000 cubic meters. Sharma (1980) estimated that the total bamboo demand in Indonesia is about 600 million pieces, equal to about 3.3 million metric tons annually. The contribution of *Gigantochloa* to the total bamboo consumption for building construction in Indonesia amounts to about 60%.

Besides houses, numerous village structures such as smoke houses for drying newly harvested tobacco, raised guard houses in rice fields called *dangau*, roadside food shops called *lepau*, hot houses for growing mushrooms, *lumbung padi* or store houses for rice, cattle sheds and many others, all use *bambu tali* (*G. apus*), *bambu gombong* (*G. pseudoarundinacea*) or *bambu ater* (*G. atter*) as their main components of construction. *Surau*-- the individual Moslem family praying center-- is often exclusively made of *Gigantochloa*, and similarly, only the split culms of *Gigantochloa apus* are used in constructing the traditional Hindu-Balinese worshipping place called *palinggih*. Because of their large size and relative strength, the culms of *G. pseudoarundinacea* and *G. atter* are more frequently used for pillars and other major framework of buildings, whereas *G. apus* is used for making floors, walls, rafters and roofs. Although structurally possible, one finds only rarely *G. atroviolacea* being used for building construction (except walls), because this species has other uses which are economically more attractive (see below).

In recent years, people in some villages have been experimenting with the use of *Gigantochloa* and other bamboos as a replacement for metal rods in reinforced concretes. Admittedly this innovative use is limited to simple construction.

Previously bamboos were extensively employed as scaffoldings in the construction of city buildings. This has declined in recent years due to the availability of metal scaffoldings which are easier to manipulate and reusable so that in the long run they are cheaper, especially in the construction of multistoried buildings.

Gigantochloa is also much used in making fences around houses, gardens and orchards. Not only the culms but even the smallest branches are employed as space fillers in the fences, especially if a compact fence is being build.

Gigantochloa is a source of popular material for building village bridges. It is also used as pipe line to bring water from distant places by interconnecting adult culms. For this purpose only *G. apus*, *G. pseudoarundinacea*, *G. robusta* Kurz, and *G. atroviolacea* seem to be suitable.

Furniture

Village houses are normally furnished with furniture partly or wholly made of bamboo. *Balai-balai* (a kind of bed), *para-para* (a combination of rack and cupboard), benches and crude tables are kinds of bamboo furnitures commonly seen in rural areas. Nowadays a number of interior decorators have begun to introduce bamboo furniture into city houses. Consequently new designs of chairs, sofas, and tables are being developed.

Gigantochloa apus is commonly used for furniture in the rural areas, followed by *G. atter* and *G. pseudoarundinacea*. In recent times *G. atroviolacea* is being used more and more for constructing modern furniture, undoubtedly due to the attractive, blackish pigmentation of the culms. The fact that in nature *G. atroviolacea* is rarer than *G. apus* or *G. pseudoarundinacea* makes this species much sought after; hence, it fetches a better price.

Food Resources

The Indonesians probably learned from the Chinese how to use young bamboo shoots as food. Species of *Gigantochloa* commonly used for this purpose are *G. atter*, *G. nigrociliata* (Büse) Kurz, and *G. levis* (Blanco) Merrill. They are mostly eaten as a vegetable and are either cooked or rarely eaten raw. During the course of this study it was noted that some people also eat *G. robusta*, *G. hasskarliana* (Kurz) Backer in Heyne, *G. pruriens* Widjaja, and *G. pseudoarundinacea*.

According to data released by the Indonesian Health Department (Anonymous, 1979) 100 grams of fresh bamboo shoots contain 27 calories, 2.6 grams of protein, 0.3 grams of fat, 5.2 grams of carbohydrate, 13 milligrams of calcium, 4 milligrams of vitamin C and 91 grams of water. On the other hand, Walther et al. (1910, 1911) reported that the young bamboo shoots of certain species release hydrogen cyanide (HCN) or prussic acid; this cyanide is contained in the glucoside taxiphyllin and it is from fresh shoots of members of the genus *Gigantochloa* that the HCN represents more than 0.15% of this glucoside. Although a high concentration of HCN may sometimes be found in commercial edible bamboo shoots, the cyanide will disappear after boiling or drying.

G. apus probably has a higher concentration of HCN than the other members of *Gigantochloa*, because the young shoots of this species are bitter. Similarly the leaves of this species also produce a bitter substance so that they are never used in making *bacang*, a rice delicacy prepared by wrapping rice and spiced meat in bamboo leaves and then boiled. Also the culms of species of *Gigantochloa* are never used in cooking another rice delicacy called *lemang*.

Packaging and Basketry

Before Indonesian daily life was invaded by plastic bags, *G. apus* represented a very important source of packaging material for the Javanese and Balinese. Various types of artifacts can be found, ranging from the strongly but crudely made huge basket for carrying dried fish and other things to distant areas, to the smallish *besek* (boxes) for food. We should also include *bongsang*, an ephemeral container for multiple purposes made from loosely interwoven, split bamboo.

Since all of these packaging containers should be disposable and able to accommodate soft things without damaging them, pliable thin strips of bamboo are invariably used; no species other than *G. apus* is appropriate as raw material for this purpose. This species is also widely used as a source of string for tying these packages and other wrappers. The specific epithet of *G. apus* was derived from the old Javanese word *apus* which means string.

For more permanent containers, several kinds of bamboo baskets have been developed in many areas of Indonesia. They differ both in size and shape as well as the purpose and the methods of carrying them according to the habits of the tribes. In Java broad based baskets called *keranjang* seem to be preferred as they are suitable for carrying on top of the head (by women) or suspended on shoulder carrying poles (by men). In

Borneo and Celebes, tall baskets provided with shoulder belts are more common since they are suitable for walking along narrow footpaths in the thick forest. Understandably, species of *Gigantochloa* other than *G. apus* are employed for this kind of basket. An example is *budak*, a huge rice container from Madura.

Handicrafts

One of the important uses of species of *Gigantochloa* in Indonesia is in the handicraft industry. Table mats, fans, boxes, hats, handbags, purses, flower vases, ash trays, lamp shades, and a thousand other bric-a-brac are woven, shaped or carved beautifully out of bamboo manifesting in some cases the artistic ability of the people.

Probably the most developed bamboo handicrafts industry in Indonesia is the weaving of bamboo splits, for which *G. apus* has been exclusively employed. In weaving splits many different patterns have been created, normally with particular meanings specific to each tribe. Basically there are 2 main groups of patterns used (Basuki, 1982): the *sasag* pattern which is made by matting one split horizontally against another split vertically, and the *kepang* pattern made by feeding one split between two splits horizontally or vertically. Within both groups numerous variations are known, each with its own specific name. In recent years new patterns have been introduced, undoubtedly influenced by wider contacts with outsiders.

Musical Instruments

Bamboo musical instruments have been variously developed by most tribes in Indonesia. They can be in the form of the simple *tong-tong* (one bamboo internode with a narrow slit cut lengthwise) to the very sophisticated *gambang* (a series of bamboo culms of different sizes and tones). Apparently bamboo musical instruments were known in Java for a very long time, because xylophone-like instruments made of bamboo and known as *calung* are illustrated on the Borobudur temple which was built in about the 8th century AD. The most complicated instruments which almost make up a complete orchestra are those developed by the Menadonese of North Sulawesi and the Sundanese of West Java. In the latter area, some of the popular bamboo musical instruments made from *Gigantochloa* are *angklung*, *calung*, *celempung*, *goong*, *gambang* and *rengkong* (see the reviews by Widjaja 1977, 1980).

The most suitable species for making musical instruments is *G. atroviolacea*, whose culms to have the right combination of size, texture, and other physical properties. Other species frequently used are *G. atter*, *G. pseudoarundinacea*, and *G. apus*. The Baduy tribe of West Java also make bamboo musical instruments from *G. robusta*.

Fishing Implements

Many traditional fishing implements are made of bamboo by most tribes in Indonesia. These range from the simple *pancing* (fishing-rods) and *karamba* (bamboo boxes placed in running water for rearing fresh water fish) to the many kinds of *bubu* (fishing traps) of various sizes and shapes.

When *G. apus* is not available in the area, the people make fishing implements of other bamboo although they are less flexible and less durable.

Weaponry

Indonesians used *bambu runcing* as an emergency weapon during the war of independence 1945-1949, no doubt learning from the experience of their forefathers who had been known to use similar armory for a long time. For this purpose, the upper part of an adult culms of *G. atter* or *G. apus* was cut into a manageable size -- normally about 3 m long with a diameter of 5-7 cm -- and sharpened so that it would serve as a javelin or spear. In Eastern Madura, large numbers of such sharpened culms of *G. atter* (as well as other bamboos), were planted as stakes on a large tract of open area to prevent parachutists from making smooth and safe landings.

Other Uses

The sharp edge of a freshly split *G. atter* culm (or other bamboo) known as *sembilu* has often served as a knife in many Indonesian traditional ceremonies. It is especially employed where there is a taboo against using metal knives such as in the severance of the umbilical cords of newborn babies as well as in the circumcision ceremony of male Moslem children. The taboo probably arose because of fatal experiences due to the lack of knowledge of aseptic technology.

In North Sumatra, *G. pruriens* which is reported to grow there is used as the harvesting-pole of fruits of oil palms largely because of the straightness and lightness of its culms; it has been suggested that *Melocanna baccifera* is also suitable for harvesting oil palm (Widjaja, 1980). Moreover the culms of *G. pruriens* are also used by the Batak people for writing their traditional calendar.

Gigantochloa apus and *G. atter* represent very important materials in making *tangga* or bamboo ladders in Indonesia. There are 3 types of bamboo ladder which can be seen in many areas. The commonest type is the one called *taraje* by the Sundanese; it is made of two, 2-3 m long, bamboo culms connected by horizontal bamboo rungs set in holes made every 30 cm. *Sigai* is a one culmed, bamboo ladder used for climbing the sugar palm tree. Notches are carved out to form convenient steps for climbing. *Ijan* is a three culmed, bamboo ladder made by binding the culms together on one end. This ladder is used to dry tobacco and cloves or for weighing rice during harvesting time.

In the old days, as in many other countries, *jajangkungan* or bamboo stilts made of small culms of *G. apus* (or other bamboos) were used for walking in flooded areas. Nowadays, they are only used as a children's toy. Many other kinds of toys, such as wiggling snakes, wistles, piston air guns, masks, frames for kites and so on, are also made of *G. apus*.

Cultivation

Bamboo was probably brought into cultivation many thousands of years ago, but there is no archaeological evidence to support this. It is assumed that the center of origin of *Gigantochloa* was probably somewhere on the mainland of South East Asia. Several species appear to have been brought to Indonesia, probably accidentally by sea, when used for making rafts during prehistoric migrations. Because of the ease of propagation of bamboo, even from a single node, people could by chance leave pieces of bamboo and these pieces would grow. The other possibility is that when people understood precisely which

species were most useful, they may have chosen these and brought them along for making temporary dwellings during migration and for other purposes.

This presumes that bamboo was used a long time ago, even before the neolithic era. In some parts of Indonesia such as Bali, Lombok, South Sulawesi (Toraja) and Timor, people use bamboo more than in any other region. Because of this, many anthropologists including Berthe-Friedberg (1980, pers. comm.) suggest there might have been a bamboo age between the stone age and the bronze age.

Nowadays, one rarely sees local people starting a new grove of bamboo in a Javanese village. The bamboos growing now were mostly planted some years ago. According to information collected around Bogor, there are three traditional methods of bamboo propagation:

1. One method is to plant a *dongkelan*, which is a piece of the lower culm, together with the rhizome basal to it. For this method, culms of 9 months to 2 years old are used to establish new plants.
2. A part of the upper portion of the culm, removed when the foregoing method is employed, are cut into pieces with one or two internodes, laid out on the ground and covered with a thin layer of soil. The buds at the nodes will start growing after some time.
3. A piece of an old culm with two internodes is split lengthwise and then laid in the soil with the convex side upwards. This method requires continuous and careful maintenance as the chance of failure is very high.

Propagation of *Gigantochloa* from seeds can also be effected and for this purpose seeds can be gathered when the bamboo clump is flowering. Few people have a chance to see the bamboos they plant themselves come to flower, because most species of *Gigantochloa* flower 30-40 years after planting the rhizome. Moreover, local people are not happy to see their bamboo flowering because they believe it is a bad omen.

The distance between bamboo plantings depends on the area and the species. Most species of *Gigantochloa* have a tufted clump habit so that they need only a limited distance between clumps. The most favorable time to propagate bamboo is the beginning of the rainy season.

People can harvest the culms any time, though the dry months of the year are considered the most appropriate harvesting time as it will diminish starch content and attack by insects. To prevent insect boring, the culms are placed in muddy water soon after cutting. In actual practice, culms are usually harvested when they are about three years old. The Sundanese and Javanese say the time for harvesting culms is after *umur dua adi* which means after the culms produce young shoots twice. In this way the young shoots will continue to flourish and the culms are old enough to be used for many purposes.

Obviously only a limited area can be planted by these traditional methods. The economic success of commercial bamboo exploitation will depend to some extent on cultivation on a large scale of useful bamboos, selected for quality and high productivity. The establishment of plantations to provide raw material for bamboo shoots, paper, and innumerable kinds of handicrafts calls for the prompt production of at least a million rooted propagules from a single plant. Therefore the large scale production of bamboo plants in the future will require the development of special techniques of micro-propagation such as tissue culture.

Folk Nomenclature and Classification

Vernacular Names

Bamboos in general are called *buluh* by the Malay speaking people (Malay Peninsula, Sumatra, Kalimantan, Sarawak, and North Borneo). The Sundanese of West Java call them *awi*, whereas the Javanese (Central and East Java), the Madurese, the Balinese, and the Bunaq call them *pring*, *perrèng*, *tiying*, and *ma* respectively. Therefore, the vernacular names given to species of *Gigantochloa* in Indonesia vary from one area to another because there are numerous local languages. Thus for a single bamboo, such as *G. atroviolacea*, we encounter different names such as *pring wulung* (Javanese), *awi hideung* (Sundanese), or *bambu hitam* (Indonesian), all of which mean black bamboo. *Gigantochloa apus* is called *pring tali*, *awi tali*, and *tiying tali* by the East Javanese, Sundanese, and Balinese respectively; each name means string bamboo. In Central Java more people call it *pring apus* than *pring tali*. The word *apus* derived from Kawi words also means string or bound. As indicated above this is the best bamboo for making string.

In North Sumatra the Batak people call *G. pruriens*, *buluh regen*, which means hairy bamboo referring to the dense itching hairs which cover the back side of the culm sheaths. In East Java, the Javanese call *G. manggong* Widjaja, *pring manggong*, from the sound of its rubbing culms when the wind blows.

Some herbarium specimens contain the vernacular names noted down by collectors. During the course of this study, it became apparent that such notes should be handled with care. Confusion has often arisen due to the carelessness of collectors in noting down the vernacular names, mostly because many collectors have a poor understanding of the local languages and a hazy concept of species. The confusion of *pring ater* (often appearing on labels of *G. atter* and *G. pseudoarundinacea*) or *pring wulung* (used to denote *G. atroviolacea* and *G. robusta*) are cases in point. Most local people know their flora by their vernacular names very well, and a plant taxonomist who is conversant with the local language and has a clear taxonomic insight of the bamboo concerned will benefit greatly from these names (Table 2.).

It is of interest to note that in Java the geographic names of many places were derived from the vernacular names for species of *Gigantochloa* such as Cigombong and Gombong (*G. pseudoarundinacea*), candi (temple) Pring Apus, Ciapus (*G. apus*), Ciater (*G. atter*), Majalengka (*G. nigrociliata*) and so on.

Folk Classification

In many parts of Indonesia, the local people easily recognize every species of bamboo occurring in their surroundings. They also recognize that bamboos represent a distinct plant group which differs from trees and grasses because bamboos have characteristic culms with internodes. Although they have not been taught the principles of taxonomy, they can separate one species from the others by using specific characters such as leaf size, culm thickness, and culm color. This folk taxonomy is revealed in many vernacular names based on local languages for different species. The Javanese divide bamboo roughly into 3 groups: first, *pring* which is big, straight with slightly thick culms and big leaves (members of the genus *Dendrocalamus* and *Gigantochloa*); second, *hawur* or *haur* which is thick bamboo, not straight, of medium size with small leaves (such as species of the genus *Bambusa*); third, *wuluh* which is very small in size, with very thin and not very tall but straight culms, and leaves of medium size (such as species of *Schizostachyum*).

This type of division is also recognized by the Sundanese and Balinese by using a special name for each group such as *awi*, *aur* and *buluh*.

In West Java the Sundanese people use some specific (although taxonomically not always diagnostic) characters such as culm thickness and culm diameter for differentiating bamboos within the genus *Gigantochloa*. Different species of *Gigantochloa* found in West Java are characterized by the Sundanese as follows: *awi gombong* (*G. pseudoarundinacea*), because of its thinner culm walls, is separated from *awi mayan* (*G. robusta*). These two species, because of their wider culm diameter, are distinguished from *awi tali* (*G. apus*), *awi lengka* (*G. nigrociliata*), and *awi lengka tali* (*G. hasskarliana*). *Awi lengka* can be separated from *awi lengka tali* easily since the former has very thin culms and more palatable, young shoots. The culms of these two species usually have a very small diameter, whereas *awi tali* culms have a medium diameter. Also, the former species have smaller leaves than the later. If the people live in the area where *awi mayan* is not found, they differentiate *awi gombong* and *awi tali* based on the leaf size together with the strength of the culm. They recognized correctly that *awi gombong* has bigger leaves than *awi tali*.

A more sophisticated system of bamboo recognition has been developed by the Dayak Kenyah people living in East Kalimantan (Widjaja, 1983). These people use more meaningful taxonomic evidence for differentiating species of *Gigantochloa* as well as other bamboos they know. One can construct a dichotomous key to the species based on their system to organize their knowledge and understanding of bamboos. Since they employ the culm sheaths and their appendages (auricle, ligule, blade) in recognizing a type of plant (which surprisingly correspond to scientifically established species), a plant taxonomist will have no difficulty using the wisdom of these people for taxonomic purposes.

The same system of bamboo recognition has also been developed by the Bunaq people living in East Timor as reported by Friedberg (1982).

Looking Ahead

In the more developed areas of Indonesia, the advance of modern technology has made its impact on the way the people conduct their daily life. For the most part many traditional customs together with their associated products have to give way to modern innovations. Consequently in areas near Bogor, for example, it is unlikely that one will find bamboo bridges or bamboo pipe lines. On the other hand, the awareness of the advantage of "return to nature" has given rise to an appreciation of the beauty of certain traditional technological products. The increasing demands for bamboo furnitures or bamboo fences produced using modern inventions in recent years bear witness to this. Unfortunately the revival is associated with the fashion of the day, so that more often than not they are frightfully expensive and beyond the reach of the average citizens.

Be that as it may, it is unthinkable that the traditional role played by bamboo will disappear totally, even in the unlikely case that modern technology will penetrate evenly the whole Indonesian archipelago. Nevertheless much of the information on the ethnobotanical meaning and significance of traditional uses of bamboos are disappearing very fast. For example, the real purpose of the green and white paints which are always used in coloring the Kabaena (South East Celebes) bamboo musical instruments is not as yet documented, and so far no satisfactory explanation has been given by old or knowledgeable people from the area. It is along this line that field research should be undertaken for

the benefit of the development of bamboo ethnobotany.

This paper forms part of a thesis submitted in partial fulfillment of the degree of Doctor of Philosophy in the University of Birmingham (United Kingdom). I should like to thank Dr. Mien A. Rifai, Herbarium Bogoriense, Bogor for kindly supervising this study.

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Table 1. Known Uses of *Gigantochloa*

Species	Areas of Distribution	Building	Furniture	Food	Packaging	Handicrafts	Musical Instruments	Fishing Implements	Weaponry	Other Uses
achmadii	WSU,NSU.									
apus	J,B,CS, R,SK.	J,B,CS, R,SK.	J,B,CS, R,SK.		J,B,CS, R,SK.	J,B,CS, R,SK.	J,B.	J,B,CS, R,SK.	J.	J,B.
atroviolacea	J,SSU.	J.	J.			J.	J.			
atter	J,B,CS,SS, MAD,ST,IJ.	J,B,CS, MAD,IJ.	J,B.	I,IJ.		B,IJ.	J.	J,B.	J,MAD.	WJ.
hasskarliana	WK,EK,J,B,SU.			EK,J.		EK.				
levis	EK,M.	EK,M.	EK.	EK.		EK.				
manggong	EJ.	EJ.			EJ.					EJ.
nigrociliata	WJ,B.			WJ.						
pruriens	NSU.	NSU.	NSU.	NSU.	NSU.	NSU.				NSU.
pseudo-arundinacea	J,B,WSU, MEN.	J,WSU.	J,WSU.	J.	B,J.	J.				J,WSU.
ridleyi	B.				B.					
robusta	WJ,B,WSU,MEN.			WJ.			WJ.			
wrayi	SSU.									

Key

B	Bali	M	: Moluccas	SS	: South Sulawesi
CJ	Central Java	MAD	: Madura	SK	: South Kalimantan
CS	Central Sumatra	MEN	: Mentawai	SSU	: South Sumatra
EJ	East Java	NK	: North Kalimantan	WJ	: West Java
EK	East Kalimantan	NSU	: North Sumatra	WK	: West Kalimantan
IJ	Irian Jaya	R	: Riau	WSU	: West Sumatra
J	Java (West, Cen				

Table 2. Vernacular Names of Indonesian *Gigantochloa*

Species	Vernacular Name
achmadii	buluh apo (P)
apus	pring tali (J); awi tali (S); perrèng talè (M); tiying tali (B); bambu tali, bambu apus (I).
atroviolacea	pring wulung, pring ireng, pring ulung (J); awi hideung (S); bambu hitam (I).
atter	pring jawa, pring legi (J); awi ater, awi temen (S); perrèng kèlès (M); bambu ater (I).
hasskarliana	awi lengka tali, awi tela (S); pring jajang kapur, pring jajang kertas (J); tiying putih (B); buluh mayan (Pal); buluh lekukai (Lamp); buluh sorik (Bat-Tap); buluh didi (Alas); bulok busi (Day-Ken); bambu lengka tali (I);
levis	bulok tup (Day-Ken).
manggong	pring manggong (J); tiying jahe (B).
nigrociliata	awi lengka (S); tiying tabah (B); bambu lengka (I).
pruriens	buluh regen (Bat-Karo, Alas); buluh belangke (Melayu); buluh yakyak (Gayo).
pseudoarundinacea	awi andong, awi gombong (S); pring gombong, pring surat (J); tiying jajang suwat (B); buluh batuang danto (P); bambu gombong (I).
ridleyi	tiying kaas, tiying jajang, tiying jajang batu, tiying aya (B).
robusta	awi mayan (S); tiying jelepung (B); buluh riaw (P); buluh poring (Bat-Tap).
wrayi	buloh dabo (Pal).

Key

Alas	:Alas	J	:Javanese
B	:Balinese	Lamp	:Lampung
Bat-Karo	:Batak-Karo	M	:Madurese
Bat-Tap	:Batak-Tapanuli	P	:Padang
Day-Ken	:Dayak-Kenyah	Pal	:Palembang
Gayo	:Gayo	S	:Sundanese
I	:Indonesian		

L. G. Clark*: **Notes on Two Viny West Indian Bamboos**

Revised manuscript received March 19, 1986

The Islands of the West Indies support a surprisingly diverse native bamboo flora. About half of the 18-20 bamboo species known from the West Indies belong to two woody bamboo genera, *Arthrostylidium* Ruprecht and *Chusquea* Kunth (McClure, 1973; Calderón and Soderstrom, 1980). These species are all slender and clambering or viny. Dr. Thomas R. Soderstrom of the Smithsonian Institution recently called my attention to a problem involving two of these bamboos, *Arthrostylidium sarmentosum* Pilger and *Chusquea abietifolia* Grisebach.

In flowering condition these two taxa are distinct (see Hooker, 1885 and Chase, 1914 for illustrations), but vegetatively their viny habit and reduced leaves are strikingly similar, making proper identification of the two difficult. Both species range from low to middle altitudes (about 800-2000 m) and are known from Cuba, Jamaica, Hispaniola and Puerto Rico. *Arthrostylidium sarmentosum* may also occur on Trinidad.

Grisebach (1864) originally described *Chusquea abietifolia* from flowering material collected in Jamaica. The specific epithet refers to the short, rigid, almost needle-like leaves of this species. *Arthrostylidium sarmentosum* was originally described by Pilger (1903 in Urban), who based his description on vegetative material from Puerto Rico. Pilger (1903 in Urban) clearly described the leaves of this species as being narrowly lanceolate, obtuse, papery and up to 4 cm long and 5 mm wide. Chase (1914) later described and illustrated the spikelets of *A. sarmentosum* after collecting flowering plants on Puerto Rico.

Recent attempts by myself and others to find *C. abietifolia* on Puerto Rico were unsuccessful, leading us to wonder whether the vegetative Puerto Rican specimens identified as *C. abietifolia* were actually *A. sarmentosum*. To our knowledge, no flowering specimens of *C. abietifolia* have ever been collected from Puerto Rico, even though two gregarious blooming episodes of this species on Jamaica were well documented (Seifriz, 1920, 1950). I examined numerous collections of these two species at the U.S. National Herbarium of the Smithsonian Institution to determine if there are any reliable vegetative characters that could be used to distinguish between them.

Although each species exhibits a branch complement typical of its genus, this feature is not easy to see on most specimens. Foliage leaves provide the best vegetative characters for separating the two species, and the differences are listed in Table 1. A foliage blade of each species is illustrated in Figure 1. The abaxially prominent midrib and thick margins of *C. abietifolia* are perhaps the most conspicuous differences.

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Table 1. Differences in Foliage Leaf Blades between *Chusquea abietifolia* and *Arthrostylidium sarmentosum*

C. abietifolia	A. sarmentosum
Stiff, with midrib abaxially prominent and margins thickened	Thin, midrib abaxially visible but not prominent and margins thin
Apex mucronate	Apex acuminate
Base tapered to cuneate, rarely somewhat rounded	Base rounded
Pseudopetiole not very distinct, about 0.5 mm long	Pseudopetiole distinct, 0.5 - 1 mm long
1 - 4 cm long	2.3 - 5 cm long
1.5 - 4 mm wide	3 - 5 mm wide

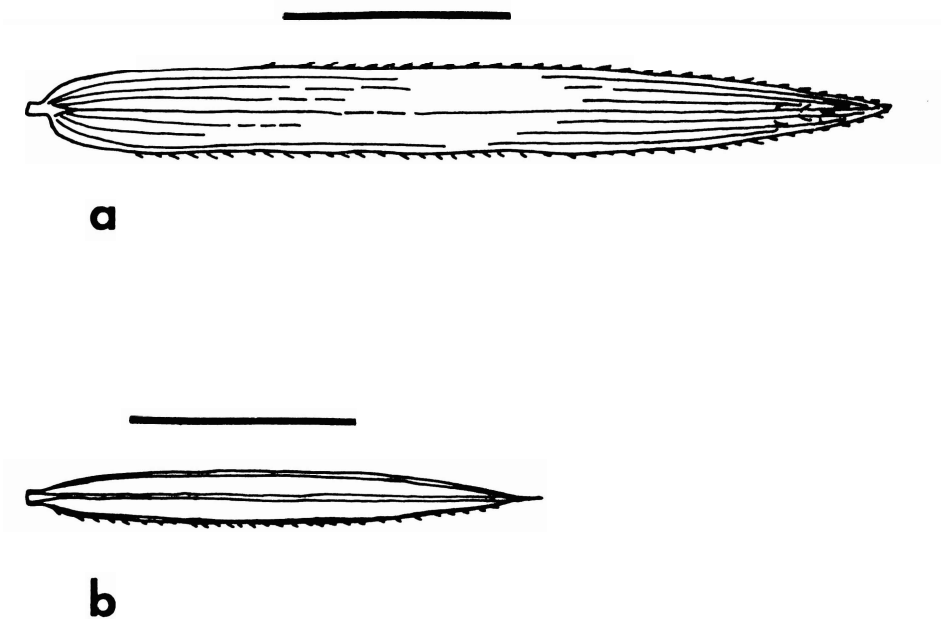

Figure 1. Foliage leaf blades, abaxial view;
a. *Arthrostylidium sarmentosum*, b. *Chusquea abietifolia*, bars = 1 cm.

Using these criteria, I found that there are indeed three collections of *C. abietifolia* from two localities in Puerto Rico. *Stevens 4755* and *Hess 116* were collected in 1913 and 1914 respectively on Monte Alegrillo. A third specimen, *Sargent 3062*, was collected from Los Tres Picachos, Jayuya in 1943. This represents the last known collection of *C. abietifolia* on the island. Currently efforts are underway to relocate this species, but it is possible that it has disappeared from Puerto Rico. Recent collections from Jamaica and Haiti indicate that *C. abietifolia* still occurs on those two islands.

In 1982, I collected *A. sarmentosum* from a vigorous population near the Reserva Forestal Maricao on Puerto Rico. Carlos Betancourt of the University of Puerto Rico, Mayaguez, has also collected this species recently from Luquillo and Toro Negro. From these observations *A. sarmentosum*, in contrast to *C. abietifolia*, is widespread on Puerto Rico and apparently thriving.

Although not closely related, the two West Indian bamboos, *C. abietifolia* and *A. sarmentosum*, have both evolved delicate culms, a viny habit, and reduced, narrow leaves. Because they share virtually the same distribution and habitat in addition to their strikingly similar vegetative morphology, identification of the two species from vegetative material has become a source of taxonomic confusion. After closely examining many specimens of both species, I found that there are consistent differences in the foliage leaf blades which can be used to separate the two. The historical distribution patterns of the two species are confirmed, but it has been over 40 years since *C. abietifolia* was last collected on Puerto Rico. Efforts to relocate *C. abietifolia*, and better document the distribution of *A. sarmentosum* and related species on Puerto Rico should be continued.

Acknowledgements

I thank Dr. Thomas R. Soderstrom of the Smithsonian Institution for bringing this interesting problem to my attention, and Dr. Richard W. Pohl of Iowa State University for reviewing this manuscript.

Addendum

Just recently (February, 1986) I received some bamboo material collected by David Edelman, who is working on a bamboo project in Mayaguez, Puerto Rico under the direction of Dr. Soderstrom. Mr. Edelman kindly agreed to search for *Chusquea abietifolia* on Puerto Rico, and I am happy to report that he did indeed relocate one vegetative population of this species near Maricao, on Monte del Estado in the drainage of the Rio Maricao (*Edelman 58*, *Edelman & Hollenberg 59*). Edelman believes this site to be the same as the Mont Alegrillo locality where this species was collected previously, but Monte Alegrillo does not appear on any maps he has found. The population of *C. abietifolia* was growing intermixed with the more common *Arthrostylidium sarmentosum*, which may explain why *C. abietifolia* has been overlooked before.

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Wen Yue Hsiung*: **Growth Pattern of Monopodial Rhizomes of Bamboo Plants**

Revised manuscript received April 14, 1986

ABSTRACT

Botanically, rhizomes are the main stems of bamboo trees which produce culms as branches and new rhizomes as propagules. The apex of a rhizome shoot consists of apical and subapical meristems from which intercalary meristems are derived by successively basipetal formation of nodal septa. Elongation of a rhizome results from the acropetal elongation of its individual internodes. Each internode undergoes cell division, differentiation, elongation and maturity through the activity of intercalary meristem.

Introduction

Rhizomes are the most important organs of bamboo plants and have multiple functions in their growth and propagation. Botanically, rhizomes are the main stems of bamboo trees which produce culms as branches and new rhizomes as propagules. Rhizomes also serve as reservoirs which store moisture and nutrients and as passages from which water and nutritional materials are transported. Around rhizome nodes, roots develop for absorption and anchorage. Actually, the growth pattern of rhizomes is closely related to the development and production of bamboo stands.

Apical Growth of Rhizome Shoots

Apical meristems are responsible for the apical growth of rhizome shoots that leads to form the underground network of the rhizome system. The apical dome of a rhizome shoot consists of an outer mantle of 4-5 layers of cells known as tunica which is remarkably uniform in cell size and cell arrangement and an interior mass of unlayered cells known as corpus. Between the tunica and corpus there is a transitional layer of cells with outward wall uniform and inward walls distorted. Both tunica and corpus are characterized by dense cytoplasm, large nuclei and active mitoses (Fig. 1).

In the lower part of apical meristem, a youngest sheath primordium is initiated by periclinal division and appears as a small protrusion. Its outer layer is directly transformed from the tunica and its interior part is derived from the peripheral meristem. As the apical meristem continues to grow, the sheath primordium develops into a young sheath and another new sheath primordium occurs alternately on the opposite position just a little above the former primordium. The initiation of a sheath primordium indicates the beginning of differentiation of apical meristem. Morphologically the youngest sheath primordium is the first appendage of a rhizome apex and may be recognized as a dividing mark with the apical meristem proper above and the subapical meristem below.

In the subapical meristem, cell division and differentiation are very active. Pith meristem and peripheral meristem become distinguishable in their cell size and nuclei. In the pith meristem, cells are large, vacuolated and loosely arranged in 14-20 longitudinal files. Their division and differentiation are much retarded as compared with those in the

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peripheral meristem where cells are small and densely packed in 6-10 longitudinal rows.

At the axil of the 4th or 5th young sheath below the new sheath primordium, there occurs a lateral bud primordium which gradually develops into an apical meristem similar to that of the main apex. In the course of apical growth, bud primordia occur alternately and successively on either side of the rhizome shoot. At the same time further differentiation is taking place to initiate procambia (provascular bundles) in the subapical meristem (Fig. 2).

Both rhizome apexes and their lateral buds consist of a number of "stem units" by successive formation of sheath primordia and ultimately develop into new rhizomes, rhizome shoots or culm shoots.

At the position of the 3rd or 4th bud primordium procambia are further developed and arranged longitudinally or somewhat distorted from the peripheral portion toward the center. Cells other than procambia are less active in division and differentiation. Some of them become enlarged in size and vacuolated and ultimately develop into ground tissue. As the growth of the rhizome shoot continues, provascular bundles increase in number and become curved transversely across the subapical meristem at the position of sheaths and lateral buds. This indicates that a new node is in the making. It is assumed such a juvenile node can be the lower limit of the subapical meristem.

In the subapical meristem, anticlinal cell division becomes dominant and increases in frequency from the outside toward the inside. The length and width of apical meristem increase in each successive plastochron from the uppermost sheath primordium downward.

Elongation of Rhizome Internodes

As mentioned above, juvenile nodes of a rhizome shoot are successively formed with advancement of apical growth and separate the subapical meristem into a number of sections which are known botanically as intercalary meristems. The newly formed intercalary meristem fully occupies the newly formed internode. Evidently the apical meristem proper gives rise to the subapical meristem and the subapical meristem undergoes further division and differentiation subsequently to form nodes and internodes. Thus, an intercalary meristem is not inserted into the mature tissue of internodes but originated directly from the apical meristem prior to other appendages and organs of the rhizome.

Elongation of a rhizome shoot results from acropetally successive elongation of its individual internodes which, connected together, form an elongating region below the subapical meristem. As new internodes are continually formed by the apical meristem, the elongating region moves forward with cessation in the lower internodes and activity in the upper ones.

In the case of a single internode, the elongation proceeds in the following successive stages: (1) the internode is fully occupied by the intercalary meristem and increases in length by cell division; (2) the internode becomes two distinguishable parts; the upper is composed of differentiated but elongating cells, while the lower remains meristematic; (3) the internode can be distinguished into three parts; cells in the uppermost gradually cease to elongate and become mature, those in the middle still elongate actively, while the meristematic cells are confined to the lower part; (4) no more meristematic activity occurs in the internode, only the mature upper part and the elongating lower part exist; and (5) the whole internode becomes mature completely (Fig. 3).

According to the morphogenetic pattern, procambia embedded in the intercalary meristem undergo further differentiation and form various elements of vascular bundles which exert their appropriate functions respectively in the course of rhizome growth. Compared with the vascular structure of culms, rhizomes possess large vessels, well developed phloem and ground tissue which are important to moisture and nutrient storage and transport, while the proxylem and fibres are poorly developed. Apparently rhizomes run in soils parallel to the ground surface and need not have much mechanical structure to support their own weight as do the culms.

Rhizome Growth and Environments

The growth of rhizomes always follows the slow-quick-slow pattern in accordance with seasonal change of climate. In winter when soil temperature drops to 5° C or lower, the rhizomes cease to elongate. With increase of temperature and rainfall in spring their elongation becomes accelerated and reaches the maximum in July and August, up to 2-4 cm within 24 hours. Then it slows down gradually and stops completely by the end of December when the soil temperature goes down to approximately 0° C. Sometimes rhizomes grow slowly due to soil dryness though the temperature is favorable.

The apex of a rhizome shoot is is a tight roll, layer by layer, of thick, hard sheaths and is sharply pointed as a borer which can penetrate through hard-textured soils and gravel gaps with a driving force generated from the internodal elongation.

Rhizome shoots do not necessarily maintain a horizontal level nor follow fixed directions. They may become twisted, bent, winding, slender or short-noded in accordance with their vigor and soil conditions. In a favorable habitat with fertile loamy soil, the vigorous rhizomes exert their strong apical dominance, grow fast and run straight forward with their lateral buds located properly on either side on a relatively horizontal level underground. Their internodes are fairly uniform in size. The reverse situation, however, more commonly occurs in hard-textured soils or in old or poor bamboo stands. As a result, internodes vary greatly both in length and in diameter (Table 1, Fig. 4).

Table 1. Length and Diameter of Rhizome Internodes.

Species	Fertile Loamy Soils		Poor Heavy Soils	
	Length (cm)	Diameter (cm)	Length (cm)	Diameter (cm)
Phyllostachys pubescens	6-8	2.5-3.0	2-5	1.0-2.0
Phyllostachys viridis	5-7	1.5-2.5	2-4	1.0-1.5
Phyllostachys glauca	4-6	1.5-2.0	2-4	0.8-1.2
Phyllostachys vivax	5-7	1.5-2.5	2-4	1.0-1.5

Sometimes the apexes of rhizomes run upward from the ground, then turn downward into the ground again leaving bow-like rhizome sections above ground. Occasionally

the apexes grow upward continually and develop into culms. It is also found that an emerged culm-shoot turns downward into the ground again and is transformed into a rhizome from which new rhizomes and roots grow (Fig. 5). Such a change may be caused by the redistribution of growth substances due to the downward growth of the culm.

When the apexes of rhizomes are fractured by mechanical means or injured by frost in winter, the apical dominance no longer exists. The lateral buds nearby sprout and develop into new rhizomes which elongate forward at different angles to the old rhizomes. Actually, the branching pattern of rhizomes is an effective way of propagation for regeneration and expansion of bamboo stands. Branching occurs on either side of rhizomes, but single branching on one side is much more common than any other type.

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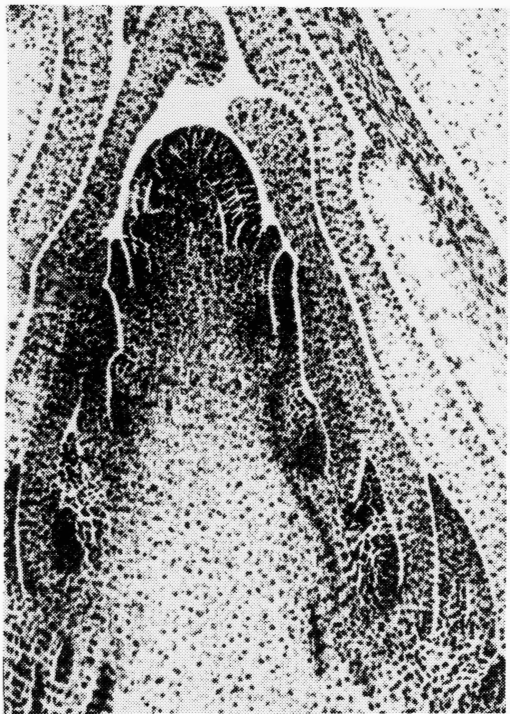

Figure 1. Apical meristem of rhizome shoot showing tunica, corpus, sheath primordia and later bud primordia. 90 ×

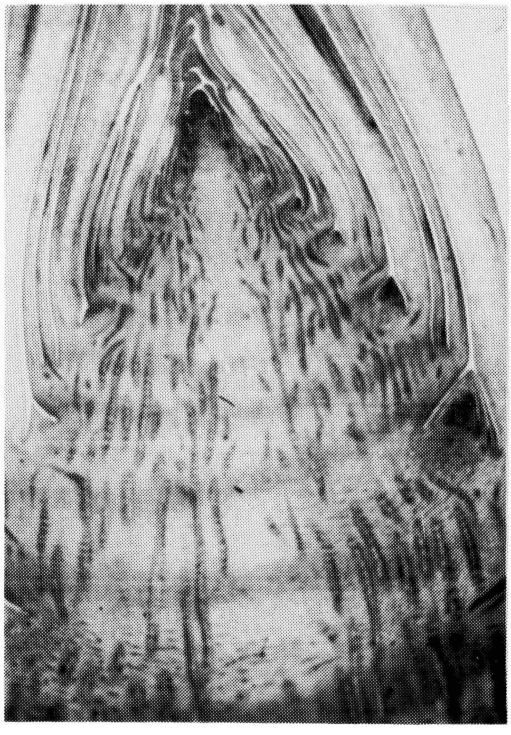

Figure 2. Apex of rhizome shoot showing initial nodes (light belts), intercalary meristem (dark belts), provascular bundles and lateral buds. 28 ×

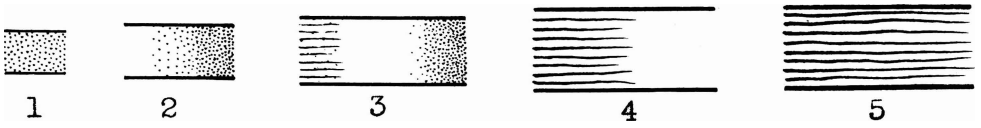

Figure 3. Five successive stages of internodal elongation: 1. Meristematic internode. 2. Internode with elongating and meristematic parts. 3. Internode with mature, elongating and meristematic parts. 4. Internode with mature and elongating parts. 5. Mature internode.

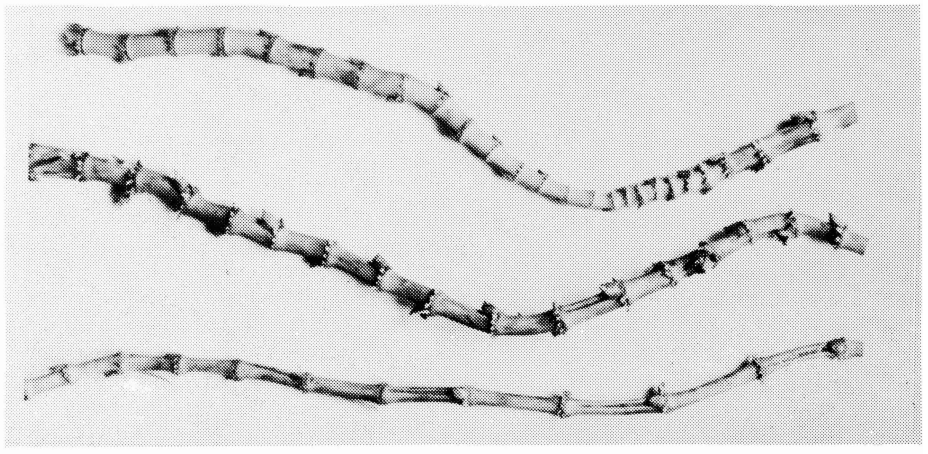

Figure 4. Variation of rhizome internodes.

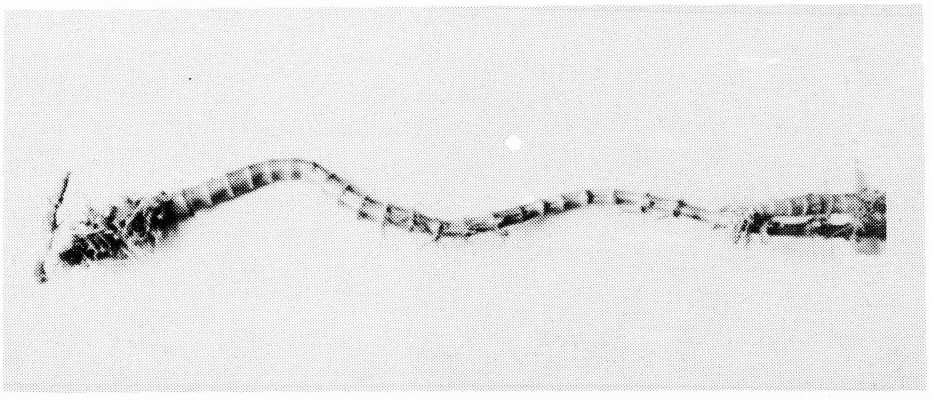

Figure 5. Transformation of a culm shoot into a rhizome.

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Research on the Raising of *Phyllostachys pubescens* Seedlings

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1. Introduction

In China, one fifth of the earth's total bamboo forest (about 3,400,000 acres), consists predominately (80%) of only one species - *Phyllostachys pubescens* Mazel ex Houzeau de Lehaie. Because it has many uses, it has become one of the more economically valuable plants in the world.

P. pubescens is spread throughout every Chinese province south of the Chang Jiang River including Taiwan. The vast area covered by this bamboo requires it to grow in a wide range of climates, soil types, and biologically competitive situations. Although there is no evidence of any relationship between these factors and flowering, it is possible to find flowers and collect seed almost anytime somewhere in its range. Once found, the seed must be planted quickly since it soon loses its viability. Small delays of any kind (due to language, transportation, import export restrictions, etc.) have a large negative impact upon the percentage of the seed that germinates.

2. Flowering and Fruit Bearing Characteristics

The germination of the seed and the seedling's subsequent growth are related in many ways to the flowering and fruiting characteristics of the plant.

2.1. Flowering

P. pubescens is a perennial plant, which flowers in China about once every 50 to 60 years. In each of the provinces south of the Chiang Jiang River, it can be found flowering from April to August. The seeds mature between June and October and then fall directly to the ground or are dispersed by the wind.

2.2. Structure of the Flower

P. pubescens is an anemophilous (wind pollinated) plant. Each flower has three stamens with slender filaments about 5 mm long (Figure 1) protruding from the flower. The ovary is conical or three-sided, about 3 mm in length. The stigma has three vents which look feathery. The pistil is generally wrapped inside the flower or sometimes it protrudes a small amount outside the flower. This makes it extremely difficult for *P. pubescens* to become pollinated. The pollination rate is less than 10%.

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2.3. Seed Metabolism

After the seeds mature, there is no dormant period. In the event conditions are not favorable for germination, the seed quickly loses its ability to germinate. After the seeds have been picked, they must be sown as quickly as possible. At first the germination rate is about 50%. Although at room temperature seeds remain vialble for half a year, the germination rate falls in that time to from 10% to 20%. After eight months, the rate of germination drops almost to zero. However, seeds kept at -5° C maintain a high rate of germination for as long as a year.

3. Seed Germination

Since *P. pubescens* seeds are hard to obtain and have a low germination rate, it is recommended they be germinated and raised indoors for about 2½ months, then moved outside and planted. Seedlings germinated and raised in a greenhouse have a much greater chance of reaching maturity than those grown outside.

At temperatures between 20° and 25° C., seeds generally start to germinate within 7 days after planting; the initial leaf on most seedlings appears after 21 days. In some groups of seed, however, individual seeds germinate as much as one month apart. We believe the reason for this is that the degree of maturity is not the same in each seed. Seed groups also vary in qualities which affect the percentage that germinate, the number of albinos and the number of plants that become sickly and yellow. One also finds at this stage a very few seedlings with variegated leaves.

Before planting, it is best to soak the seeds in warm water (20° to 25° C.) for 24 hours. The seeds should be planted in loose soil rich in humus with pH between 5 and 7.

A thousand husked *P. pubescens* seeds weigh from 8 to 15 grams, while unhusked they weigh 15 to 25 grams. Taking several factors into consideration, the weight of the seeds, their age, etc., one may estimate the number of seeds which will germinate. This in turn helps one estimate the amount of potting soil, pots and space to set aside in the nursery. Taking this one step further, a long range projection can be made to determine the amount of land needed for a permanent planting.

When the seeds germinate, the rate of growth of the tap root is 1-2 times greater than that of the stem. The stem grows upward slowly, putting out new leaves to become the first generation of bamboo culmlets. If soil moisture is insufficient during germination, the growth of the tap root is faster and the young stem's growth is restricted. If the moisture is excessive, the situation is reversed - the stem's growth is faster and the tap root's growth is restricted. In either case, the seedling does not grow to be strong and healthy. Generally a soil moisture of 70% to 80% is best; it should not be allowed to become soggy and stagnant. We have found from flood experiments that bamboo rhizomes, however, are able to endure fairly well submerged in water. The root system of two year old plants was kept submerged in fresh standing water. Under these conditions (water was not over the tops of the plants), there were no visible signs of debilitating effects for half a month, and the plants were still living after two months, though the leaves began to yellow and stop growing.

4. Growth Stages in Juvenile Plants

The first generation of seedling culmlets grows to full height in 1-2 months. Most are under 15 cm tall; they have 10-18 leaves and no branchlets.

At about the time that the first generation culmlet is putting out its third leaf, the seedling reaches a critical period. We call it the "three leaf period". During this time, some of the young seedlings develop yellowed leaves, stop growing, and gradually wither and die. Even though they may have had excellent care, the phenomenon is unavoidable. From statistics gathered during the times we have raised seedlings, this kind of death occurs in about 25% of the seedlings. We believe that since the nutrients needed for the young seedling's growth during the initial stages are dependent upon the seed itself, the fault lies in the seed's quality.

As a young seedling grows, its feeder roots develop and gradually take up more nutrients from the soil. At the time the third leaf appears, the nutrients in the seed have almost been used up. The seedling then starts to depend completely upon the root system for its intake of minerals and water. We believe some seeds are not mature enough when harvested. They are unable to supply the nutrients long enough for the root system to become developed. Such seedlings die at the three leaf period when the root system is too weak to take over (Figure 2).

The death of a portion of the young seedlings is not necessarily a negative phenomenon. It functions as the natural selection process, weeding out the weak from the strong. Extreme care can save about 25% of these young seedlings.

5. Development of Shoot Types

When the first generation of culmlets has grown to full height, basal shoots start to grow. Generally one basal shoot develops initially, but occasionally two shoots appear at the same time (Figure 3). With good care, 6-8 basal shoots grow in one year, each new shoot becoming larger and thicker than the last (Figure 4). In the second year, it is possible to have a small clump of 40-50 culmlets. There are some differences between a seedling clump of *P. pubescens* and other bamboos. We divide the clumping stage into four categories.

5.1. Type A

These are mainly the first generation of culmlets. Their special characteristic is that they rarely have branches. The culmlets grow upwards in all directions.

5.2. Type B

These are the second year basal shoots that grow straight up. Branchlets grow from the culmlet nodes. One branchlet per node grows from the lower nodes, and two, side-by-side branchlets grow from each upper node. At this time, the bamboo clump clearly has a tiered appearance with the older, first year growth below and the younger growth above as shown in Figure 5.

5.3. Type C

Starting with the second or third year, some shoots grow straight up from the base to become Type B culmlets while others grow first outward horizontally 1-2 feet then curve upward to become Type C culmlets (Figure 6).

5.4. Type D

During the third to fourth year, mature rhizomes grow some distance from the base of the clump and give rise to culms from their lateral buds. In the fourth to fifth year, new culms unmistakably resemble the mature plant (Figure 7).

Perhaps the above-mentioned changes in the clump reflect the stages of development in the evolution of *P. pubescens* from a clumping variety to a mixture of clumper and runner to finally a true runner. Because of this, one of us (Y.Y. Cheung) believes that *Phyllostachys* and other running bamboos are at a more advanced stage of evolution than clumpers.

6. Care of Young Seedlings

One of the basic rules of agricultural production is "30% planting and 70% care". The following few points are important for the care of young seedlings.

6.1. Protective Shade

Bamboo seedlings need shade because of their large juvenile leaves and the excess transpiration these cause. Also, their root system dries out easily. The practice of supplying adequate shade protection can produce greater seedling growth, early secondary shoots, more secondary shooting and deep green, healthy leaves. If shade protection is not provided, seedlings are stunted, the leaves become yellow and the secondary shoots are affected. Conversely, if there is excessive shade, the plant's culms become long, slender and weak. There is also an obvious decrease in the number of basal shoots. The optimum shade protection is one which transmits 40% to 50% of the incoming light.

Shade protection is most important in the summer to avoid strong direct sunlight. But in autumn or winter, the shade material should be slowly removed to let the seedlings harden their culms. At this time, permanent planting of the seedlings is possible.

6.2. Watering and Fertilizing

Soil moisture should be maintained at a level of 70% to 80% as mentioned above. About a month after the seedlings have come up, a solution of ammonium sulfate or calcium nitrate at a rate of one tablespoon to one gallon of water can be used to irrigate them. Generally, nitrogen is the most important element with potassium second. Fertilize once every 2 to 3 weeks.

Another method is to use a potting mix specially prepared for germinatiing seeds. Use 4 oz. of Sierra-blen per cubic foot of potting mix. Sierra-blen is a trade name for an 8 to 9 month, slow release fertilizer with a formula of 18-7-10 plus 1% iron. Make sure the commercial seed germination potting mix is not already ammended with fertilizer.

The same Sierra-blen may be added to a homemade mix consisting of 90% fine grade fir bark, 10% fine clean beach sand and ½ oz. per cubic foot of micronutrient Zn-Mn-Fe mix.

We recommend that seed flats be given ample aeration to discourage the growth of fungus on the ungerminated seeds. A dusting with fungicide during sowing, before the seeds are covered up, assists in deterring fungal growth.

6.3. Topping to Promote Shooting

When the seedlings shoot for the third time and the culmlets have reached their full height and stopped growing, cutting off the tops of the culmlets to a couple of inches above the soil along with careful watering and fertilizing greatly encourages otherwise latent buds to start shooting. This method produces 30% to 70% more shoot growth.

6.4. Transplanting Seedlings

The question of how deep the seedlings should be planted is always ignored. Generally it is best to make sure the base of the plant is about 1 cm. below the surface of the soil. If planted too shallow, the basal shoots are often stunted by extreme changes of temperature, moisture and wind. If planted too deep, the basal shoots can not grow. Instead, the node nearest the surface of the soil, above or below, grows a "mock" shoot. The mock shoot is extremely detrimental as it causes the primary growth area to wither and die or become useless stunting overall growth (Figure 8). It does not help to remove the excess soil to the proper level after several months have passed. The remedy is to apply soil until it slightly covers the mock shoot. After a time, a new root system starts to grow and the seedling begins shooting from the branchlet within two weeks to a month. However, these "node sprouters" lag far behind properly planted seedlings.

6.5. Weeding and Loosening Soil

Since young seedlings grow slowly, one should get rid of weeds. The soil should be cultivated once to a depth of about 10 cm especially during the fall and winter. Cultivation promotes secondary root growth by cutting or breaking off the terminal parts of roots, thereby causing more lateral root growth and developing a more efficient root system (Figure 9). Done occasionally, cultivation not only takes care of weed problems but also increases aeration of the soil.

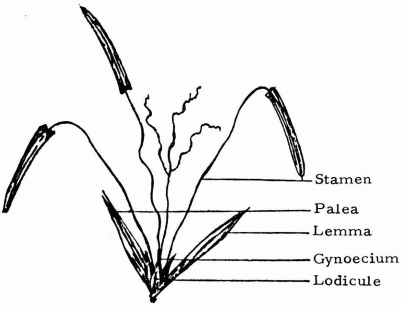

Figure 1. Flower of *P. pubescens*.

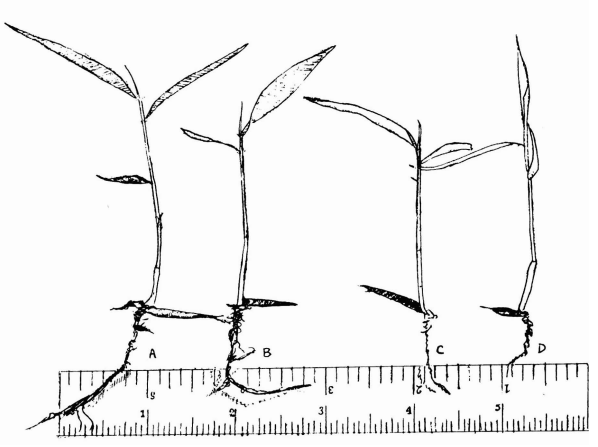

Figure 2. Seedlings at the "three leaf period". A and B are healthy and normal. C and D are sickly and stunted.

Figure 3. Shoot development. From left to right: too deep, undeveloped new shoot and mock shoot at culm node; normal with one new shoot; advanced with two new shoots.

Figure 4. Clump about 12 months old.

Figure 5. Two year old plant, lower leaves from first year growth, upper leaves from second year growth.

Figure 6. First rhizomes at about 3 years, some curve up to become whips, others arch down into the soil.

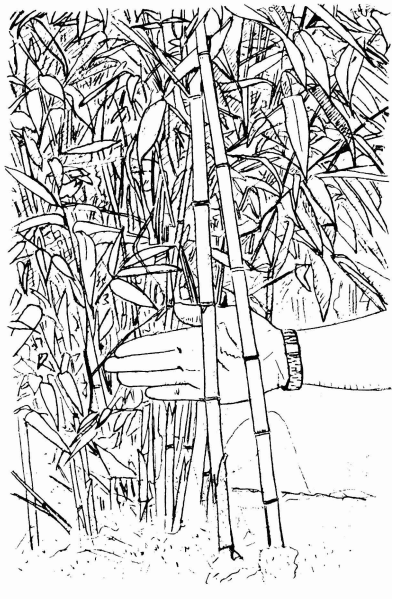

Figure 7. Fourth to fifth year culms.

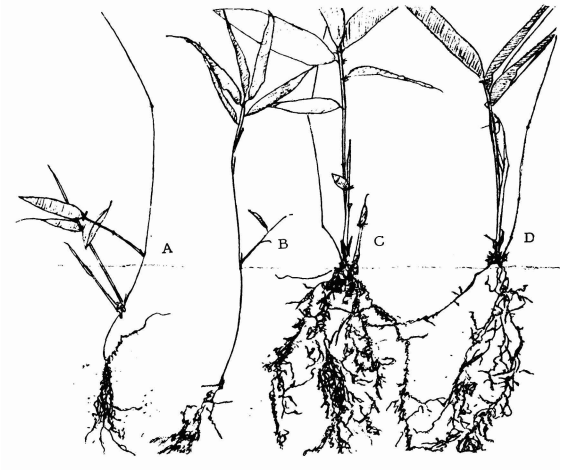

Figure 8. Effect of soil depth, six month old seedlings. A and B are too deep resulting in 3 mock shoots on A and one on B. C is at the proper depth. D is too shallow exposing roots to the air.

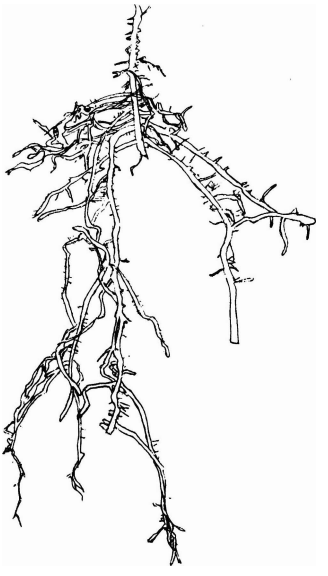

Figure 9. Stimulation of lateral root growth by cultivation.

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