



PLATE 2329 *Senna didymobotrya*

Senna didymobotrya

Fabaceae: Caesalpinioideae

Northwestern, eastern and southern Africa, and Madagascar

Senna didymobotrya (Fresen.) H.S.Irwin & Barneby in *Memoires of the New York Botanical Garden* 35: 467 (1982); Lock: 37 (1989); Pooley: 154 (1993). *Cassia didymobotrya* Fresen.: 53 (1839); Oliver: 276 (1871); Taubert: 201 (1895); Harms: 498 (1915); Baker: 62 (1911); Brenan & Greenway: 97 (1949); Steyaert: 504, fig.36 (1952); Mendonça & Torre: 177 (1956); White & Angus: 120 (1962); Drummond: 243 (1975); Ross: 195 (1972); Gordon-Gray: 79 (1977). *Cassia verdeckii* De Wild.: 49, t.16 fig.6–11 (1902); Harms: 498 (1915); Baker: 638 (1930).

Senna Mill. is a large genus in the Fabaceae family, subfamily Caesalpinioideae, tribe Cassieae with approximately 350 species. The subfamily is usually divided into five tribes: Cercideae, Caesalpineae, Cassieae, Detarieae and Macrolobieae (Tucker 2003; Resende et al. 2013). Irwin & Turner (1960) included the species of *Senna* among the approximately 600 species of the genus *Cassia sensu lato*. In their taxonomic treatment, Irwin & Barneby (1981 & 1982) subdivided the genus *Cassia* into *Cassia* L. emend. Gaertn. sensu stricto, *Chamaecrista* Moench and *Senna*; these three genera were ascribed to subtribe Cassiinae. Irwin & Barneby (1982) further divided the genus *Senna* into six sections (*Astroiles* [1 species], *Chamaefistula* [c. 140 species], *Paradictyon* [1 species], *Peiranisia* [c. 55 species], *Psilorhagma* [c. 30 species] and *Senna* [c. 20 species]) distinguishing them mainly on stem, leaf and flower characters. This classification has been supported by a number of studies of these three genera based on morphology, ontogenetic characteristics, molecular systematics and cytogenetics (Resende et al. 2013). Many species of *Senna* exhibit enantiostyly floral symmetry, meaning that the deflection of the style is either to the left or to the right within the same inflorescence (Marazzi et al. 2006).

The genus *Senna* is pantropic in distribution but also occurs in most subtropical regions. Its distribution includes North America, South America, Asia, Australia and Africa (Irwin & Barneby 1981; Henderson 2001; Du Puy et al. 2002; Marazzii et al. 2006; Orwa et al. 2009). It is paraphyletic and amongst the largest genera in the Caesalpinioideae. In southern Africa *Senna* is the largest genus in the subtribe Cassiinae, followed by *Chamaecrista* and *Cassia* (Nkonki et al. 2003). Species vary, from trees and shrubs to woody herbs (some monocarpic) and occur mainly in tropical seasonal vegetation and occasionally in forests, especially along forest margins. There are about 18 species of *Senna* present in southern Africa, of which the majority are naturalised aliens and have been cultivated for their attractive flowers. Only *S. italica* subsp. *arachoides* (Burch.) Lock and *S. petersiana* (Bolle) Lock are indigenous (Germishuizen et al. 2006). According to Brummitt et al. (2007), none of the species in the genus is known to form root nodules. *Senna didymobotrya* is morphologically similar to *S. alata* (L.) Roxb. The former can be distinguished by its oblong-elliptic leaflets that are shorter than 65 mm, bright yellow flowers with darker veins, and pods that are not winged; whilst the latter has oblong leaflets that are longer than 60 mm, deep yellow or orange flowers, and pods that are 4-winged (Brummitt et al. 2007). The genus is character-

ised by a distinctive floral morphology and the presence of extrafloral nectaries. These organs attract ants (e.g. in *S. occidentalis* (L.) Link) that feed on the nectar and, in turn, protect the plant against herbivory (Marazzi et al. 2006; Marazzi & Sanderson 2010).

Senna didymobotrya has various common names, including African senna, African wild sensitive plant, candelabra tree, peanut butter cassia, peanut butter tree, popcorn bush, popcorn cassia, popcorn senna, wild senna and *grondboontjiefbotter kassia* in Afrikaans (Environmental Weeds of Australia [EWA] 2016; Invasive Species South Africa 2016).

Senna didymobotrya, illustrated here, is native to tropical Africa including Kenya, Tanzania and Uganda, and widely cultivated in tropical areas around the world. In its natural range the species is found at elevations from sea level to 2 500 m altitude. In South Africa it is widely distributed in the coastal areas of the Western Cape, Eastern Cape, KwaZulu-Natal and northeasterly towards the highveld region of Mpumalanga, Gauteng and Limpopo provinces. According to EWA (2016), *S. didymobotrya* is naturalised in Australia (mainly in Queensland and New South Wales) and parts of America (Mexico, southern USA). It is also naturalised in several Pacific Ocean islands (e.g. Hawaii). The distribution of *S. didymobotrya* in Africa, based on the Botanical Database of Southern Africa (BODATSA), Southern African Plant Invaders Atlas (SAPIA) and Global Biodiversity Information Facility (2016) databases, is illustrated in Figure 1.

The genus name is derived from the Arabic word *sana* or *sanna* for species with leaves and pods with cathartic and laxative properties. *Senna didymobotrya* is a popular medicinal plant within its native range, where it is commonly used as a purgative, an antimalarial medicine, and used to treat other fevers and jaundice. A decoction of the leaves, stems and roots is used for the treatment of stomach problems such as diarrhoea, intestinal worms and general abdominal pains. Higher doses are, however, reported to be toxic and in some cases may cause vomiting and may be fatal. Root powder mixed in water or infusions of the fresh parts are known to treat some skin diseases. Sometimes the concoction may cause the patient to be weak if not taken with milk (Tabuti 2007). When treating children, the young leaves are cooked in banana leaves to lower toxicity levels and given orally. For livestock, a decoction made from leaves is used to treat external parasites such as ticks. The species is also used to preserve milk for longer periods (up to a year) by coating the inside of the vessel to be used for storing milk with ash of burnt twigs. In the craft industry the wood is used to make handicrafts. Outside of its native range (e.g. tropical Asia, America),

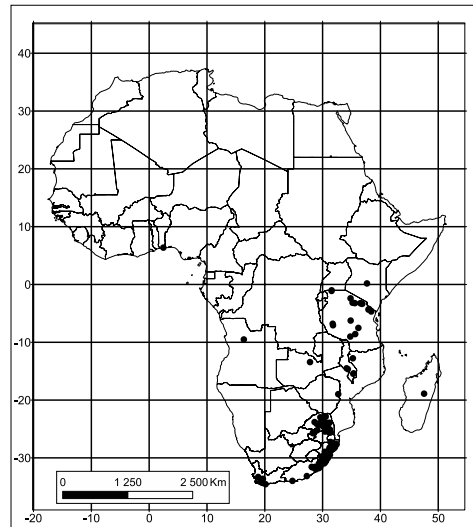


FIGURE 1.—Distribution of *Senna didymobotrya* in Africa based on the Botanical Database of Southern Africa (BODATSA), the Southern African Plant Invaders Atlas (SAPIA) and the Global Biodiversity Information Facility database.

S. didymobotrya is reported to be used as a fodder, green manure, cover crop and shade tree in tea plantations. The species is also known to contain bioactive metabolites, including anthraquinone, choline, triterpenoids and raffinose (Tabuti 2007; Mining et al. 2014). In their findings, Mining et al. (2014) concluded that the root bark of *S. didymobotrya* contains anthraquinone and triterpenoids and can be used as biopesticides against a bean weevil beetle (*Acanthoscelides obtectus* Say) to improve grain production in Kenya.

In South Africa *Senna didymobotrya* occurs in a variety of habitats (Figure 2) including riparian areas, riverine forests (for example along the edges of damp forests in the Kruger National Park) and along forest margins, riverbanks, wastelands, woodlands, grasslands, coastal scrublands and roadsides (Henderson 2001; Foxcroft & Richardson 2003). In its native region the species occurs in swamps and beside seasonal rivers, on roadsides and in waste places, mainly in tropical seasonal vegetation but also in forest (Brummitt et al. 2007). In some parts of the world the species prefers typical savanna habitats, exposed rocky slopes, disturbed sites, grasslands and rarely in moister habitats such as dense thickets and forests (Randell 1990; EWA 2016). In other areas where it has been introduced, the species is regarded as a minor weed or potential environmental weed that has escaped cultivation (EWA 2016). Females of the carpenter bee, *Xylocopa pubescens* Spinola, are known to exclusively pollinate species of *Senna* and *Cassia* (Dulberger 1981).

According to the National Environmental Management: Biodiversity Act (2004), *Senna didymobotrya* is a declared category 1b invader in the Eastern Cape, KwaZulu-Natal, Limpopo, Mpumalanga and Western Cape provinces. Category 1b means that the species must be controlled and, wherever possible, removed and destroyed, and that any trade or planting is strictly prohibited. The species was probably introduced to South Africa as an ornamental and hedging plant. Its robust growth habit and rapid, easy seed germination give it a competitive advantage over indigenous species allowing it to form dense impenetrable thickets (Figure 2) that impede the growth and regeneration of native plants and affects the movement of wildlife. In some parts of its native range, *Senna didymobotrya* can be a bush encroacher especially in disturbed areas such as overgrazed land.

Description (compiled from specimens examined in the National Herbarium, Pretoria, and based on Brenan 1967; Irwin & Barneby 1981; Brummitt et al. 2007).—Shrub, 1–4(6) m tall or more, evergreen, unarmed, unpleasant smelling when fresh. *Branchlets* dark brown, mostly ascending, sparsely pubescent, with scattered, inconspicuous glandular hairs. *Stems* cylindrical, straight; young stems pubescent, sometimes villous. *Leaves* paripinnate; stipules (7)12–20 × 5–13 mm, broadly ovate, cordate at base, acuminate at apex, palmately veined from the broad base; persistent; petioles 17–40(85) mm long, pubescent; rachis 150–270(300) mm long, pubescent to pilose; brownish to dark purplish-red hairs between leaflet pairs, without extrafloral nectaries; petiolules 1–2 mm long; leaflets in 14–18 pairs, spaces 8–20 mm apart along rachis, opposite, 21–55(60) × 10–20 mm, oblong, slightly oblique at base, margins entire, acute and mucronate at apex, mucro 1–3 mm long, pinnately veined with midrib raised on lower surface, pubescent on both sides. *Inflorescence* a dense axillary raceme, axis 220–340 mm long, 14–55-flowered, densely pubescent and glandular hairy, peduncle 35–70 mm long; bracts present in bud, falling before anthesis, 10–16(20) × 8–13 mm, dark brown to dark olive brown, broadly ovate, pubescent, base cordate, apex acute, apiculate. *Flower* bisexual, slightly bilateral,



FIGURE 2.—*Senna didymobotrya* at Mokopane in Limpopo: a and b, in habitat; c, flowers and fruits; d, plants form dense thickets. Photographs: T.P. Jaka.

14–18 mm across, cup-shaped; nectar-producing receptacle below ovary. *Sepals* 5, unequal 12–15 × 4.5–7.0 mm, obovate to elliptic, narrower from outermost to innermost sepal, dark yellowish green to brownish yellow-green, light yellow-green on margins and tip, apically rounded, lower surface puberulent, somewhat glandular. *Petals* 5, bright yellow, cupuliform, with prominent darker (pinnate) veins particularly when dry, shortly clawed up to 1.6 mm, (14)20–25 × 10–14 mm, standard petal somewhat wider, broadly oblong to obovate, glabrous. *Stamens* 10, free, heteromorphous, 7 fertile, 3 probably sterile staminodes, filaments 2.0–2.8 mm long, greenish at base grading to yellow above, anthers 5–10 mm long. *Ovary* 12 mm long, densely pubescent; stipe ± 5 mm long; style ± 12.5 mm long, glabrous. *Pods* blackish or dark brown, 80–110 × 19–24 mm, oblong, corrugated on the flat surface, very tardily dehiscent along both sutures, shortly pubescent and foul-smelling, not winged. *Seeds* slightly oblong, tapered at base, dull brown, 7–9 × 3.6–5.0 mm, flattened, apiculate at proximal end, with narrowly obovate to oblong areole in the centre of each face, hilum laterally sub-basal. Flowering time: all year in South Africa. Plate 2329.

REFERENCES

- BAKER, E.G. 1911. Contributions to the Flora of Gazaland. *Journal of the proceedings of the Linnean Society Botany* 40: 62.
- BAKER, E.G. 1930. *Leguminosae of Tropical Africa*. Erasmus Press, Ghent.
- BOTANICAL DATABASE OF SOUTHERN AFRICA (BODATSA). 2016. *Senna didymobotrya*. South African National Biodiversity Institute, <http://newposa.sanbi.org/sanbi/Explore>. [Accessed 17 March 2017].
- BRENAN, J.P.M. 1967. Leguminosae: subfamily Caesalpinioideae. In E. Milne-Redhead & R.M. Polhill (eds), *Flora of Tropical East Africa* 2: 66–68.
- BRENAN, J.P.M. & GREENWAY, P.J. 1949. *Checklist of the forest trees and shrubs of the British Empire* 5: Tanganyika Territory (part 2). Imperial Forest Institute, Oxford.
- BRUMMITT, R.K., CHIKUNI, A.C., LOCK, J.M. & POLHILL, R.M. 2007. Leguminosae subfamily Caesalpinioideae. *Flora zambesiaca* 3(2): 144–152.
- DE WILDEMAN, E.M. 1902. Études Sur La Flore du Katanga. *Annales du Musee du Congo (Belge). Botanique* 1(4–2): 49, t. 16, fig. 6–11. Brussels.
- DRUMMOND, R.B. 1975. A list of trees, shrubs and woody climbers indigenous or naturalised in Rhodesia. *Kirkia* 10,1: 243.
- DULBERGER, R. 1981. The floral biology of *Cassia didymobotrya* and *C. auriculata* (Caesalpinaceae). *American Journal of Botany* 68: 1350–1360.
- DU PUY, D.J., LABAT, J.N., RABEVOHITRA, R., VILLIERS, J.F., BOSSER, J. & MOAT, J. 2002. *The Leguminosae of Madagascar*. Royal Botanic Gardens, Kew.
- ENVIRONMENTAL WEEDS OF AUSTRALIA. 2016. *Senna didymobotrya*: http://keyserver.lucidcentral.org/weeds/data/media/Html/senna_didymobotrya.htm. [Accessed 10 June 2016].
- FOXCROFT, L.C. & RICHARDSON, D.M. 2003. Managing alien plant invasions in the Kruger National Park, South Africa. In L. Child, J.H. Brock, G. Brundu, K. Prach, P. Pyšek, P.M. Wade & M. Williamson (eds), *Plant Invasions: Ecological Threats and Management Solutions*: 385–404. Backhuys Publishers, Kerkwerpe.
- FRESEN, J.B.G.G.W. 1839. Flora oder Botanische Zeitung: welche Recensionen, Aufsätze, Neuigkeiten und Nachrichten, die Botanik betreffend, enthält /herausgegeben von der Königl. Botanischen Gesellschaft in Regensburg 22,1: 53.
- GERMISHUIZEN, G., MEYER, N.L., STEENKAMP, Y. & KEITH, M. (eds). 2006. *A checklist of South African plants*. South African Botanical Diversity Network Report No. 41. SABONET, Pretoria.

- GLOBAL BIODIVERSITY INFORMATION FACILITY. 2016. Available at: <http://www.gbif.org/species/2957556>. [Accessed 2 July 2016].
- GORDON-GRAY, K.D. 1977. *Cassia*. In J.H. Ross (ed.), *Flora of southern Africa* 16,2: 79.
- HARMS, H. 1915. Die Pflanzenwelt Afrikas. In A. Engler. *Die Vegetation der Erde* 3,1: 498.
- HENDERSON, L. 2001. *Alien weeds and invasive plants: a complete guide to declared weeds and invaders in South Africa*: 208. Plant Protection Research Institute, Agricultural Research Council, Pretoria.
- INVASIVE SPECIES SOUTH AFRICA. 2016. Peanut butter cassia (*Senna didymobotrya*). Available at: <http://www.invasives.org.za/legislation/item/344-peanut-butter-cassia-senna-didymobotrya>. [Accessed 29 June 2016].
- IRWIN, H.S. & BARNEBY, R.C. 1981. Tribe 2. Cassiae Bronn (1822). In R.M. Polhill & P.H. Raven (eds), *Advances in legume systematics* 1: 97–106. Royal Botanic Gardens, Kew.
- IRWIN, H.S. & BARNEBY, R.C. 1982. The American Cassiinae. *Memoirs of the New York Botanical Garden* 35: 1–918.
- IRWIN, H.S. & TURNER, B.L. 1960. Chromosomal relationships and taxonomic considerations in the genus *Cassia*. *American Journal of Botany* 47: 309–318.
- LOCK, J.M. 1989. *Legumes of Africa: a checklist*. Royal Botanical Gardens, Kew.
- MARAZZI, B., ENDRESS, P.K., DE QUEIROZ, L.P. & CONTI, E. 2006. Phylogenetic relationships within *Senna* (Leguminosae, Cassiinae) based on three chloroplast regions: patterns in the evolution of floral symmetry and extrafloral nectaries. *American Journal of Botany* 93: 288–303.
- MARAZZI, B. & SANDERSON, M.J. 2010. Large-scale patterns of diversification in the widespread legume genus *Senna* and the evolutionary role of extrafloral nectaries. *Evolution* 64(12): 3570–3592.
- MENDONÇA, F.A. & TORRE, A.R. 1956. *Cassia* L. In A.W. Exell & F.A. Mendonça. *Conspectus Florae Angolensis [Balsaminaceae], Leguminosae (Caesalpinioideae-Mimosoideae)* 2: 177.
- MINING, J., LAGAT, Z.O., AKENGA, T., PARUS, P., IMBUHA, M. & TSANUO, M.K. 2014. Bioactive metabolites of *Senna didymobotrya* used as biopesticide against *Acanthoscelides obtectus* in Bungoma, Kenya. *Journal of Applied Pharmaceutical Science* 4(9): 56–60.
- NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT 10/2004. 2004. Alien and Invasive Species Regulations. Department of Environmental Affairs, South Africa. Available at: https://www.environment.gov.za/sites/default/files/legislations/nemba10of2004_alienandinvasive_speciesregulations.pdf. [Accessed 20 June 2016].
- NKONKI, T., GLEN, H.F., SWELANKOMO, N., JORDAAN, M., GERMISHUIZEN, G. & MOTEETEE, A.N. 2003. Fabaceae. In G. Germishuizen & N.L. Meyer (eds), *Plants of southern Africa: an annotated checklist*. *Strelitzia* 14: 497–549. National Botanical Institute, Pretoria.
- OLIVER, D. 1871. Leguminosae. *Flora of Tropical Africa* 2 (Leguminosae to Ficoideae). Reeve, London.
- ORWA, C., MUTUA, A., KINDT, R., JAMNADASS, R. & ANTHONY, S. 2009. Agro Forest Tree Database: a tree reference and selection guide version 4.0. Available at: http://www.worldagroforestry.org/output?field_type_tid=63. [Accessed 10 May 2016].
- POOLEY, E. 1993. *Complete field guide to trees of Natal; Zululand and Transkei*. Natal Flora Publication Trust, Durban.
- RANDELL, B.R. 1990. Revision of the Cassinae in Australia. 3 *Senna* Miller sect. *Senna*. *Journal of Adelaide Botanical Garden* 13: 1–16.
- RESENDE, K.F.M., DAVIDE, L.C. & TORRES, G.A. 2013. Chromosome number and meiosis in populations of *Senna* species (Caesalpinioideae – Fabaceae) from Southeast Brazil. *International Journal of Cytology, Cytosystematics and Cytogenetics* 66,1: 1–5.
- ROSS, J.H. 1972. Flora of Natal. *Botanical Survey Memoir* 39. Government Printer, Pretoria.
- SOUTHERN AFRICAN PLANT INVADERS ATLAS (SAPIA) DATABASE. 2016. *Senna didymobotrya*. Agricultural Research Council, Plant Protection Research Institute, Pretoria.
- STEYAERT, R. 1952. Cassieae. *Flora du Congo Belge et du Ruanda-Urundi* 3: 504 (fig. 36).
- TABUTI, J.R.S. 2007. *Senna didymobotrya* (Fresen.) H.S.Irwin & Barneby. In G.H. Schmelzer & A.

- Curib-Fakim (eds), *Prota* 11,1: Medicinal plants/Plantes médicinales 1 [CD-Rom]. PROTA, Wageningen.
- TAUBERT, P. 1895. Tribus: Cassieae. In A. Engler, *Die pflanzenwelt Ost-Africas und der Nachbargebiete*: 201.
- TUCKER, S.C. 2003. Floral development in legumes. *Plant Physiology* 131,3: 911–926.
- WHITE, F. & ANGUS, A. 1962. *Forest Flora of Northern Rhodesia*. Oxford University Press, London.

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