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On the identity and status of *Desmanthus* (Leguminosae, Mimosoid clade) in Macaronesia

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Abstract

ON THE IDENTITY AND STATUS OF *DESMANTHUS* (LEGUMINOSAE, MIMOSOID CLADE) IN MACARONESIA.— In this paper, the identity and degree of naturalization of *Desmanthus* (Leguminosae, Mimosoid clade) in the Canary Islands (Gran Canaria, Fuerteventura) and Cape Verde (Santo Antão, São Vicente) are critically re-assessed. The study of morphological features of the plant material sampled allowed to conclude that all specimens must be assigned to *D. pernambucanus*, instead of *D. virgatus* as previously thought. Previous records for *D. virgatus* from Macaronesia still require confirmation but are probably all erroneous. *D. pernambucanus* is well-established and the number of populations is increasing in the studied area. The species can be classified as an environmental weed or even as a transformer species in natural habitats, often *barrancos*. The results also show that the distinction between *D. pernambucanus* and *D. virgatus* is not always clear-cut and that for an accurate identification the study of living material usually is required.

Key words: *Desmanthus pernambucanus*; *Desmanthus virgatus*; Fabaceae; identification; invasive species.

Resumen

SOBRE LA IDENTIDAD Y EL ESTATUS DE *DESMANTHUS* (LEGUMINOSAE, CLADO MIMOSOIDEAE) EN MACARONESIA.— En este artículo se reevalúa la identidad y grado de naturalización del género *Desmanthus* (Leguminosae, clado Mimosoideae) en diversas áreas de las Islas Canarias (Gran Canaria, Fuerteventura) y de Cabo Verde (Santo Antão, São Vicente). El estudio de los caracteres morfológicos del material vegetal permitió concluir que todos los especímenes deben ser asignados a *D. pernambucanus*, en lugar de a *D. virgatus*, como se pensaba hasta ahora. Los registros previos de *D. virgatus* para Macaronesia requieren confirmación, pero posiblemente sean todos erróneos. *Desmanthus pernambucanus* está bien establecido en la zona estudiada y el número de poblaciones se está incrementando. La especie puede ser clasificada como “mala hierba alóctona” o, incluso, como una especie transformadora en hábitats naturales, especialmente en barrancos. Los resultados también muestran que no siempre está clara la distinción entre *D. pernambucanus* y *D. virgatus* y que, generalmente, el estudio de material vivo es necesario para una identificación precisa.

Palabras clave: *Desmanthus pernambucanus*; *Desmanthus virgatus*; especies invasoras; Fabaceae; identificación.

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INTRODUCTION

Desmanthus Willd. (bundleflower) is, in its current circumscription, an exclusively New World genus with 24 representatives (Luckow, 1993). The center of diversity of the genus seems to be in Mexico where 14 species occur, seven of which are endemic. Several species are grown as cover crops, fodder or pasture species (e.g. Gardiner *et al.*, 2013) and at least one, *Desmanthus pernambucanus* (L.) Thell., has become a pantropical weed (Mabberley, 2008). This species naturally occurs in the Caribbean (most islands, including Bermuda, Bahamas, Cuba, Hispaniola, Puerto Rico, Virgin Islands, Guadeloupe, Anguilla, St. Kitts, Montserrat, Antigua, Martinique, Barbados, Grenada, Tobago and Trinidad) and is also known from South America (Guyana, Surinam, and in coastal areas in northeastern Brazil). It is widely introduced and naturalized elsewhere, including on islands in the Pacific and Indian Ocean, in South Africa, southeastern Asia and southeastern USA (Florida) (Luckow, 1993). In its area of origin, *D. pernambucanus* is usually found along moist roadsides and ditches, in abandoned pastures, coastal thickets and at the edges of marshes (Luckow, 1993). A very similar species, *Desmanthus virgatus* (L.) Willd., has an even wider natural distribution and ranges from Texas and Florida in the USA., across eastern and southern Mexico, Central America and the Caribbean to South America. It grows in often heavily disturbed habitats such as railroad tracks, pastures, roadsides, coastal thickets and on beaches (Luckow, 1993).

The taxonomy of the genus is particularly challenging and this is most notable in the *D. virgatus* complex. In her monograph of *Desmanthus*, Luckow (1993) resolved many taxonomic problems in the genus. The detailed cladistic and morphometric analyses shed new light on species relationships. For instance, it became clear that *D. virgatus*, the species with the most extensive native distribution in the complex, has widely been confused with *D. pernambucanus*. Claims of it from the Old World (sub-) tropics turned out to be mostly referable to the latter. Since the publication of Luckow's monograph, several regional data recording *D. virgatus* as a weed have been corrected, e.g. in Hawaii (Wagner & Herbst, 1995), Australia and South Africa (Cook *et al.*, 2005) and China (Wu & Nielsen, 2010).

Linnaeus (1753) distinguished both (as *Mimosa pernambucana* L. and *Mimosa virgata* L. respectively) based on stamen number: flowers pentandrous in

D. pernambucanus, while decandrous in *D. virgatus*. However, this is a variable character and both species can have either ten (usually) or five (rarely) stamens (Luckow, 1993). Moreover, both were shown to be only remotely related (Luckow, 1993). Species of the *D. virgatus* group [*Desmanthus glandulosus* (B. L. Turner) Luckow, *Desmanthus pubescens* B. L. Turner and *D. virgatus*] were characterized by upward nyctinastic pinnae movements while pinnae move downward in *D. pernambucanus*. The latter belongs to the *Desmanthus acuminatus* group, along with *D. acuminatus* Benth., *Desmanthus paspalaceus* (Lindman) Burkart—probably its closest relative—and *Desmanthus tatyuhensis* Hoehne. A synapomorphic trait of this group is seen in the fruits in which sutural ridges roll back longitudinally over the valves; after dehiscence the valves are thus slightly concave. Molecular data presented by Pengelly & Liu (2001) are congruent with the findings of Luckow (1993). Out of 284 accessions representing 11 species, *D. pernambucanus* was the only species with representatives from regions other than the Americas, suggesting that this species has the capacity to colonize new regions. They concluded that many of the reports of *D. virgatus* in extensive regions of the tropics may be *D. pernambucanus*.

In parts of Macaronesia, a collection of four archipelagos in the North Atlantic Ocean off the coast of the continents of Europe and Africa, a species of *Desmanthus* was formerly introduced for forage and subsequently became naturalized. It has usually been referred to as *D. virgatus* (e.g. Hansen & Sunding, 1993; Vidigal, 1996). However, one of the earliest introductions from the Americas in the Jardín de Aclimatación de la Orotava in Tenerife, Canary Islands, was named as "*Mimosa pernambucana*", the basionym of *Desmanthus pernambucanus* (A. Reyes-Betancort, pers. comm., January 2017). Although *Desmanthus* was already considered an annoying weed in plant nurseries in Gran Canaria in the 1970's (e.g. in Tafira and Santa Lucía, see Kunkel, 1972a; sub *D. virgatus*) it long remained localized and restricted to anthropogenic habitats, mostly as a garden weed. In the Canary Islands it was also reported from Fuerteventura (Kunkel, 1972b, 1977; Scholz *et al.*, 2013). It was not included in a list of naturalized and potentially invasive species in the Canary Islands (Sanz-Elorza *et al.*, 2005), while Hohenester & Welss (1993) accepted it as an escape of cultivation. In this paper the distinguishing features of both species are critically discussed. In addition,

the current status of *Desmanthus* in Macaronesia is re-assessed.

MATERIALS AND METHODS

Numerous herbarium specimens of *Desmanthus pernambucanus* and *D. virgatus* were examined from the following herbaria: BR, LG, LPA, ORT, SPF and SPSC (herbarium acronyms according to Thiers, 2017). These included specimens collected in the study area as well as from various other regions of the world, several of them cited by Luckow (1993) in her monographic study of the genus.

Field work was conducted by the first author in Gran Canaria in 2011, 2012, 2015 and 2017. In order to accurately assess seedling type and nyctinastic leaf movements, seeds obtained in the field in Gran Canaria were grown in the laboratory.

RESULTS AND DISCUSSION

According to Luckow (1993), *Desmanthus pernambucanus* differs from *D. virgatus* in several respects. However, as shown in Table 1, most of the distinguishing features that can be observed in herbarium

specimens, such as stipules indumentum or number of pinnae pairs per leaf, overlap or do not clearly separate the two species. Also, leaflet base shape usually can be used to set *D. pernambucanus* and *D. virgatus* apart, but particularly in specimens of *D. pernambucanus*, square-oblique and rounded-oblique bases are sometimes seen on the same individual [e.g. *Brace 4325* (SPSC), from Bahamas]. Habit also appears to be variable in both species (Table 1). Among features that are observable on pressed specimens, the particular morphology of fruiting valves during dehiscence (valves slightly concave vs. rather convex; Table 1) remains as a marked difference between *D. pernambucanus* and *D. virgatus*.

All individuals seen from the Atlantic islands are homomorphic: plants are relatively robust with usually erect stems up to 2 m tall; stipules are nearly always markedly pubescent; extra-floral nectaries are very conspicuous, the largest wider than the petiole on which they sit; petioles of mature leaves are distinct, the longest up to 20+ mm long, leaflets have square-oblique bases and fruiting valves tend to become concave at maturity. In addition, based on plants grown from seed collected in the Canary Islands (Gran Canaria) some other important traits were observed: the hypocotyl elongates markedly in seedlings and at night pinnae move downward while petioles

Table 1. Distinguishing features for *Desmanthus pernambucanus* and *D. virgatus* (based on Luckow, 1993 and observations of the first author in the field in Gran Canaria as well as in the laboratory).

	<i>Desmanthus pernambucanus</i>	<i>D. virgatus</i>	Macaronesia specimens
Habit	Erect or decumbent and scrambling	Prostrate, decumbent, more rarely erect	Usually erect, rarely decumbent and scrambling
Nyctinastic leaf movements	Pinnae move downward, petiole remains stationary	Pinnae and petiole move upward	Pinnae move downward, petiole remains stationary
Color of foliage (when fresh)	Yellow-green	Glaucous (blue-green)	Green, not glaucous
Stipules	Usually puberulent	Glabrous, or pubescent	Puberulent
Pinnae number per leaf	2–4 pairs	2–5 pairs	2–4(–6) pairs
Leaf petiole size	6–16 mm long	1–5 mm long	6–20+ mm long
Leaflet base	Rounded-oblique	Square-oblique	Square-oblique
Nectary	1–2.6 mm wide, the largest wider than petiole	0.3–1.2 mm wide, at most as wide as petiole	1–2.6 mm wide, the largest wider than petiole
Legume	Sutural ridges curling back over the valves causing the inner surface of the pods to be slightly concave	Valves becoming convex rather than concave	Valves concave
Seedling type	Hypocotyl elongates markedly	Hypocotyl does not elongate at all	Hypocotyl elongates markedly

remain stationary. All these features, except for leaflet base shape, are characteristic of *D. pernambucanus*. Seedling morphology and nyctinastic leaf movement patterns were decisive in excluding *D. virgatus* as occurring in Macaronesia.

Desmanthus pernambucanus (L.) Thell., Fl. Adv. Montpellier: 296 (1912) (Figs. 1–3, Table 1).
 ≡ *Mimosa pernambucana* L., Sp. Pl.: 1: 519 (1753).

Description (mostly based on specimens seen from Macaronesia): A subshrub, 0.5–1(2) m tall. Stems slender, erect or decumbent, few branched, glabrous or more often slightly hairy, somewhat angular (especially when young). Leaves greenish (not glaucous), alternate, bipinnate, with 2–4(6) pairs of pinnae, each pinna 1–2.5(5) cm long, with 6–21 pairs of leaflets; leaflets linear-oblong to obovate, 4–7 × 0.7–1.6(2) mm, apex abruptly acute, base truncate (square oblique), asymmetric; stipules 3–7 mm long, puberulent, linear; petiole (3.6)4.8–16(20+) mm long, glabrous or hairy, with a nectar gland between the lowest pair of pinnae, this round or elliptic cup-shaped, 1–2.6 mm across. Inflorescence a fascicle of axillary, pedunculate heads, each *ca.* 7–10 mm across, peduncle 1–4.5 cm long; each head with (4)8–13(30) florets; bracteoles ovate, 1–2 mm long; florets sessile, white-green; calyx tubular, with 5 lobes, 2–2.5 mm long; petals 5, free, ovate, apex acute, 3–4 mm long; stamens 10 (rarely 5), free, white, filaments 5 mm long, anthers 1 mm long; ovary linear-oblong, about 2 mm long; style 2.5–3 mm long; stigma truncate. Fruit a dehiscent, linear, flat, erect to very slightly curved, red-brown pod, 4–8.5(11) × 0.3–0.4 cm, the margins thickened with sutural ridges curling back over the valves (valves slightly concave at maturity), the apex beaked. Seeds *ca.* 10–20+ per pod, rhomboid, 2.4–3.2 mm long, reddish brown to nearly black, striate (a very detailed description is provided by Luckow, 1993).

Distribution (see also Appendix): In the Canary Islands collections were seen from Gran Canaria and Fuerteventura. In the Cape Verde Islands its presence is here confirmed from Santo Antão and São Vicente. Claims of *Desmanthus virgatus* from São Nicolau, Boavista, Maio, Santiago and Brava (Vidigal, 1996; Diniz *et al.*, 2002) require confirmation; all are probably also referable to *D. pernambucanus*. A picture of a seedling in Diniz *et al.* (2002) shows an elongated hypocotyl and

clearly refers to *D. pernambucanus*, not to *D. virgatus*. It is worth mentioning that, also in the Macaronesian Region, there are two recent citations of “*Desmanthus virgatus*” from Madeira in the GBIF database (<https://www.gbif.org/occurrence/921427717>, <https://www.gbif.org/occurrence/921468911>). These claims should be critically re-assessed. *Desmanthus* was not yet reported from Madeira in recent floras and checklists (Press *et al.*, 1994; Silva Vieira, 2002; Borges *et al.*, 2008) and probably is a recent introduction there.

Habitat (Fig. 4): In the Canary Islands it is found in anthropogenic (roadsides, gardens, etc.) as well as natural (seasonally dry, gravelly river beds) habitats. In the Cape Verde Islands it is mostly recorded on stony slopes and as a weed in agricultural fields and pastures (Vidigal, 1996).

Status in Macaronesia: In recent years *Desmanthus pernambucanus* was found in Gran Canaria on many occasions and in several different parts of the island, in the arid south as well as in the more humid northern regions. It is particularly common in the seasonally dry, gravelly river bed of the barranco de Arguineguín, at least between Arguineguín and Los Peñones, a stretch of about 12 kilometers in a relatively remote, little disturbed area. It forms dense, often nearly monospecific stands or is accompanied by invasive aliens such as *Aca-cia farnesiana* (L.) Willd., *Cyperus involucratus* Rottb., *Dysphania anthelmintica* (L.) Mosyakin & Clemants or *Pennisetum setaceum* (Forssk.) Chiov. Other aliens found in close proximity are: *Ageratina adenophora* (Spreng.) R. M. King & H. Rob., *Argemone ochroleuca* Sweet, *Cladium jamaicense* Crantz, *Datura inoxia* Mill. and *Symphytotrichum squamatum* (Spreng.) G. L. Nesom. At least in this area and in the sense of Richardson *et al.* (2000), *Desmanthus pernambucanus* can be classified as an environmental weed or even as a transformer species (a taxon that has clear ecosystem impacts, for instance as an excessive user of resources such as water and light). Similar stands, but on a more local scale, have been observed in other barrancos in southern Gran Canaria, for instance in Barranco del Negro near Maspalomas. A future expansion into other suitable habitats is predicted. In Fuerteventura, its presence in the Jandía area has been confirmed recently, although until now it seems to be restricted to disturbed habitats.



Figure 1. General habit of *Desmanthus pernambucanus*. Stems are erect and foliage green, not glaucous (Maspalomas, April 2017; photograph: F. Verloove).



Figure 2. Detail of flowers of *Desmanthus pernambucanus* (Maspalomas, April 2017; photograph: F. Verloove).



Figure 3. Legumes of *Desmanthus pernambucanus* in a vegetation with *Cyperus involucreatus* and other invasive species (Arguineguín, November 2011; photograph: F. Verloove).

In the Cape Verde Islands the oldest collections cited by Vidigal (1996) date from the 1950's but it was certainly introduced long before that. At the time of Schmidt (1852) it was probably already cultivated for forage, but Coutinho (1914) reported its first occurrence in the wild. Two decades later Chevalier (1935) reported it as already present on several different islands and, today, it is a naturalized invasive species in pastures and on rocky slopes (Vidigal, 1996). Moreover, it is a noxious weed in agricultural fields, for instance in crops of maize (e.g. Jansen, 1993; Diniz *et al.*, 2002).

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Figure 4. Habitat invaded by *Desmanthus pernambucanus* in Gran Canaria (Arguineguín, November 2011; photograph: F. Verloove).

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Appendix. Specimens examined from the study area.

Desmanthus pernambucanus (L.) Thell.: Cabo Verde, Santo Antão: Ribeira de Torre, cumbres de Ribeirinha Curta, Delgadin – bordes del Pedregal, 750–800 m.s.m., 25°05'00" O – 17°08'50" N, riscos y bordes de carretera, 11.07.2004, *A. Marrero and R. Almeida* (LPA 8004); Caibros, chemin, alt. 250 m, 04.03.2007, *J. Bouharmont 35501* (BR). São Vicente, Monte Verde (massif culminant de l'île), bord de chemin, en bordure d'un groupement frutescent sur lave, près du sommet, alt. env. 720 m, 20.08.2008, *J. Lambinon 08/CV/21* (BR, LG). Spain, Canary Islands: Fuerteventura, El Matorral (Jandía), borde de paseo marítimo, 21.08.2008, *S. Scholz* (ORT 40540); Pájara, Saladar de Jandía, 3 m, 25.04.2014, *C. Samarín and E. Ojeda-Land* (ORT 46203). Gran Canaria, Las Palmas de Gran Canaria, confluencia Barranquillo Don Zoilo con Paseo del Chil, UTM 28R DS 578 104, 30 m.s.m., espontáneo en parterres, 03.07.2009, *A. Marrero* (LPA 26637, LPA 26639); Las Palmas de Gran Canaria, laderas del Parque Doramas a Altavista, UTM 28R DS 577

105, 65 m.s.m., espontáneo en laderas ajardinadas, 03.07.2009, *A. Marrero* (LPA 26641, LPA 26642); San Agustín, Playa del Águila, plantation weed, 06.11.2011, *F. Verloove 9971* (BR); San Agustín, dry talus slope, common, 06.11.2011, *F. Verloove 9972* (BR); Arguineguín, barranco de Arguineguín, GC500 +/- km 5–6, dry gravelly riverbed, very invasive weed, 10.11.2011, *F. Verloove 9969* (BR); Arguineguín towards Soria, barranco de Arguineguín, GC500 km 4-8, dry gravelly riverbed, very invasive, 12.11.2012, *F. Verloove 9910* (BR, LPA 30177, LG); Las Palmas de Gran Canaria, Vega de San José, plantation weed, 15.11.2015, *F. Verloove 12070* (SPSC); Pedraza, barranco del Negro, dry river bed, invasive weed, 17.11.2015, *F. Verloove 12095* (SPSC); Maspalomas, Av. Touroperator Tjaereborg, dry rough ground, common, 30.03.2017, *F. Verloove 12793* (BR); Maspalomas, right bank of barranco de Fataga N of Av. Alejandro del Castillo, river bank, ruderal, common, 2.04.2017, *F. Verloove 12801* (BR); Pasito Blanco, close to the entrance of camping, roadside, ca. 20 fruiting individuals and many seedlings, 03.04.2017, *F. Verloove 12807* (BR).