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, MIMOSOIDEAE) 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. *Desmanthus 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.
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 Bentham, Desmanthus pascalaeus (Lindman) Burkart—probably its closest relative—and Desmanthus tatuyhensis 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 “Mimosapernambucana”, 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 Hohenerste & 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 pinnæa 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 pinnæa move downward while petioles...

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**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).

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


**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 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; Silvia 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 *Acaicia farnesiana* (L.) Willld., *Cyperus involucratus* Roth., *Dysphania anthelmintica* (L.) Mosyakin & Clemants or *Pennisetum setaceum* (Forssk.) Chiov. Other aliens found in close proximity are: *Ageratinha adenophora* (Spreng.) R. M. King & H. Rob., *Argemone ochroleuca* Sweet, *Cladium jamaicense* Crantz, *Datura inoxia* Mill. and *Symphyotrichum 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.
Identity and status of Desmanthus in Macaronesia

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).
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).
Identity and status of *Desmanthus* in Macaronesia


Appendix. Specimens examined from the study area.