

***Dipteracanthus chichesterensis* (Acanthaceae: Ruellieae), a new geographically and edaphically restricted species from the Pilbara bioregion of Western Australia**

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Abstract

Trudgen, M.E., de Kock, P-L. & Barrett, R.L. *Dipteracanthus chichesterensis* (Acanthaceae: Ruellieae), a new geographically and edaphically restricted species from the Pilbara bioregion of Western Australia. *Nuytsia* 25: 161–170 (2015). *Dipteracanthus chichesterensis* Trudgen & de Kock is described as a new species of Acanthaceae (tribe Ruellieae Dumort.) restricted to the Chichester Plateau in the Pilbara bioregion of Western Australia. The new species is known from five localities and is considered poorly known and of conservation significance. It is most closely related to *D. australasicus* F.Muell., differing in stem and leaf indumentum, pollen ornamentation and seed characteristics. A distribution map, photographs and a key to *Dipteracanthus* Nees taxa currently recognised in Western Australia are provided.

Introduction

Dipteracanthus Nees (Acanthaceae tribe Ruellieae Dumort.) is a small genus of herbs or subshrubs, comprising in Australia three native and one introduced species. The status of the genus is contentious, with many authors regarding it as a section or subgenus of a broadly defined *Ruellia* L. (see Barker 1986; Tripp *et al.* 2013). While the species described here may need to be transferred to *Ruellia* in the future, *Dipteracanthus* is currently accepted as distinct in the Australian Plant Census (Council of Heads of Australasian Herbaria 2007–) and *FloraBase* (Western Australian Herbarium 1998–), and it seems most appropriate to describe it in that genus pending resolution of generic limits in *Ruellia*.

The most recent revisions of the genus in Australia are by Barker (1986, 1996), who recognised six taxa: *D. bracteatus* (R.Br.) Nees, the polymorphic *D. australasicus* F.Muell. with four subspecies (Barker 1986), and a phrase-named taxon, *D. sp.* Kalpowar (D.G.Fell+ DGF2969B). The Indian *D. prostratus* (Poir.) Nees has been subsequently found to be sparingly naturalised in northern Australia (Australia's Virtual Herbarium 2007–). Of these, *D. prostratus* and two subspecies of *D. australasicus* are known from Western Australia.

Dipteracanthus australasicus subsp. *australasicus* is moderately common in the Pilbara bioregion and adjoining areas, and has populations in all other mainland states except Victoria. The Western Australian populations are geographically widely disjunct from those in the eastern states. *Dipteracanthus australasicus* subsp. *corynothecus* (F.Muell. ex Benth.) R.M.Barker occurs on Barrow Island in the Pilbara bioregion and on North West Cape in the Carnarvon bioregion; elsewhere it occurs in widely disjunct localities in the Northern Territory (one location), Queensland and the north-east corner of New South Wales. Western Australian populations are disjunct by *c.* 2,000 km from the nearest populations elsewhere in Australia. The introduced *D. prostratus* is currently only known from the eastern Kimberley region.

The *Dipteracanthus* species described here first came to our attention amongst specimens collected during biological surveys of the Chichester Plateau in the Pilbara bioregion. These specimens were poor, lacking flowers or fruit, but were distinctive enough to warrant further investigation. Examination of *Dipteracanthus* collections at the Western Australian Herbarium found more specimens that appeared to be the same taxon. Like the specimens from recent surveys, these were also of poor quality.

The locations noted from the herbarium specimens were visited in March 2013, to study the new taxon in the field and to collect better quality material. While the new species was not found at the original locations, two new populations were found when other areas of suitable habitat were visited, and good fertile collections were made. Further study of this material, including comparison with eastern Australian taxa and microscopic comparison of its pollen and seeds to the other Pilbara *Dipteracanthus* taxa, confirmed that the taxon is new. It is described here as *D. chichesterensis* Trudgen & de Kock and illustrated in Figure 1.

Methods

The study was based on examination of pressed and dried material held at PERTH, supplemented by observations made in the field. Measurements and descriptions of flowers were based on rehydrated material. Pollen and seeds were mounted using double-sided carbon tape with conductive carbon paint, coated with gold using an EMITECH K550X Sputter Coater and imaged at 15 kVA using a Joel JCM 6000 NeoScope bench-top Scanning Electron Microscope at Kings Park and Botanic Garden.



Figure 1. *Dipteracanthus chichesterensis*. A – plants growing in typical basaltic boulder cracking clay habitat with *Acacia xiphophylla* (Snakewood) dominated vegetation; B – leaves and flower. Images of P-L. de Kock & R. Butler PLDK 1047 by P-L. de Kock.

Leaf and stem indumentum were imaged using a Leica MDG35 microscope fitted with a Leica DFC450 camera. Images were compiled as layers and focus-stacked using Leica Application Suite V3.8.

As very few flowering specimens were available, some measurements are given as approximate, in anticipation that their ranges will increase when more specimens become available. Where comparisons are made to the subspecies of *D. australasicus*, they are made to specimens determined by R.M. Barker and held at PERTH. This was done as material placed under these subspecies at PERTH may be mixed. Comparisons with taxa not represented at PERTH (*D. australasicus* subsp. *dalyensis* R.M. Barker and *glabratus* R.M. Barker, *D. bracteatus*, *D. sp.* Kalpowar) are made based on descriptions in Barker (1986, 1996).

An important aspect of the morphology of *Dipteracanthus* is the indumentum of stem internodes. Stems in all taxa are glabrescent; when indumentum is described it refers to young stems that have not yet aged or weathered. Stems in *Dipteracanthus* are four-sided, with grooves on two of the sides; we refer to the more or less flat sides of the internodes as ‘faces’.

Pollen and seed ornamentation in Western Australian taxa of *Dipteracanthus*

Pollen morphology provides important characters supporting delimitation of genera and subgroups within tribe Ruellieae (see e.g. Scotland 1992; Furness 1994, 1995; Daniel 1998; Tripp 2007; Tripp *et al.* 2013). Pollen exine ornamentation has also been used as a diagnostic tool for the separation of species in *Ruellia s. lat.* (Furness & Grant 1996).

The pollen of the three Pilbara *Dipteracanthus* taxa is spherical with a reticulate or ‘honeycomb’ exine (Figure 2A–C), sometimes referred to as ‘waben pollen’ (Lindau 1893). The reticulations are formed by smooth muri, comprising numerous rod-like elements (columellae) dividing the pollen surface into lumina. The surface of each lumen is composed of a number of small granules (Furness & Grant 1996).

Pollen exine in *D. australasicus* subsp. *australasicus* and *corynothecus* (Figure 2A, C) is similar, being coarsely reticulate with the muri enclosing large lumina. In contrast, *D. chichesterensis* (Figure 2B) has an exine that is much less coarsely reticulated, with the lumina significantly smaller. Additionally, *D. australasicus* subsp. *australasicus* and *corynothecus* lumina have two to three times the number of granules in them compared with *D. chichesterensis* (Figure 2B). The granules in all three taxa are more or less the same size.

Seed morphology is also important for delimiting genera and species in Acanthaceae. All three Pilbara species of *Dipteracanthus* have discoid seeds with a distinct rim formed from a band of trichomes matted with hygroscopic mucilage, the flattened surfaces of the disk being smooth and glabrous. There are distinct differences between the taxa in the width of the trichome band (Figure 2D–F). *Dipteracanthus chichesterensis* (Figure 2E) has the widest band relative to the rest of the seed surface, being more than twice the relative width of the other two taxa. The testa surfaces of the three Pilbara taxa also differ in the shape of the testa cells both near the margins of the testa (adjacent to the trichome band) and away from it (Figure 2G–L). Testa cells in the two *D. australasicus* subspecies are generally elongate with smoothly tapering ends, and only obscurely visible, while in *D. chichesterensis* the cells are more distinct and have relatively blunt ends.

Pollen and seed morphology thus indicate that the two Pilbara *D. australasicus* subspecies are closely related, and support the recognition of *D. chichesterensis* as distinct.

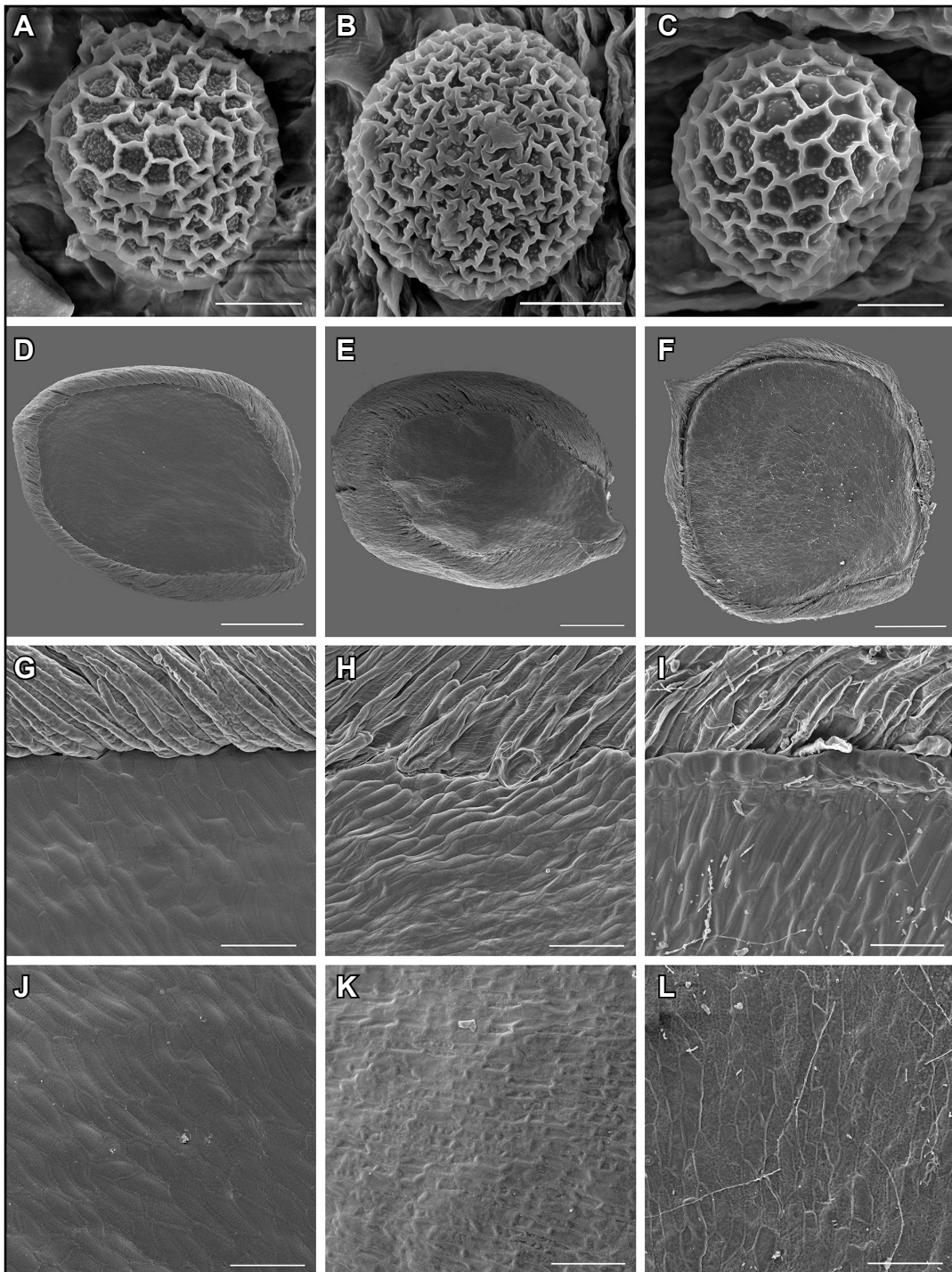


Figure 2. Pollen and seeds of *Dipteracanthus australasicus* subsp. *australasicus* (left column), *D. chichesterensis* (middle column) and *D. australasicus* subsp. *corynothecus* (right column). A–C – pollen grain; D–F – seed in side view; G–I – seed margin; J–L – seed centre surface. Images by R.L. Barrett from R. Butler & S. Colwill BES 00575 (A, D, G, J); P.-L. de Kock & R. Butler PLDK 1040 (B, E, H, K); M.E. Trudgen & P. Jobson MET 23010 (C, F, I, L). Scale bars = 20 μ m (A–C); 1 mm (D–F); 100 μ m (G–L).

Key to taxa of *Dipteracanthus* in Western Australia

1. Capsule pubescent..... ***D. prostratus**
- 1: Capsule glabrous
2. Internode faces glabrous or very sparsely hairy, with the grooves pubescent **D. chichesterensis**
- 2: Internode faces pubescent, or if sparsely hairy, then the grooves not pubescent
3. Abaxial leaf surface pubescent with short and long hairs (rarely absent), the hairs 0.3–1.5 mm long, either 2- or 3-celled and frequently bent with no preferred orientation, or 3–7-celled and spreading **D. australasicus** subsp. **australasicus**
- 3: Abaxial leaf surface sparsely pubescent to pubescent, the hairs 0.2–0.3 mm long, 2- or 3-celled, bent to appressed and mostly retrorse or nearly so **D. australasicus** subsp. **corynothecus**

Taxonomy

Dipteracanthus chichesterensis Trudgen & de Kock, *sp. nov.*

Type: east-north-east of Kenjenjie Outstation on Coolawanyah Station, Western Australia [precise locality withheld for conservation reasons], 14 March 2013, *P.-L. de Kock & R. Butler* PLDK 1040 (*holo*: PERTH 08644969; *iso*: AD, CANB, K, PERTH 08644977, RSA).

Spreading, glabrescent, perennial *subshrubs* to 30 cm tall, with short-lived, quadrangular stems from a perennial rootstock; hairs simple, soft, eglandular, septate, (2–)3–7-celled. Older *stems* with light grey bark; young stems light green or grey-green, the two opposite faces shallowly grooved (the grooved faces alternating at the nodes); internodes pubescent in the grooves, glabrous to sparsely hairy elsewhere, the hairs of two types, retrorse (to 0.26 mm long) and spreading (to 1(–2) mm long); nodes with spreading hairs, less commonly also with retrorse hairs; cystoliths abundant, parallel to stem axis. *Leaves* petiolate; lamina elliptic to ovate, 15–25(–38) mm long, 7–10(–28) mm wide; base tapering; margin entire, somewhat undulate; apex acute to less commonly obtuse; midrib raised on both surfaces; lateral veins ascending, the lower three pairs sub-opposite or alternate, the remainder alternate; surface very sparsely hairy to sparsely pubescent above, sparsely pubescent below, the hairs to 2 mm long, not scabrid; cystoliths present on both surfaces, randomly oriented; petiole 1–2.4 mm long, deeply to shallowly concave above, convex below. *Inflorescences* comprising 1(–2) flowers per axil in the 2–4 uppermost leaf pairs. *Flowers* pedunculate, the peduncle 1.7–5(–9) mm long; *bracteoles* at base of calyx, petiolate, the lamina narrow-elliptic, 6.5–12.3 mm long, lamina glabrous to very sparsely hairy above, sparsely pubescent below; petiole 0.7–1.3 mm long, glabrescent. *Calyx* with a campanulate tube and narrow-acuminate lobes, pubescent; tube 2–3 mm long; lobes 2.5–4(–7) mm long, 0.8–2 mm wide at base. *Corolla* tubular, 22–33 mm long, 5-lobed, with two upper, two lateral and a lower central lobe; tube with a short, cylindrical base 3.5–5 mm long, expanding into a dorsally compressed, broader tubular section 11–21 mm long; lobes spreading, broad- to very broad-elliptic to irregularly oblong, rounded or truncate at the apex, 5–9.5 mm long, mauve, the centre of lower lobe with a pair of creamy yellow, rounded ridges that run down the bottom of the corolla tube to near the base; outside of tube and lobes shortly hairy, the inside hairy along the rounded ridges and style traces. *Stamens* 4, inserted in pairs *c.* 3.5 mm above the top of the short cylindrical base of the corolla tube, each pair with one long and one short filament; filaments sparsely hairy on lower $\frac{1}{4}$ – $\frac{1}{2}$ (hairs extending

along filament trace below insertion) otherwise glabrous; short filaments *c.* 3 mm long; long filaments *c.* 7 mm long; anthers narrow-oblong, 2-celled, white, 2.4–2.9 mm long, attached 0.3–0.5 mm from base; loculi parallel. *Ovary* ovoid, *c.* 2 × 0.9 mm, glabrous, tapering into style; style *c.* 17 mm long (including stigma), pilose with spreading to antrorse hairs; stigma an irregular to lacerated surface on one side of the upper 1.5 mm of the style, included in throat of corolla. *Nectariferous disc* clasping the lower part of the ovary, cup-shaped with a point on one side, *c.* 0.7 mm long. *Ovules c.* 6, superposed in two rows in each cell, on long funicles. *Capsule* glabrous, compressed-ellipsoid with a flattened base and acute tip, *c.* 15 × 6 mm. *Seeds* oval in outline, 3.5–3.8 × 4–5.2 mm, with a distinct rim formed from a band of hairs matted with hygroscopic mucilage, the centres smooth, glabrous, pale tan, the trichome band smooth (and the seed appearing glabrous) when dry; mature seeds held on the ends of prominent, hook-like, lignified funicles (retinacula), the developed ovules usually near the middle of the capsule. *Pollen* spherical with reticulate exine.

Diagnostic characters. *Dipteracanthus chichesterensis* can be uniquely diagnosed among Western Australian *Dipteracanthus* taxa in its combination of leaf surface with an indumentum of sparse, long (to 2 mm), erect hairs, and distinctly glabrous to sparsely hairy internodes with pubescent grooves. In addition, *D. chichesterensis* has the longest peduncle of the Western Australian taxa, up to 9 mm long, with more than half of specimens having peduncles over 6 mm long.

Other specimens examined. WESTERN AUSTRALIA: [localities withheld for conservation reasons] 12 Sep. 1995, *A.A. Mitchell* PRP 775 (PERTH, AD 99610124 *p.p.*); 19 May 1996, *A.L. Payne* PRP 1350 A (PERTH); 28 Mar. 2004, *K. McCreery* BES 00576 (PERTH); 14 Mar. 2013, *P-L. de Kock & R. Butler* PLDK 1041 (AD, BRI, PERTH, RSA); 15 Mar. 2013, *P-L. de Kock & R. Butler* PLDK 1047 (CANB, K, P, PERTH).

Phenology. *Dipteracanthus chichesterensis* was flowering in March 2013 following good rainfall at the new collection localities. It is probable that, like many Pilbara species, it flowers sporadically following significant rainfall events.

Distribution. *Dipteracanthus chichesterensis* is known from only five locations on the Chichester Plateau (Figure 3) in the Chichester subregion (May & McKenzie 2003) of the Pilbara bioregion of Western Australia (Department of the Environment 2014). These locations fall within Beard's (1975) vegetation association Chichester Plateau 175 and the Wona Land System, which has a similar extent, and which is a Priority Ecological Community (Department of Parks and Wildlife 2014). In the Pilbara the range of *D. australasicus* subsp. *australasicus* comes close to that of *D. chichesterensis*, but on available data (Australia's Virtual Herbarium 2007–; Pilbara vegetation dataset of M.E. Trudgen) does not overlap it, although one mixed collection (*A.A. Mitchell* PRP 775) suggests that they may come very close or at times grow together.

Habitat. All known collections of *D. chichesterensis* are from areas of red-brown cracking clay soils associated with basalts on the Chichester Plateau. The collections are from a variety of landforms on the plateau, including slopes, tablelands, benches and creek margins.

All the collections for which vegetation was recorded were from *Acacia xiphophylla* tall shrublands (Figure 1A). Where the understorey was described, it was a *Triodia wiseana* very open hummock grassland with scattered shrubs to an open shrub layer, often with *Senna artemisioides* subsp. *×sturtii*, *S. artemisioides* subsp. *oligophylla*, *Ptilotus* aff. *obovatus* and *Rhagodia eremaea*. Other associated species included *Abutilon fraseri* subsp. *fraseri*, *Boerhavia paludosa*, *Hibiscus brachysiphonius*,

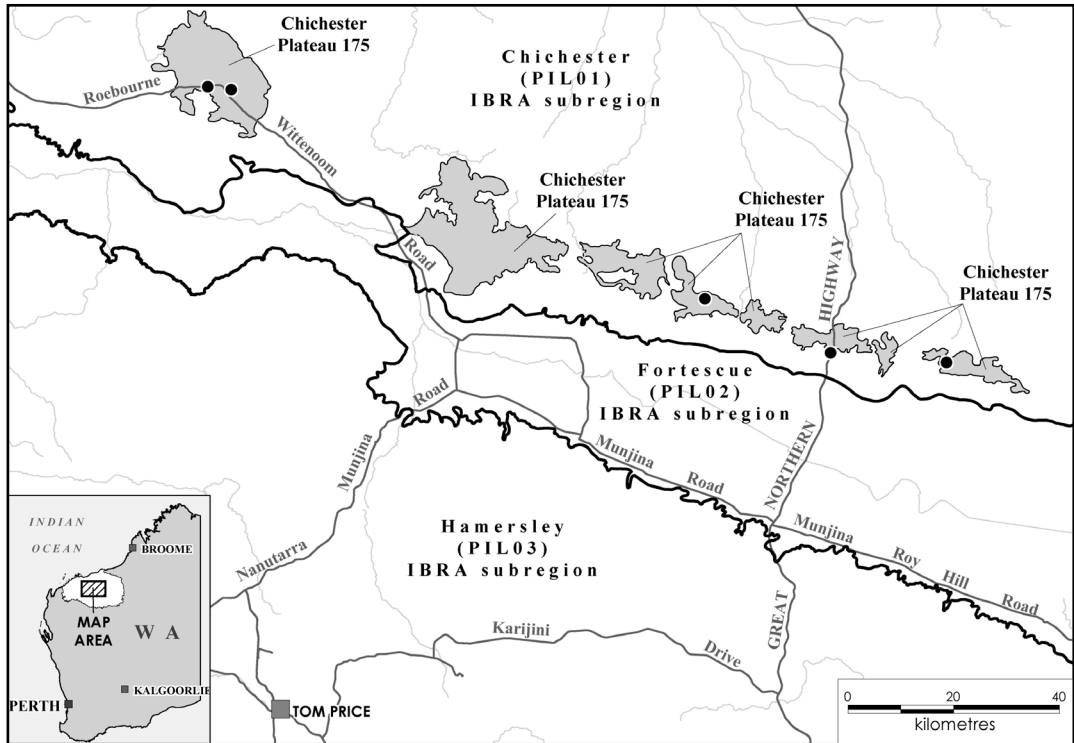


Figure 3. Distribution of *Dipteracanthus chichesterensis* (*) in Western Australia. IBRA subregions (May & McKenzie 2003) and Beard's vegetation association Chichester Plateau 175 (Beard 1975) are also shown. Figure drawn by K. Webster of Biota Environmental Sciences.

Ptilotus gomphrenoides var. *gomphrenoides*, *Rhynchosia minima*, *Sida rohlenae*, *Sida* aff. *fibulifera*, *Stemodia grossa* and *Streptoglossa bubakii*, with grasses *Digitaria brownii*, *D. ctenantha*, *Eriachne obtusa*, *Triodia epactia* and *Urochloa occidentalis*.

In the Pilbara bioregion, *D. australasicus* subsp. *australasicus* usually occurs on loamy to clayey creek banks rather than the cracking clay habitats on slopes and crests where *D. chichesterensis* occurs. These two habitat types have quite different species assemblages driven by their very different soil types. *Dipteracanthus australasicus* subsp. *corynothecus* occurs in Western Australia in areas that have predominantly limestone soils.

Conservation status. To be listed as Priority One under Department of Parks and Wildlife Conservation Codes for Western Australian Flora (A. Jones pers. comm.). *Dipteracanthus chichesterensis* is geographically and edaphically restricted, all five known locations are on active pastoral stations, and the populations appear to be small.

Etymology. The specific epithet refers to the restricted distribution of the new species on the Chichester Plateau.

Notes. *Dipteracanthus chichesterensis* is clearly different from the eastern Australian *D. bracteatus*, which has a white, cream or pale yellow corolla that opens at night and is glabrous internally (Barker 1986) (*cf.* mauve corolla that opens during the day and is hairy internally in *D. chichesterensis*) and from the introduced *D. prostratus* which has prostrate-ascending stems, leaves that are sparingly

strigose above and pubescent capsules (*cf.* erect stems, leaves sparsely pubescent above, and capsules glabrous in *D. chichesterensis*). *Dipteracanthus* sp. Kalpowar is described in Barker (1996), and differs from *D. chichesterensis* in having a branch and petiole indumentum of short, dense, sub-erect hairs obscuring the cystoliths.

In the keys provided in Barker (1986, 1996), *D. chichesterensis* keys to *D. australasicus* subsp. *australasicus*, but clearly differs from that taxon (Table 1). It differs from *D. australasicus* subsp. *glabratus* in its leaf and flower indumentum (subsp. *glabratus* has leaves that are almost glabrous except for sparse, fine, curled, eglandular hairs, and external corolla surface and style glabrous) and from *D. australasicus* subsp. *dalyensis* in stem, leaf and corolla indumentum (subsp. *dalyensis* has stems with a mix of fine, lax, 3–8-celled hairs over shorter, conical hairs, scabrous leaves, and a corolla which is glabrous inside except for very sparse hairs decurrent below the filament insertions).

Apart from the internodes (see key and Table 1), *D. chichesterensis* differs from the two subspecies of *D. australasicus* occurring in Western Australia in abaxial leaf surface indumentum (Figure 4). In *D. chichesterensis* the hairs are long (to 2 mm), patent, and more or less straight, while in *D. australasicus* subsp. *australasicus* they are short (to 0.3 mm) and long (to 1.5 mm), usually inclined and often bent and in subsp. *corynothecus* they are short (to 0.3 mm), usually bent, and often appressed and retrorse. Other external morphological differences between *D. chichesterensis* and the subspecies of *D. australasicus* occurring in Western Australia are given in Table 1, and pollen and seed differences are given in the introduction.

Cleistogamous flowers were not present on any of the specimens examined.

Table 1. Comparison of *Dipteracanthus chichesterensis* with the two subspecies of *D. australasicus* occurring in Western Australia.

Species	Indumentum		Peduncle length	Distribution
	leaf abaxial surface	internode		
<i>D. chichesterensis</i>	Sparsely hairy; hairs 1.2–2 mm, erect (3–7-celled)	Glabrous to sparsely hairy on faces, pubescent in grooves; hairs short & bent to long spreading 0.2–1(–2) mm	1.7–9 mm more than half of specimens > 6 mm	Chichester Plateau in the Pilbara bioregion
<i>D. australasicus</i> subsp. <i>australasicus</i>	Pubescent; hairs short & bent to long spreading 0.3–1.5 mm (2–5-celled)	Pubescent on faces and in grooves; hairs short & bent to long spreading 0.2–1 mm	0.5–4 mm in Pilbara material to 6 mm in eastern states material	Fortescue Valley, Hamersley Range, Ophthalmia Range in the Pilbara bioregion and south into adjoining parts of the Gascoyne bioregion
<i>D. australasicus</i> subsp. <i>corynothecus</i>	Pubescent; hairs short & bent to 0.2–0.3 mm (2- or 3-celled)	Pubescent on faces and in grooves; hairs short & bent to 0.2 mm	0.5–2 mm	Barrow Island in the Pilbara bioregion, the Exmouth Peninsula and south towards Carnarvon in the Carnarvon bioregion

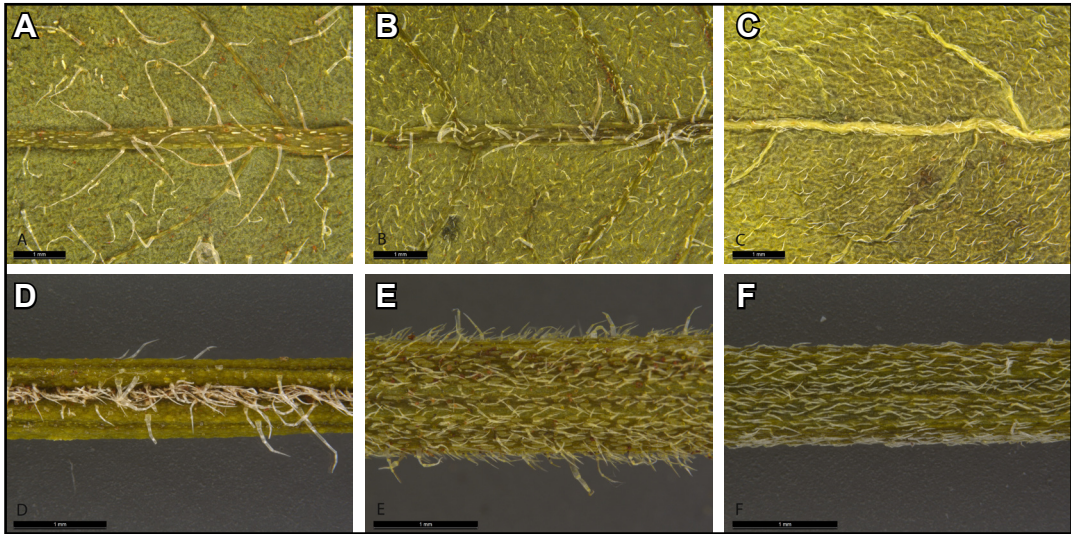


Figure 4. Abaxial leaf surfaces (A–C) and internodes (D–F) of *D. chichesterensis* (A, D), *D. australasicus* subsp. *australasicus* (B, E) and *D. australasicus* subsp. *corynothecus* (C, F). Images by R.L. Barrett from *P.-L. de Kock & R. Butler* PLDK 1040 (A, D); *R. Butler & S. Colwill* BES 00575 (B, E); *M.E. Trudgen & P. Jobson* MET 23010 (C, F).

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