

***Triodia veniciae* (Poaceae), a new species from the Pilbara region, Western Australia**

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Abstract

Barrett, M.D. *Triodia veniciae* (Poaceae), a new species from the Pilbara region, Western Australia. *Nuytsia* 30: 221–228 (2019). The Australian hummock grass genus *Triodia* R.Br. is currently undergoing taxonomic revision following increased botanical survey in remote Australia. This paper describes a recently discovered species of ‘soft’ *Triodia* from the Pilbara region, *T. veniciae* M.D.Barrett. The lemma lobes of the new species are narrow and produced into a short awnlet, intermediate between the old, and now united, generic concepts of *Plectrachne* Henrard with awned lemmas and *Triodia* with lobed lemmas. *Triodia veniciae* M.D.Barrett is only known from rocky shale slopes of the eastern Chichester Range, and has priority conservation status. Diagnostic character combinations for *T. veniciae* are given to allow discrimination from all other *Triodia*.

Introduction

Triodia R.Br. hummock grasses are restricted to mainland Australia, where they are characteristic components of many arid and semi-arid communities, and the dominant elements of hummock grasslands that cover 18% of Australia (Department of the Environment and Heritage 2007). As at late 2018 the genus *Triodia* consists of 82 described and accepted species (Lazarides 1997; Barrett *et al.* 2005; Armstrong 2008; Barrett & Barrett 2011, 2015; Hurry *et al.* 2012; Crisp *et al.* 2015; Anderson *et al.* 2017a; Barrett & Trudgen 2018) but is currently undergoing phylogenetic investigation and taxonomic revision (e.g. Toon *et al.* 2015; Anderson *et al.* 2016, 2017b). This paper describes a new species of *Triodia*, in the group of less pungent species colloquially known as ‘soft’ spinifex.

In 2016, during a survey of ploidy variation in *Triodia* in the eastern Pilbara, a morphologically anomalous variant was located on shale near Roy Hill Mine, referred to in an unpublished report under the informal name “*Triodia* sp. Roy Hill (M.D. Barrett MDB 5412)”. Although this taxon had been previously overlooked amongst the similarly resinous *T. epactia* S.W.L.Jacobs, which is abundant in the same area, subtle features of its glumes, lemmas and leaf sheaths were found to be consistently discrete from all known *Triodia* species. Its morphology suggested a relationship with *T.* sp. Karijini (S. van Leeuwen 4111), *T. melvillei* (C.E.Hubb.) Lazarides or *T. basitricha* M.D.Barrett. Despite these

apparent similarities, DNA sequences from the ITS and ETS regions suggest that it is phylogenetically closer to *T. bynoei* (C.E.Hubb.) Lazarides of the eastern Kimberley and adjacent Northern Territory than to the aforementioned species. Previous reports of *T. bynoei* from the Pilbara region (Lazarides 1997; Lazarides *et al.* 2005) were based on misidentified specimens that are morphologically and genetically indistinguishable from *T. melvillei*. An intensive further survey for the new species located additional populations over a range of c. 140 km, between Roy Hill and Mulga Downs, and confirmed its exclusive occurrence on shale substrates. The Roy Hill *Triodia* is described below as a new species, *T. veniciae*.

The lemma lobes of *T. veniciae* could be interpreted as either long lobes or short awns at the extremes of variation, and are here termed ‘sub-awned’. Along with *T. hubbardii* and *T. triaristata*, the sub-awned lemma lobes of *T. veniciae* provide an additional example of an intermediate between the old concepts of *Plectrachne* Henrard and *Triodia*, which were delimited on the presence or absence of lemma awns. As noted by Lazarides (1997), lemma lobing is untenable as a generic character, and the presence of an awn is homoplastic across the whole of *Triodia s. lat.* (Toon *et al.* 2015).

Methods and terminology

The term epistomatous (Toon *et al.* 2015; *cf.* amphistomatous) is taken up for the soft-type leaf anatomy in which stomata, stomatal grooves, and green chlorenchyma tissues are lacking adjacent to the lateral faces of the abaxial side of the leaf blade, with a corresponding lateral increase in colourless mesophyll tissue to fill the same space. Stomata are also extremely difficult to visualise, being protected within longitudinal grooves, so this condition is usually inferred from associated structures. Epistomatous leaf blades are diagnosed externally by a lack of stomatal grooves on the adaxial surface other than in a central band, and in section by the lack of chlorenchyma tissues adjacent to the lateral adaxial surfaces. Epistomatous leaf anatomy is synonymous with the terms ‘soft-type leaf anatomy’ or ‘centro-abaxial stomata’ that are sometimes used (e.g. Mant *et al.* 2000). Use of the term ‘epistomatous’ for *Triodia* leaf blades is, however, slightly misleading, since stomatal grooves (and presumably also stomata) are still present on the abaxial surface but are confined to a median band.

The conclusions made here are based on morphological data, but some notes are made on relationships inferred from phylogenetic analyses of sequence alignments from ITS and ETS (Internal Transcribed Spacer and External Transcribed Spacer respectively of the nuclear ribosomal DNA region). Extraction and sequencing protocols followed those described in Anderson *et al.* (2016). Results mentioned here are based on preliminary phylogenetic trees generated using both Maximum Parsimony and Maximum Likelihood tree generation methods. Full results of these analyses will be presented elsewhere.

Taxonomy

Triodia veniciae M.D.Barrett, *sp. nov.*

Type: North of Roy Hill Station, Western Australia [precise locality withheld for conservation reasons], 25 February 2017, M.D. Barrett 5414 (*holo*: PERTH08776245; *iso*: BRI, CANB, DNA, K, NSW, MEL).

Hummock-forming *perennial*, very resinous, not obviously stoloniferous; *hummocks* loose, 30–70 cm high, 40–60 cm wide; *flowering culms* 1.1–1.5 m high. *Culm internodes* 0.1–10 cm long and obscured by subtending foliage, red-brown, glabrous; aerial roots absent. *Fastigate branching* absent. *Leaf sheaths* 2.8–5.4 mm wide near apex, surface glabrous or sparsely to moderately pilose with hairs 1.5–3.2 mm

long, resinous or not resinous, pale green to straw coloured, prominently nerved; margins (excluding orifice) glabrous; margins of orifice truncate to oblique, with a dense fringe of hairs, the longest hairs 3.5–5.5 mm long. *Ligule* a dense fringe of hairs 0.5–0.9 mm long; *pseudopetiole* obscure. *Leaf blades* flattened-V-shaped when fresh, conduplicate and tightly in-rolled when dry, initially straight but becoming somewhat curled in older and dead leaves, 20–35 cm long, 0.8–1.5 mm wide when rolled, 1.5–3 mm wide when unrolled, relatively soft when fresh, weakly pungent, glabrous abaxially and densely papillose adaxially, resinous or not over abaxial surface, bright green to dark green when fresh, dull green when dry; abaxial stomatal grooves confined to central part, 4 (2 either side of midrib), unequally spaced, absent on marginal *c.* 1/3 but the surface finely obscurely ribbed; abaxial stomatal grooves 7–8 each side of midrib; margins minutely scaberrulous with prickly hairs *c.* 0.05 mm long. *Panicle* linear to ovate, 14–37 cm long, 1.0–1.5 cm wide, with 61–192 spikelets; primary axis minutely antrorsely scabrous, angular and ribbed; branches openly racemose with some basal branches ternate, loose, glabrous including the branch axils, non-resinous; longest basal panicle branches 5.6–15.8 cm long, sub-terete to angular, with 6–15 loosely-arranged $\pm$ uniform-sized spikelets, which are 7–16 mm apart (the distance between point of insertion of adjacent pedicels along the branch) with adjacent glumes not or slightly overlapping; *longest basal pedicels* (on longest basal panicle branches) 4.3–14 mm long, 0.1–0.2 mm wide, $\pm$ filiform, becoming slightly thicker just below spikelet, angular to slightly flattened, minutely scabrous; terminal pedicel 7–14 mm long; *Spikelet* 8–15 mm long, 1.9–3.9 mm wide, loosely 4–8-flowered with 3–7 fertile florets, sometimes with 1 apparently sterile (but possibly immature) floret at apex, narrowly elliptic to narrowly oblanceolate, compressed at maturity; lowest rachilla internode *c.* 0.8–1.7 mm long, *c.* 0.15–0.2 mm diam., glabrous. *Lower glume* narrowly lanceolate, 5.4–8.5 mm long, 1.0–1.6 mm wide, L:W 5.0–6.8, apex acute, shorter than the combined florets (including lobes), scarious, sub-membranous to chartaceous, with minute scabrosities less than 0.1 mm long over whole surface or only on margins and apex, 3–5-nerved, the midnerve distinctly raised, lateral nerves slightly raised; margins narrowly membranous, glabrous. *Upper glume* inserted *c.* 0.3–0.6 mm above lower glume, 5.0–8.5 mm long, similar to and subequal to lower glume, shorter than the combined florets (including lobes). *Lowest lemma* narrowly elliptic to narrowly lanceolate, 6.6–8.5 mm long including lobes, uniformly chartaceous, deeply 3-lobed, the midlobe somewhat drawn out into an awnlet; body 3.8–5.2 mm long including callus, 0.8–1.1 mm wide, the lower 1/2–3/4 with dense indumentum of appressed to lifting hairs 0.15–0.35(0.5) mm long arranged in 6–10 rows (or hair lines sometimes missing from the central zone), with nerves mostly obscure, but the upper part with 3 groups of 3 faint nerves visible and radiating into the lobes; midlobe 1.8–3.2 mm long, narrowly triangular at base narrowing to apex and sometimes produced into a short awnlet, similar in width to the lateral lobes; lateral lobes 1.0–2.3 mm long, 1/3–3/4 as long as midlobe, narrowly triangular at base, long-acuminate at apex but lacking a distinct awnlet, margins with a narrow membranous wing; *callus* 0.2–0.6 mm long, straight to distinctly curved in profile, attached obliquely, blunt to acute with an abruptly blunt apex in face view, acute in profile, white-bearded except in midline, the longest hairs 0.3–0.6 mm long. *Upper lemmas* similar to but smaller than lowest lemma, the midlobe becoming more awn-like toward the apex of the spikelet (i.e. the awnlet becomes a more prominent fraction of the length as lemmas decrease in size). *Palea* of basal lemma very slightly longer than lemma body, oblanceolate, 4.0–5.6 mm long, 0.6–0.8 mm wide, 2-keeled, not bitextured, membranous, glabrous or with a tuft of hairs between 1/4 and 1/2 of the length, apex acute, entire or erose; keels with a very narrow wing *c.* 0.1 mm wide, keel margins scabrous; flaps *c.* 0.15 mm wide, broadest in central part, narrower than 1/2 width of the palea body and not overlapping, entire. *Lodicules* *c.* 0.4 mm long, apex $\pm$ truncate, undulate, glabrous. *Anthers* 3, 1.9–2.7 mm long, exserted at maturity. *Styles* 2, *c.* 0.5–0.9 mm long. *Caryopsis* lenticular to narrowly obovate, 2.0–2.2 mm long, *c.* 0.7 mm wide, L:W 3.2–3.5:1, abruptly obtuse at apex, $\pm$ acute at base, slightly dorsiventrally flattened in section, with a broad shallow furrow on ventral side, pale reddish straw-coloured, base of styles only slightly thickened; hilum 0.55–0.65 mm long, *c.* 0.27–0.30 times as long as caryopsis. (Figure 1)

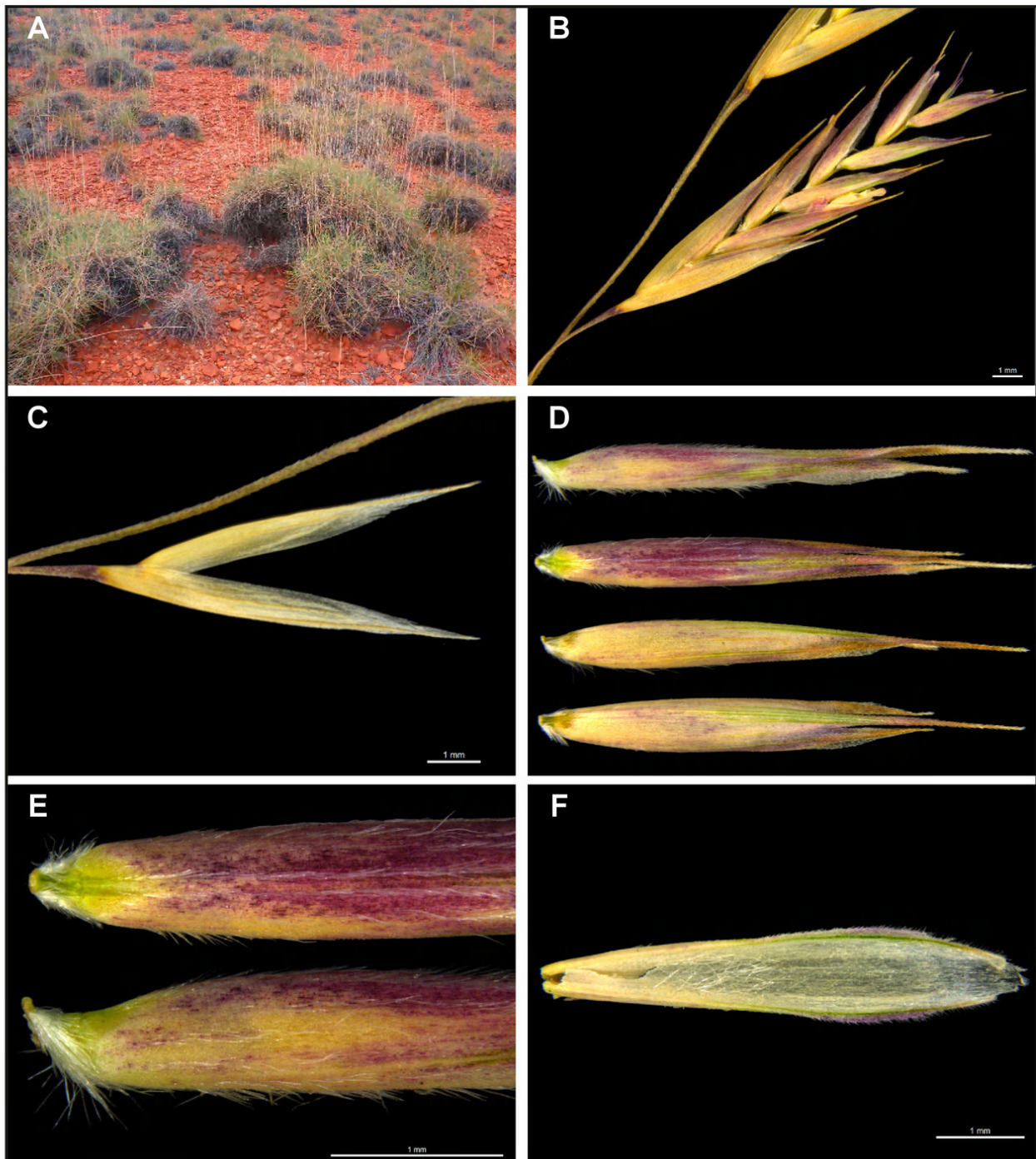


Figure 1. *Triodia veniciae*. A – flowering plants *in situ* showing habit and broken shale substrate; B – spikelet, showing the awned lemmas, variation in florets and relative midlobe (awnlet) length within a spikelet, and glumes shorter than combined florets; C – glumes, showing shape in side view; D – lemma of basal florets in side and face view showing relative proportions of body and lobes; the intense purple pigmentation in this specimen is atypical; E – base of lemma of basal floret in side and face view, showing hairs in longitudinal rows; F – palea in face view showing zone hairs in central area (paleas can also be glabrous), and very shortly winged lemma keels. Scale bars = 1 mm. Images from M.D. Barrett MDB 5414. Photographs by M. Barrett.

Diagnostic features. Foliage copiously resinous. Leaf sheaths glabrous or hairy on surfaces, glabrous on margins. Leaf blades epistomatous (soft-type), lacking stomatal grooves on the lateral margins of the abaxial surface. Panicles open, prominently ternately branched, lacking hairs in panicle axils. Glumes 5.4–8.5 mm long, narrowly lanceolate. Lemmas with short callus 0.2–0.3 mm long, body uniformly textured, lobes long-acute to shortly awned, the midlobe 1.8–3.2 mm long. Palea uniformly textured. Habitat restricted to shale slopes of the Chichester Range, Pilbara.

Other specimens examined. WESTERNAUSTRALIA: Chichester Range, [precise localities withheld for conservation reasons] 6 Aug. 2016, *M.D. Barrett* MDB 5408 (PERTH); 8 Aug. 2016, *M.D. Barrett* MDB 5412 (PERTH); 22 Feb. 2016, *M.D. Barrett* MDB 5415 (PERTH); 19 Mar. 2016, *M.D. Barrett* MDB 5416 (PERTH); 22 June 2017, *M.D. Barrett & N. Bezemer* MDB 5421 (PERTH); 23 June 2017, *M.D. Barrett & N. Bezemer* MDB 5424 (PERTH); 24 June 2017, *M.D. Barrett & N. Bezemer* MDB 5434 (PERTH); 25 June 2017, *M.D. Barrett & N. Bezemer* MDB 5440 (PERTH); *M.D. Barrett & N. Bezemer* MDB 5441 (PERTH); *M.D. Barrett & N. Bezemer* MDB 5442 (PERTH); 27 June 2017, *M.D. Barrett & N. Bezemer* MDB 5455 (PERTH); 27 June 2017, *M.D. Barrett & N. Bezemer* MDB 5458 (PERTH).

Phenology. Observed flowering February to March. Aseasonal fertile collections (very rare plants flowering among thousands of non-flowering plants) have been made in June and August following significant winter rainfall.

Distribution and habitat. Occurs on slopes of low hills of broken shale on the northern/eastern flanks of Marra Mamba mesa formations, along a 140 km transect of the eastern Chichester Ranges, between Roy Hill Station in the east and Mulga Downs Station in the west (Figure 2). Often occurs intermixed with or immediately adjacent to *T. epactia*. Replaced by other species such as *T. brizoides*, *T. scintillans* and *T. wiseana* on the more widespread ironstone hills in the area.

Conservation status. *Triodia veniciae* is to be listed as Priority One under Conservation Codes for Western Australian Flora (A. Jones pers. comm.). It is currently known from 27 patches, but aggregating patches of close proximity (0.1–2 km apart) consolidates the known distribution to 14 ‘populations’, spread over a 140 km distance along an almost linear zone of the eastern Chichester Range system. These 14 populations were estimated to have a total of more than 144,500 clumps. Some of the populations are potentially under threat due to the existence of mines in close proximity to known patches. Further evidence of substantial genetic division within *T. veniciae* might also increase the protection required for the eastern genetic lineage.

Etymology. The epithet *veniciae* is after Venicia De San Miguel, from Roy Hill Environment Department, who was instrumental in the discovery, collection of type material and surveys for this species.

Affinities. Morphologically, *T. veniciae* is similar to a number of other *Triodia* species from the Pilbara. It co-occurs with the similarly resinous *T. epactia*, with which it is easily confused in the field. *Triodia epactia* (and *T. pungens* R.Br.) can be separated from *T. veniciae* by the broader ovate to elliptic glumes (L:W 1.7–4.0), glabrous sheath surfaces in *T. epactia* / *T. pungens*, and lemma hairs present only along the midline and margins, compared to lanceolate to narrowly lanceolate glumes (L:W > 5.0–6.8), frequently hairy sheath surfaces, and lemma hairs concentrated in many longitudinal rows in *T. veniciae*.

Triodia veniciae is similar to *T. sp. Karijini* (S. van Leeuwen 4111), in having narrow lemma lobes 2.0–3.2 mm long that could be interpreted as short awns, but differs in being copiously resinous (non-resinous to weakly resinous in *T. sp. Karijini*), in having paleas usually with some hairs (palea always glabrous in *T. sp. Karijini*) and 6–15 spikelets on its longest basal panicle branches (3–6 spikelets in *T. sp. Karijini*). *Triodia sp. Karijini* is only known from above 900 m on ironstone ridges on mountains in the Hamersley Range, while *T. veniciae* is only known from shale slopes in the Chichester range north of the Fortescue River (Figure 2).

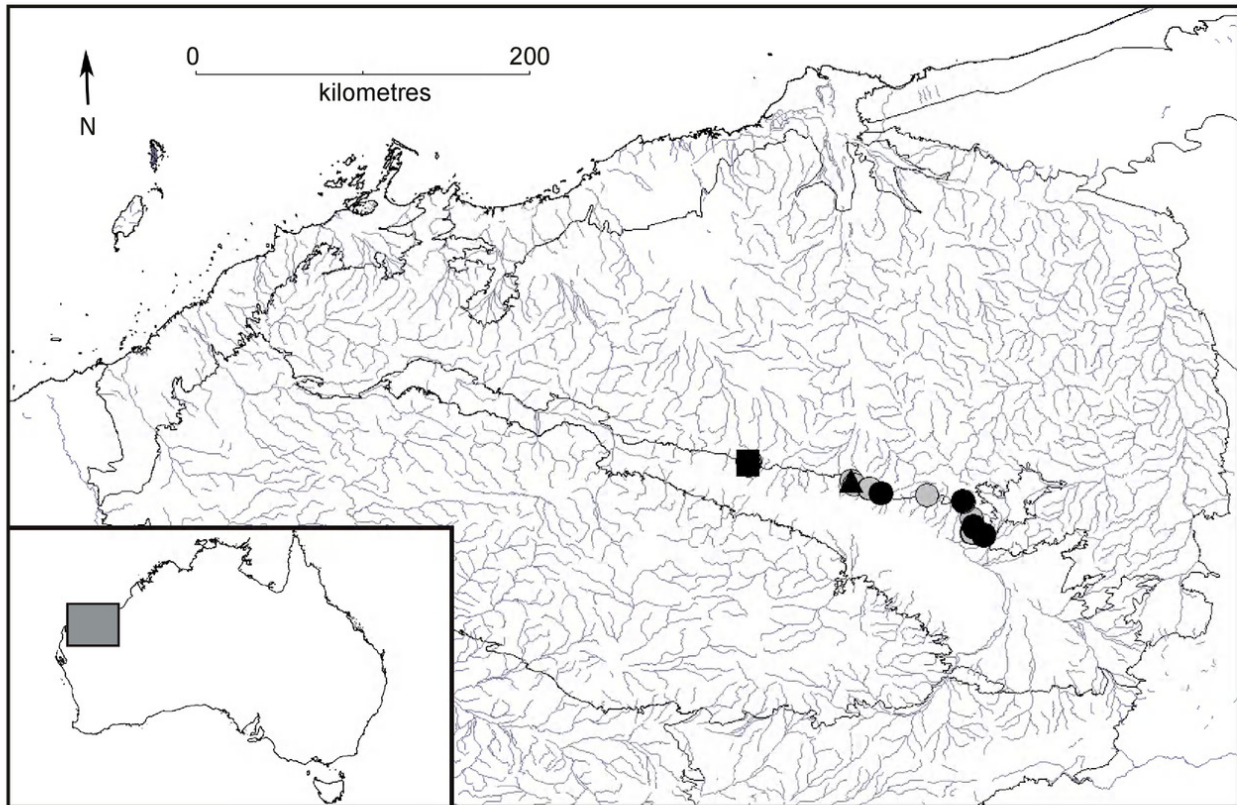


Figure 2. Distribution map of *Triodia veniciae*, showing the location of known populations along the eastern Chichester Range just to the north of the Fortescue Valley sub-region of the Pilbara bioregion. Black circles – eastern diploid populations. Black triangle – eastern tetraploid population. Black square – western population that is genetically somewhat divergent and is inferred to have a reduced-tetraploid DNA content, see text for details. Grey circles – eastern populations not assessed for ploidy.

Triodia veniciae is also similar to *T. melvillei* (to which it would key in Lazarides *et al.* 2005), sharing a very resinous habit, narrow glumes and lemma hairs concentrated in longitudinal rows. However, the lemmas are 3-awned in *T. melvillei* (lowest lemma midlobe 5.5–6.8 mm long in Pilbara specimens), compared to lobed to sub-awned with lowest lemma midlobe 2.1–3.2 mm long in *T. veniciae*. The leaf sheaths are most frequently hairy on their surfaces in *T. veniciae*, whereas they are always glabrous in *T. melvillei* (at least in hundreds of specimens seen by me, including all Pilbara specimens at CANB and PERTH, however Lazarides (1997) reports lower sheaths can be partially hirsute, without reporting specimen details nor their origin). The panicle axis and branches are strongly scabrous in *T. veniciae* but only weakly scabrous in *T. melvillei*. The distributions of *T. melvillei* and *T. veniciae* do not overlap, with *T. veniciae* restricted to the Chichester Range north of the Fortescue River, while *T. melvillei* occurs in the Pilbara south of the Fortescue River, south and east into central Australia.

The Pilbara species *T. basitricha* also has hairy leaf sheaths, but has awned lemma lobes, and lemmas bitextured with a sharp transverse demarcation line (uniformly textured in *T. veniciae*). Although both species occur in the eastern Pilbara, they are not known to occur in close proximity. Specimens of *T. veniciae* lacking florets can be distinguished by having shorter lower glumes 5.4–8.5 mm long (10–12.5 mm long in *T. basitricha*) and more numerous spikelets on longest basal branches (7–14 compared to 4–5 in *T. basitricha*).

Despite the morphological similarities of the above Pilbara species, ITS and ETS sequences (data not shown) suggest *T. veniciae* has a closer relationship to the Kimberley and Top End species *T. bynoei*. *Triodia bynoei* has distinct lemma awns, and lemma hairs scattered over the surface, not clearly concentrated in rows.

Notes. Preliminary unpublished genetic investigation suggests that there may be two genetic units within *T. veniciae*, as plants from the Mulga Downs patches (Western group, n=2) consistently differ from samples from more eastern populations (Eastern group, n=6) in three and five substitutions in ITS and ETS regions respectively (data not shown). The Mulga Downs patches also appear to have a ‘reduced tetraploid’ DNA content based on flow cytometric measurements of DNA content, consistent with a long-divergent tetraploid population that is in the process of becoming diploidised (Wendel 2015). Flow cytometric measurements of DNA content from populations in the Eastern group are predominantly diploid, or in one population tetraploid with a typical 2:1 ratio relative to diploid populations (M. Barrett unpublished data).

Field investigations have shown that plants in the western-most populations on Mulga Downs always have glabrous leaf sheaths, while in those around Roy Hill Station and Christmas Creek Mine always have sparsely to moderately densely hairy sheaths. In geographically intermediate areas near Cloudbreak Mine (genetically belonging to the ITS/ETS Eastern group), plants can have either glabrous or hairy sheaths, and these populations often have a mixture of the two morphotypes. As a result, the glabrous sheath character is not completely diagnostic for the Western group lineage. No other characters differing between the two groups are known, and characteristics from Mulga Downs specimens (M.D. Barrett & N. Bezemer MDB 5440 to MDB 5442) were always within the variation found amongst other collections made from further east.

The vernacular name Roy Hill Spinifex is suggested.

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