Tradescantia crassula (Commelinaceae) naturalised outside the Americas: first records of the species in Taiwan

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ABSTRACT – We present here the first records of Tradescantia crassula Link & Otto outside the Americas, due to the discovery of populations of the species in Taiwan, on Formosa Island. The species is native to northeastern Argentina, southern Brazil, Paraguay and Uruguay, and is naturalised in Arkansas state, southeastern USA. It is not known how the species was introduced to Taiwan. We also provide an identification key to the four species of Tradescantia that occur in Taiwan.

Keywords: Asia, distribution extension, identification key

INTRODUCTION


Some species of Tradescantia were introduced to and became naturalised in areas where they are not native, such as T. fluminensis Vell., T. pallida (Rose) D.R.Hunt (= Setcreasea purpurea Boom), T. spathacea Sw. (= Rhoeo discolor (L’Hér.) Hance ex Walp.) and T. zebrina hort. ex Bosse (= Zebrina pendula Schnizl.). A number of species of Commelinaceae were recently reported as naturalised in Taiwan: T. fluminensis (Yang et al. 2008), Callisia fragrans (Lindl.) Woodson (Wang & Chen 2008) and C. repens (Jacq.) L. (Tseng et al. 2010). In this work we present the first records of T. crassula Link & Otto outside the Americas, due to the discovery of populations of the species in Taiwan, on Formosa Island. This discovery was made in the context of the continuous monitoring of the non-native plant species occurring in the Yangmingshan National Park, in northern Taiwan. The species is native to South America, and is known to be naturalised in Arkansas state, southeastern USA (Sundell et al. 1999). We also provide an identification key to the four species of Tradescantia that occur in Taiwan, in order to facilitate the identification of these species.

MATERIAL AND METHODS

We studied specimens of Tradescantia kept at ASE, B, C, EFC, FI, FLOR, FT, FURB, GB, HAST, HBR, HUFSJ, K, MA, MBM, P, TAI, TAIIF, UPCB and UPS, and images of specimens kept at CEN, CVRD, EAC, ESA, F, FCAB, GH, HUEFS, INPA, MO, NY, RB, RON, SP, UB, UEC, UFRN, US, VIES and WU (acronyms according to Thiers 2019). The conservation status of T. crassula was assessed following the International Union for Conservation of Nature (2012, 2017) criteria. For the elaboration of the distribution maps, we used ArcGIS v.10 (ESRI, Inc.),
while the orthoimages were provided by the Yangmingshan
National Park.

In order to investigate the populations of *T. crassula*
and *T. fluminensis* in the Yangmingshan National Park we
set up ten transects, totalling 58.5 km in length. For each
population, the area of occupancy was measured with a
measuring tape. It was not possible to count the number of
individuals of both species because the stems are entwined
within a population; for this reason we investigated the area
of occupancy of each population, rather than the number
of individuals. At the centre point of each population,
the geographical coordinates and the elevation above sea
level were recorded using a handy GPS receiver, and an
image of the canopy was taken using a fish-eye lens. The
coordinates were then used to calculate the distance between
the population and the closest developed (i.e. anthropised)
area. The canopy images were used to calculate the coverage
in Gap Light Analyzer software (Simon Fraser University,
Cary Institute of Ecosystem Studies). Soil pH was averaged
over ten random sites in the population. Stone to soil rate
was estimated by visual observation.

**RESULTS AND DISCUSSION**

*Tradescantia crassula* Link & Otto, Icon. Pl. Rar.: 13–14,
t. 7. 1828.


Epitype (designated by Funez et al. 2016: 71): BRAZIL.
RIO GRANDE DO SUL, XI–XII.1825, F. Sello 3033 (B
barcode B100521014!).

**Description:** Herbs up to 45 cm tall, terrestrial, rupicolous
or epiphytes. Stems erect, succulent, green, glabrous,
generally poorly branching. Leaves distichously or spirally-
alternate, sessile; ptyxis convolute; sheaths 0.8–2.1 cm
long, light green, glabrous, margin ciliate, hairs hyaline;
blades 4.0–12.0 × 1.5–2.7 cm, elliptic to ovate to obovate
to lanceolate, succulent, glabrous on both faces, margin
slightly revolute; apex acute to obtuse, rarely acuminate;
midvein not conspicuously distinct from the secondary
veins; secondary veins on both faces not impressed, rather
inconspicuous. Inflorescences in the distal portion of the
stems, 1 per leaf axis, consisting of a pedunculate double-
cincinni, 9–20-flowered; peduncles 1.0–3.5 cm long, green,
glabrous; peduncle bracts absent; supernumerary bracts
absent; cincinni bracts 1.0–3.7 × 0.8–2.0 cm, leaf-like,
generally equal (or almost so) in size, rarely unequal or
reduced, ovate, glabrous, green, base cordate to obtuse,
not saccate, slightly revolute, apex acute. Flowers 0.8–1.3
cm wide, pedicels 0.6–1.6 cm long, green, glabrous; floral
buds broadly ovoid; sepals 4.5–7.4 × 2.8–4.3 mm, dorsally
keeled, green, setose, with long hyaline hairs along the
keel; petals 6.2–7.2 × 4.6–5.3 mm, flat, white; filaments
5.0–6.5 mm long; anthers 0.6–0.8 × 1.0–1.3 mm; ovary
1.7–2.0 × 1.5–1.7 mm, style 4.1–5.1 mm long; pistil longer
than the stamens. Fruits not seen from Taiwanese material.

**Etymology:** The specific epithet refers to the fleshy aspect
of the stems and leaves of the species.

**Illustrations:** Plate 7 in Link & Otto (1828)—also available
in Fig. 1 in Hassemer et al. (2017a); Plate 2935 in Curtis
& Hooker (1829); Plate 1560 in Loddiges (1829).

**Photographs of living specimens:** Fig. 1 (specimens
from Taiwan); Fig. 6 in Funez et al. (2016) (specimens
from Brazil).

**Photographs of herbarium specimens:** Fig. 2 (specimen
from Taiwan); Fig. 5 in Funez et al. (2016) (the epitype).

Figs. 1A–D. *Tradescantia crassula* in Taiwan. **A.** Overview of
a population; **B.** Flowering specimens; **C.** Inflorescence; **D.**
Detail of flower. Photographs by Mong-Huai Su. Scale bars: C = 1 cm; D = 2 mm.
Distribution: *Tradescantia crassula* is native to northeastern Argentina (Misiones province), southern Brazil (Minas Gerais, Paraná, Rio Grande do Sul, Santa Catarina and São Paulo states), Paraguay (Paraguari department) and Uruguay. The species is also recorded as naturalised in Arkansas state, southeastern USA (Sundell et al. 1999). In this work we confirm its naturalised distribution in Taiwan (Fig. 3), which is the first record of the naturalised occurrence of the species outside the Americas.

Conservation status: Least Concern (LC). *Tradescantia crassula* is a widespread species and is not currently threatened with extinction.

Observations: In 2018, when conducting an investigation on alien plants in Yangmingshan National Park, in northern Taiwan, we found populations of an unknown species of *Tradescantia* in the area (Fig. 1). The species was morphologically similar to *T. fluminensis*, which was already known to be naturalised in Taiwan (Yang et al. 2008), but had larger, fleshy leaf blades and prominently pilose sepals. After careful study of specimens the plants were identified as *T. crassula*, a herbaceous species native to South America. Directed searches throughout the Park found ten populations of the species, which occupy an area of 193.1 m² in total (Tab. 1). These populations are distributed in the western part of the Park (Fig. 4).

Both the number of observed populations and the occupied area were less for *T. crassula* than that of *T. fluminensis*, which could perhaps be explained by the history of invasion of the two species in Taiwan. *Tradescantia fluminensis* became naturalized in Taiwan in 1987 (Wu et al. 2010), much earlier than *T. crassula*. Unlike *T. fluminensis*, all populations of *T. crassula* were distributed adjacent to developed (i.e. anthropised) areas. Compared to *T. fluminensis*, *T. crassula* prefers lower canopy coverage, which suggests that the latter benefits from stronger sunlight.
Fig. 3. Distribution map of *Tradescantia crassula* (triangle) and *T. fluminensis* (circles) in Taiwan.

Table 1. Population and environmental factors of *Tradescantia crassula* and *T. fluminensis* in Yangmingshan National Park, northern Taiwan.

<table>
<thead>
<tr>
<th>Species</th>
<th><em>T. crassula</em></th>
<th><em>T. fluminensis</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of populations observed</td>
<td>10</td>
<td>34</td>
</tr>
<tr>
<td>Area occupied (m²)</td>
<td>193.1</td>
<td>14029.6</td>
</tr>
<tr>
<td>Canopy coverage (%)</td>
<td>43 ± 27</td>
<td>65 ± 27</td>
</tr>
<tr>
<td>Soil pH</td>
<td>5.8 ± 1.0</td>
<td>5.2 ± 1.0</td>
</tr>
<tr>
<td>Stone / soil rate (%)</td>
<td>35 ± 15</td>
<td>31 ± 16</td>
</tr>
<tr>
<td>Distance to developing area (m)</td>
<td>0 ± 0</td>
<td>80 ± 17</td>
</tr>
<tr>
<td>Elevation (m)</td>
<td>872 ± 104</td>
<td>741 ± 197</td>
</tr>
</tbody>
</table>
Tradescantia crassula (Commelinaceae) naturalised outside the Americas...

This is probably the reason why the populations of *T. crassula* in the Park are concentrated close to developed areas, where the arboreal vegetation was suppressed for farming or paving. The greater dependence of *T. crassula* of more direct sunlight exposure suggests that the control of this species would probably be easier than that of *T. fluminensis*, which is much more shade-tolerant.

According to an interview with staff members of the Park, it is believed that *T. crassula* has been occurring in the area since at least 2003. However, so far they were misidentifying those plants as *T. fluminensis* because of their morphological similarity. Both species are native to South America and belong to *Tradescantia* subg. *Austrotradescantia* (D.R.Hunt) M.Pell. It is known that *T. fluminensis* was introduced into Taiwan for ornamental purposes (Yang et al. 2008, Wu et al. 2010), but there is no information about the means of introduction of *T. crassula*, and this species is not commercialised in Taiwan. There is no evidence that *T. crassula* is cultivated in Taiwan or that it has been cultivated in the past. It is important to mention that *T. crassula* was described in Germany based on specimens that grew from seeds accidentally transported along with substrate with which ornamental plants were shipped from southern Brazil (Link & Otto 1828, Hassemer et al. 2017a). Considering that *T. crassula* is not cultivated or commercialised in Taiwan, it is possible that this was also the manner in which the species was accidentally introduced to this country.

We are here following the circumscription of *T. crassula* as in Barreto (1997), Funez et al. (2016) and Hassemer et al. (2017b), which does not include the southern Brazilian endemic species *T. schwirkowskiana* Funez et al.—see Funez et al. (2016) and Hassemer et al. (2017b)

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**Figs. 4A–C.** A. Location of the Yangmingshan National Park in Taiwan; B. Distribution and coverage of *Tradescantia crassula* in the Park; C. Distribution and coverage of *T. fluminensis* in the Park. In B and C, lines inside the Park indicate the main trails.
 Tradescantia crassula is the fourth species of Tradescantia to become naturalised in Taiwan. In addition to this species and T. fluminensis, T. pallida and T. zebrina also occur in the country (Wu et al. 2010). Furthermore, two other species of Commelinaceae are naturalised in Taiwan: Callisia fragrans and C. repens (Wang & Chen 2008, Tseng et al. 2010).


... for information on T. schwirkowskiana and a thorough explanation of the differences between these two species. Tradescantia crassula is the fourth species of Tradescantia to become naturalised in Taiwan. In addition to this species and T. fluminensis, T. pallida and T. zebrina also occur in the country (Wu et al. 2010). Furthermore, two other species of Commelinaceae are naturalised in Taiwan: Callisia fragrans and C. repens (Wang & Chen 2008, Tseng et al. 2010).

2. Stems normally erect to decumbent. Leaves sessile; blade coriaceous, succulent, pale purple .......... T. pallida
2'. Stems normally prostrate. Leaves petiolate; blade papyraceous, green with white stripes adaxially ..... T. zebrina
1'. Flowers flat. Sepals equal, free. Petals white. Stamens equal ................................................................. 3
3. Stems normally erect. Leaves with convolute ptyxis; sheath margins ciliate; blade fleshy, falcate to complicate. Cincinni bracts not saccate at base. Petals flat. Pistil longer than the stamens ........................................... T. crassula
3'. Stems normally prostrate. Leaves with involute ptyxis; sheath glabrous; blade membranous to slightly fleshy, flat. Cincinni bracts saccate at base. Petals plicate. Pistil about the same length as the stamens .................. T. fluminensis

Identification key to the species of Tradescantia that occur in Taiwan

All four Tradescantia species in this key are non-native in Taiwan.

2. Stems normally erect to decumbent. Leaves sessile; blade coriaceous, succulent, pale purple .......... T. pallida
2'. Stems normally prostrate. Leaves petiolate; blade papyraceous, green with white stripes adaxially ..... T. zebrina
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ACKNOWLEDGEMENTS

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REFERENCES


Material examined (herbarium specimens from Taiwan): TAIWAN. Taipei City, Yangmingshan National Park, Mt. Datun, 25°11’08” N, 121°31’34” E, 28.IV.2019, M.-H. Su 724 [Fig. 2], 725, 726 (TAIF), 727, 728 (TAI), 729, 730, 731, 732 (FURB).
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