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# The genera *Dracunculus* and *Helicodiceros* (*Araceae*: *Aroideae*)

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ABSTRACT: The genera *Dracunculus* and *Helicodiceros* are described.

KEY WORDS: *Araceae, Aroideae, Dracunculus, Helicodiceros.*

## Introduction

The genera *Dracunculus* MILLER (1754) with two species and the monotypic *Helicodiceros* SCHOTT (1853) are the most spectacular of the European aroids. They belong to the tribe Areae of subfamily Aroideae (sensu BOGNER et NICOLSON 1991) and are related to *Arum* L. and *Eminium* (BLUME) SCHOTT.

*Dracunculus vulgaris* SCHOTT (1832) is an ubiquitous element of the flora in the Balkans, the Aegean Islands and SW Turkey. *Dracunculus canariensis* KUNTH (1841) is restricted to the Atlantic Islands. *Helicodiceros muscivorus* (L.f.) ENGL. (ENGLER 1879), is restricted to a few sites in the Balearics (Mallorca, Minorca) and the islands of Corsica and Sardinia.

PRIME et WEBB (1985) treated *Helicodiceros* as a synonym of *Dracunculus.* Most genera in the tribe Areae are separated primarily on placentation type and ovule number. On these criteria *Dracunculus* and *Helicodiceros* are inseparable; both have few-ovulate ovaries and apical and basal placentation. However, the genera differ in many other characters. The spathes are different, with *Helicodiceros* distinguished from *Dracunculus* by the spathe shape, spathe limb surface indumentum and spathe tube interior sculpturing. The spadix of *Helicodiceros* is different from that in *Dracunculus* in having large to massive, subulatefalcate pistillodes and a densely hairy appendix. The staminate flowers differ; in *Helicodiceros* they dehisce via confluent apical slits whereas in *Dracunculus* dehiscence occurs via discrete, tiny apical pores. THANIKAIMONI (1969) found the pollen of *Helicodiceros* to be spherical with 'echinulate' (spinose) sculpturing. GRAYUM (1992) studied *D. vulgaris* and reported it to have boat-shaped-elliptic or subspheroidal pollen with verrucate sculpturing.

The pseudostems are of different types. In both *Dracunculus* species the pseudostem is stout, comprised of tightly convolute petiole sheaths and capable of supporting an inflorescence of over one metre in length without the need of vegetation, rock formations etc. for additional support. By contrast the pseudostem of *Helicodiceros* is

formed of loosely convolute petiole sheaths and invariably emerges through rock fissures and gaps with the leaves and inflorescence supported on the surrounding rock surface.

The leaves are distinct, those of *Helicodiceros* have the posterior lobes ascending in a prominent spiralled arrangement, giving the appearance of antlers, similar to some species of *Eminium* (e.g. *E. spiculatum* (BLUME) O. KUNTZE and *E. alberti* (REGEL) ENGL). The developmental processes responsible for this leaf type have been discussed by GOEBEL (1911, 1913) and TROLL (1932). In *Dracunculus* the posterior lobes are flat and not spirally arranged. I think that the differences listed above support *Helicodiceros* as a separate genus.

**Conservation**

There is a considerable horticultural trade in tubers of *Dracunculus vulgaris* and to a lesser degree, *Helicodiceros muscivorus*. Almost all of the tubers available commercially in Europe are wild collected, those of *D. vulgaris* from southwestern Turkey and *H. muscivorus* from Corsica or Sardinia. The impact of this collecting is difficult to assess. Horticultural demand for these striking plants is still relatively limited and it is hoped that it will remain so. The need for wild collecting of tubers is not justifiable, both species are readily grown from seed and will flower, with careful cultivation, in three to four years from sowing.

There appears to be no wild source trade in *D. canariensis*. Plants have been established in cultivation from wild-collected seed and are becoming increasingly available from seed produced in cultivation. *Dracunculus canariensis* is easy to grow from seed and often flowers in the second season.

**Key to *Dracunculus* and *Helicodiceros***

1a Spadix densely hairy, pistillodes large to massive; spathe limb interior hairy, spathe tube interior with prominent, longitudinal ridges; leaves pedatisect, hastate in outline, posterior lobes spirally ascending ..... ***Helicodiceros muscivorus***

1b Spadix appendix smooth, pistillodes much reduced or absent; spathe limb and spathe tube interior smooth; leaves pedate, reniform in outline, posterior lobes flat ..... **2**

2a Whole plant, especially pseudostem, glaucous, unmarked; tuber stoloniferous; spathe limb greenish white, spathe tube weakly convolute to ± gaping; spadix pale yellow, staminate and pistillate flower zones usually contiguous. Newly opened inflorescence smelling of semen ..... ***Dracunculus canariensis***

2b Plant not glaucous, pseudostem with prominent jagged purple markings, leaves concolorous green or with conspicuous irregular white lines; tuber not stoloniferous; spathe limb usually deep, velvety purple, rarely greenish white to dirty yellowish, very rarely with conspicuous white, lilac and purple marbling, spathe tube strongly convolute; spadix glossy deep purple, rarely lilac, staminate and pistillate flower zones at least slightly separated by an interstice, this often furnished with short, stubby pistillodes. Newly opened inflorescence smelling strongly of dung and carrion ..... ***Dracunculus vulgaris***

***Dracunculus*** MILLER, Gard. Dict. Abridg. ed. 4 (1754). Type: see note under *Dracunculus vulgaris* below.

*Anarmodium* SCHOTT in Bonplandia 9:368 (1861). Type: Based on the type of *Dracunculus canariensis* KUNTH.

Slender to very robust tuberous herbs. Stem: a large compressed-globose to discoid tuber, growth point situated dorsally, slightly raised to somewhat sunken, tuber offsetting sparsely by budding from peripheral adventitious shoots *(D. vulgaris)* or producing long, simple to few-branched, slender stolons giving rise to new shoots and tubers *(D. canariensis)*. Leaves: petiole sheaths very long, tightly convolute into a conspicuous pseudostem enclosing the developing peduncle, petiole terete to D shaped in cross-section; leaf lamina reniform in outline, pedate, mid-lobe larger than posterior lobes, all lobes ± flat. Inflorescence solitary, peduncle robust to somewhat slender, terete, barely to somewhat exserted from pseudostem apex; spathe moderate to very large; spathe tube oblong to elliptic-oblong, strongly convolute to ± gaping, constricted or not, marcescent; spathe limb ovate-lanceolate to oblong-triangular, acuminate, erect on opening, soon curving back, eventually deciduous; spadix shorter than to equalling the spathe limb; spadix appendix slender to vary large, cylindric to flattened, stipitate. Flowers: pistillate flowers arranged in a sessile, oblong zone, ovary oblong to oblong-fusiform, unilocular, few-ovulate on an apical and a basal placenta, stigma on a short style; staminate flowers arranged in an oblong to oblong-fusiform zone, separated by a brief naked or pistillodebearing interstice *(D. vulgaris)* or contiguous with the pistillate zone *(D. canariensis)*, staminate flowers 3-4-androus, stamens quadrate, filaments very short, conspicuous, fused, connective exceeding thecae and extending further after anthesis, thecae dehiscing via tiny discrete apical pores, pollen released in strands. Infructescence consisting of few to very many obovoid, few-seeded berries. Seed globose-ovoid, somewhat laterally compressed and angled, testa rugose. Eophyll elliptic.

***Dracunculus canariensis*** KUNTH, Enum. Pl. 3:30 (1841). Type: 'Teneriffe' (holotype B destroyed).

*Anarmodium canariense* (KUNTH) SCHOTT in Ann. Soc. Bot. Lyon. 7:119 (1861).

Slender, clump-forming herb to 1.5 m. Tuber 4-6 x 2-3 cm, solitary while immature, later producing numerous slender, 4-12 cm x 5-10 mm, simple to few-branched stolons from the upper surface, these soon producing shoots and tubers. Pseudostem 20-130 x 1-6 cm, pale glaucous green. Leaves 8-20 x 6-30 cm, pale to mid-glaucous green. Inflorescence 24-55 cm in total length, newly opened inflorescence smelling of semen; peduncle mostly enclosed by the pseudostem, visible portion 4-12 x 1-1.5 cm, glaucous green; spathe tube 4-8 x 2-3.5 cm, oblong-cylindric, weakly convolute to gaping, exterior glaucous green, interior pale greenish white; spathe limb 20-47 x 6-14 cm, narrowly ovatelanceolate, acuminate, exterior pale glaucous green, interior pale greenish white; spadix 16-42 cm in total length; spadix appendix 12-37 cm x 7-20 mm, briefly stipitate, slender cylindric to slender fusiform, pale yellow. Flowers: pistillate flowers arranged in an oblong zone 10-20 x 5-12 mm, ovary oblong-fusiform, 2-3 x 1-1.5 mm, pale greenish cream, stylar region similarly coloured, stigma 0.5-0.75 x 0.3 mm, punctate-conic, papillate, pale cream; staminate flowers arranged in an

oblong zone 10-20 x 5-10 mm, anthers 1-2 x 0.75-1.5 mm, mid-yellow. Infructescence 2-5 x 2-3 cm, comprised of c. 50 berries, often partially to completely encased in the dry spathe tube remnants; berries obovoid, 4-6 x 3-5 mm, orange when ripe. Seed compressed globose, 2-3 mm diam., pale brown. Chromosome count 2n = 28 (LARSEN 1960, BORGEN 1969, MARCHANT 1972).

Distribution. Atlantic Islands: Madeira, Gran Canaria, La Palma, Tenerife.

Ecology. Laurel forest margins, open, dry woodland, scrubby field margins. 0-225 m a.s.l.

Although the inflorescence of *D. canariensis* is superficially similar to that of *D. vulgaris* it appears that *D. canariensis* has evolved in association with a different pollinator. The pale spathe limb, yellow spadix appendix and semen-like odour attracts small flies, wasps and small bees (BOYCE, pers. obs.) The spathe tube gapes at the front and allows insects direct access to the flowers whereas in *D. vulgaris* the potential pollinators (large flies, Staphylinid and Scarabidinid beetles) enter the spathe tube and gain access to the flowers by descending the spadix appendix.

***Dracunculus vulgaris*** SCHOTT in SCHOTT et ENDL., Melet. Bot. 17 (1832). Type: based on Linnaeus' *Arum dracunculus*, the typification of which is not yet resolved.

*Arum dracunculus* L., Sp. Pl. 964 (1763), non THUNB. (1784). Type: See above note under *Dracunculus vulgaris*.

*Arum dracunculus* L., Sp. Pl. 964 (1763), non TBUNB. (1784). Type: See above note under *Dracunculus vulgaris*.

*Dracunculus polyphyllus* BLUME, Rumphia 1:124 (1836) ('1835'), *nom. illegit.*

*Dracunculus creticus* SCHOTT, Prodr. Syst. Aroid. 120 (1860). Type: Crete, Therisso, Sieber s.n. (syntype B destroyed; isosyntype K!); Thebes, Anon s.n. (syntype M!).

*D. vulgaris* SCHOTT var. *creticus* (SCHOTT) ENGL. in A. et C. DC., Monogr. Phan. 2:603 (1879).

*D. vulgaris* SCHOTT var. *elongatus* ENGL., loc. cit. Type: Turkey, Lycia, prope Tchazyklar (Caziklar), Borgeau s.n. (holotype B destroyed).

*D. vulgaris* SCHOTT var. *laevigatus* ENGL., loc. cit. Type: Rhodes, ad margines camporum prope Bastida, Borgeau 148 (holotype B destroyed).

*Aron dracunculum* (L.) ST. LAG. in Ann. Soc. Bot. Lyon 7: 119 (1880), *nom. illegit.*

*Dracunculus dracunculus* (L.) VOSS in VILMORIN, Blumeng. ed. 3, 1:1166 (1895), *nom. illegit.*

Moderate to very robust, solitary to clump-forming herb to 2 m. Tuber 5-12 x 3-6 cm, solitary, sometimes producing offsets from adventitious buds. Pseudostem 35-150 x 3-9 cm, pale to mid-grey-green with numerous jagged dark purple to almost black markings. Leaves 10-21 x 18-45 cm, bright mid- to deep green, occasionally with conspicuous white streaks. Inflorescence 25-135 cm in total length, smelling strongly of dung and carrion when newly opened; peduncle mostly enclosed by the pseudostem, visible portion 5-18 x 2-5 cm, concolorous mid-green; *spathe tube* 8-15 x 3-7 cm, oblong-cylindric to ellipsoid, convolute, exterior mid-green, slightly glaucous, rarely pale greenish white or dirty yellowish, interior deep purple, sometimes white to cream towards the opening; spathe limb 17-110 x 8-34 cm, ovate-lanceolate to oblong-triangular, acuminate, exterior mid- to dark green, margins and outer parts of limb

usually stained deep purple, rarely pale greenish white or dirty yellowish, interior deep velvety purple, rarely greenish white or dirty yellowish, very rarely with conspicuous white, lilac and purple marbling; spadix 24-134 cm in total length; spadix appendix 20-128 x 1.5-7 cm, stipitate, stout-cylindric to fusiform, larger appendices often strongly flattened laterally, deep glossy purple, rarely lilac, stipe deep purple, rarely white. Flowers: pistillate flowers arranged in an oblong-fusiform zone 2-4 x 1.5-3 cm, ovary oblong, 2-3.5 x 1.5-2 mm, cream to yellow green, stylar region purple, stigma 0.5-0.75 x 0.3-0.5 mm, subcapitate, papillate, cream; interstice 1-5 mm long, cream; pistillodes present or absent, 1.5-3 x 0.5-1 mm, peg-like, cream; staminate flowers arranged in an oblong to oblong-fusiform zone 2-5 x 1.5-3, anthers 1.5-2 x 2-2.5, dark yellow, thecae stained mid-purple apically. Infructescence 4-12 x 3-5 cm, comprised of c. 60-80 berries, sometimes partially to completely encased in the dry spathe tube remnants; berries obovoid, 3-5 x 4-7 mm, orange-red when ripe. Seed compressed globose, 3-4 mm diam., pale brown. Chromosome count 2n = 28 (BEDALOV 1972, MARCHANT, 1972, STRID et FRANZEN, 1981).

Distribution. Balkans, Aegean Islands, SW Turkey. Collections from Italy are possibly introduced; material from further west and from North Africa almost certainly represents introductions.

Ecology. Maquis, garrigue, undisturbed olive groves, waste land. 0-450 m a.s.l.

*Dracunculus vulgaris* displays variation in overall size, degree of leaf division and leaf marking. None of the taxa yet described based on variation in these characters can be upheld as taxonomically distinct from *D. vulgaris.*

The status of the 'white' *Dracunculus* plants originally reported from the Kamares region of central Crete is not clear. These have a pale greenish white to pale yellowish spathe limb and deep purple spadix appendix. Since the first reports in the early 1970s a number of other forms have been found in the same area with variously marbled purple and white spathes and pale lilac to deep purple spadix appendices. Recently I have seen a photograph of a plant on Rhodes with the same type of pale spathe. These plants are morphologically indistinguishable from the typical plants and it appears they are sports of *D. vulgaris.*

The report by MILL (1984) of *D. vulgaris* with a white-haired spathe and spadix appendix from Çanakkale in northwestern Turkey is interesting. Two collections are known, one with prominent, very short hairs, the other with a similar but sparser indumentum. More collections from the Çanakkale region are needed to resolve the status of this plant.

***Helicodiceros*** SCHOTT in Oesterr. Bot. Wochenbl. 3: 369 (1853). Type: based on the type of *Arum muscivorum* L.f.

*Megotigea* RAFIN., Fl. Tellur. 3:64 (1836), in *syn. nom. rejic.* Type: based on the type of *Arum muscivorum* L.f.

Moderate, solitary to clump-forming tuberous herbs. Stem: a moderate to large compressed-globose tuber, growth point situated dorsally, slightly sunken, tuber offsetting sparsely by budding from peripheral adventitious shoots. Leaves: petiole sheaths moderately long, loosely convolute into a poorly defined pseudostem, this partly to completely enclosing the developing peduncle, petiole D shaped in cross-section, leaf

lamina hastate in outline, pedatisect, mid-lobe broadest, ascending, posterior lobes becoming sequentially narrower, spirally erect (see GOEBEL 1911, 1913, TROLL 1932), the whole structure resembling antlers. Inflorescence solitary, peduncle robust, terete, slightly to much exerted from the apex of the pseudostem, spathe moderate to large, spathe tube oblong, strongly convolute, strongly constricted, densely hairy at opening, strongly longitudinally ridged inside, marcescent to somewhat persistent; spathe limb oblong-ovate, loosely to densely hairy inside, held obliquely to almost horizontally to spathe tube, marcescent, later deciduous; spadix shorter than spathe limb; spadix appendix slender to somewhat massive, cylindric-fusiform, stipitate, densely hairy. Flowers: pistillate flowers arranged in a short-stalked oblong zone, ovary oblong, unilocular, few-ovulate on an apical and a basal placenta, stigma sub-punctate; staminate flowers arranged in an ± oblong zone separated from the pistillate flower zone by an interstice densely clothed with large to massive subulate-falcate pistillodes, staminate flowers 2-3-androus, stamens quadrate, ± sessile, connective shorter than thecae, thecae dehiscing via lateral, apically-confluent slits, pollen released in strands. Infructescence consisting of many obovoid to globoseellipsoid, few-seeded berries. Seed broadly ovoid, c.4 mm diam. Eophyll unknown.

***Helicodiceros muscivorus*** (L.f.) ENGL. in A. et C. DC., Monogr. Phan. 2: 605 (1879). Type: based on *Arum muscivorum* L.f., the typification of which is yet to be resolved.

*Arum muscivorum* L.f., Suppl. 410 (1782). Type: see note above under *Helicodiceros muscivorus.*

*A. crinitum* AIT. in Hort. Kew. 3: 314 (1789), *nom. illegit.*

*A. spirale* SALISB., Prodr. 259 (1796), *nom. illegit.*

*Dracunculus crinitus* (AIT.) SCHOTT in SCHOTT ENDL., Melet. Bot. 17 (1832), *comb illegit.*

*Dracunculus minor* BLUME, Rumphia 1: 129 (1836) ('1835'), *nom. illegit.*

*Megotigea crinita* (AIT.) RAFIN., Fl. Tellur. 3:64 (1836), *comb. illegit.*

*Helicodiceros crinitus* (AIT.) SCHOTT in Oesterr. Bot. Wochenbl. 3:369 (1853), *comb illegit.*

*Dracunculus muscivorus* (L.f.) PARL., Fl. Ital. 2:252 (1857) ("1852").

Moderate, solitary to clump-forming tuberous herb to 75 cm. Tuber 5-14 x 2.5-6.5 cm, solitary when immature and occasionally so when adult but usually offsetting sparsely by budding from peripheral adventitious shoots. Pseudostem 25-50 x 2-4.5 cm poorly defined, partly to completely enclosing the developing peduncle, pale to mid slightly glaucous green with large jagged purple-brown to greenish brown marking especially on the petiolar sheath. *Leaves* 10-35 x 6-20 cm, pale to mid- slightly glaucous green. Inflorescence 15-45 cm in total length, smelling very strongly of rotting fish, dung or carrion when newly opened; penduncle partially enclosed by pseudostem visible portion 2-15 x 1-2 cm, pale to mid- slightly glaucous green; spathe tube 5-11 x 3-6 cm, oblong, strongly convolute, exterior pale green with jagged brown-purple to dull greenish purple blotches, interior pale green with purple staining, conspicuous deep purple, longitudinal ridges and very dense reflexed bristle-like to subulate deep purple hairs at the entrance; spathe limb 10-40 x 8-34 cm, oblong-ovate, acute to

acuminate, interior dull pale green with dense dull pinkish staining and blotching, densely to somewhat sparsely hirsute, hairs deep purple, reflexed, considerably more dense towards the base and near the spathe tube entrance, spathe limb marcescent to deciduous; spadix 13-43 cm in total length, recurved, lying on the spathe limb; spadix appendix 9-38 x 1.5-2.5 cm, stipitate, slender to somewhat massive cylindric-fusiform, dull cream stained purple, densely clothed with deep purple, upwardly-directed processes varying gradually from massive and subulate at the appendix base to slender and hair-like at the apex. Flowers: pistillate flowers arranged in a short-stalked, oblong zone 1.5-3 cm x 5-15 mm; ovary oblong, 2-3.3 x 1.5-2 mm, pale cream to very pale green, stylar region pale purple, stigma 0.5-0.75 x c. 0.3 mm, cream; pistillodes 5-25 x 1-4 mm, subulate-falcate, dull yellow, upper 2/3 stained purple; staminate flowers arranged in an ± oblong zone 1.5-2.5 x 1.5-2 cm, anthers 1.5-2.5 x 0.75-1.5 mm, deep purple. Infructescence 5-12 x 2.5-7 cm, comprised of c. 60 berries; berries obovoid to globose-ellipsoid, 3.5-7 x 3-5 mm, orange-red when ripe. Seed broadly ovoid, c. 4 mm diam, mid-brown. Chromosome count 2n = 56 (BEDALOV 1976 [as *Dracunculus crinitus*], SCRUGLI et BOCCHIERI 1977, PETERSEN 1989).

Distribution. Balearics (Mallorca, Minorca), Corsica, Sardinia.

Ecology. Rocky slopes, cliffs close to the sea. 25-250 m a.s.l.

The colonies known all occur on rocky slopes or cliffs close to the sea. The tubers are buried deep beneath boulders, the plant emerging through gaps and fissures in the rocks and resting on the rock surface so that, in flower, a rosette of foliage surrounds the inflorescence. *Helicodiceros* almost always occurs close to cliff-side gull colonies and the flies and beetles associated with these colonies appear to be the main pollinators (MEEUSE et MORRIS 1984).

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**References**

BEDALOV M. (1972): Novi broj kromosoma za vrstu Dracunculus vulgaris Schott. - Acta Bot. Croat. 31:87-89.

BEDALOV M. (1976): Cytotaxonomical investigation in the genus Dracunculus. - Biol. Écol. Médit. 3(2):41-43.

BOGNER J. et NICOLSON D.H. (1991): A revised classification of Araceae with dichotomous keys. - Willdenowia 21:35-50.

BORGEN L. (1969): Chromosome numbers of vascular plants from the Canary Isles, with special reference to the occurrence of polyploidy. - Nytt Magasin for Botanik 16:81-121.

ENGLER H. G. A. (1879): In: A. et C. DC.: Monographiae Phanerogamarum 2. Paris.

GOEBEL K. (1911): Über Wendeltreppenblätter. - Naturwiss. Wochenschr 10:97-100.

GOEBEL K. (1913): Wendeltreppenblätter discussed. In: Organographie de Pflanzen, 1:25-26. Jena.

GRAYUM M. H. (1992): Comparative External Pollen Ultrastructure of the Araceae and Putatively related Taxa. - Monographs in Systematic Botany 43. Missouri Botanical Garden.

KUNTH K. S. (1841): Enumeratio Plantarum 3. - Stuttgart and Tübingen.

LARSEN K. (1960): Cytological and experimental studies on the flowering plants of the Canary Isles. - Kgl. Danske Vidensk. Selsk. Biol. Skr. 11(3):1-60.
MARCHANT C. J. (1972): Chromosome variation in Araceae: 4. Areae. - Kew Bull. 26(3):395-404.
MEEUSE B. et MORRIS S. (1984): The Sex Life of Flowers. London.
MILL R. R. (1984): Araceae. In: DAVIS P. H. (ed.): Flora of Turkey 8:41-63.
MILLER P. (1754): Gardeners Dictionary Abridged ed. 4. London.
PETERSEN G. (1989): Cytology and systematic of Araceae. Nord. J. Bot. 9(2):119-166.
PRIME C. T. WEBB D. A. (1980): Dracunculus. In: TUTIN, T.G. et. al. (eds.): Flora Europaea 5:272. Cambridge University Press. London.
SCHOTT H. W. (1832): In: SCHOTT H. W. et ENDLICHER S.F.L.: Meletemata Botanica. Vienna.
SCHOTT H. W. (1853): Pflanzenskizzen. - Oesterr. Bot. Wochenbl. 3:396-370.
SCHOTT H. W. (1856): Synopsis Aroidearum. Vienna.
SCRUGLI A. et BOCCHIERI E. (1977): Numeri cromosomici per la flora Italiana: 348-357. - Inf. Bot. Ital. 9:127-133.
STRID A. et FRANZEN R. (1981): In: LÖVE A.: IOPB chromosome number reports: LXXIII. - Taxon 30(4):829-861.
THANIKAIMONI G. (1969): Esquisse palynologique des Aracées. - Inst. Franc. Pondichéry, Trav. Sect. Sci. Tech. 5:1-31.
TROLL W. (1932): Über Diplophyllie und verwandte Erscheinungen in der Blattbildung. - Planta 15:355-406.

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