



Carpology of the genus *Tragopogon* L. (Asteraceae)

ALEXANDER P. SUKHORUKOV¹* & MAYA V. NILOVA¹

¹Department of Higher Plants, Biological Faculty, Moscow Lomonosov State University, 119234, Moscow, Russia; suchor@mail.ru

*Corresponding author

Abstract

67 species of *Tragopogon* were investigated with regard to fruit anatomy. The outer achenes, especially the beak and the central part of the seed-containing body, provide the most valuable features (diameter and outlines of the body and the beak, and arrangement of the mechanical elements in the body parenchyma). Some specimens of widely distributed taxa (e.g. *T. capitatus*, *T. dubius*, *T. pratensis*, *T. pseudomajor*) show variation in the character set and require more investigation prior to further taxonomic treatment. The species studied are classified into informal groups to demonstrate the diversity of carpological traits within the genus, and a comparison is made with the existing molecular phylogeny. The separation of the genus *Geropogon* from *Tragopogon* is supported by the achene anatomy.

Key words: *Geropogon*, *Scorzonerinae*, *Cichorieae*, taxonomy, molecular phylogeny

Introduction

The genus *Tragopogon* L. (Asteraceae: *Cichorieae*, *Scorzonerinae*) comprises about 150 species distributed mostly in semiarid and mountainous regions of Eurasia (Bell *et al.* 2012). As a rule they are easily recognized by the grass-like, long, undifferentiated, basally broadened, semi-amplexicaul leaves; well-developed, sometimes apically inflated peduncules; cylindrical involucre consisting of (5–6)7–12 phyllaries arranged usually in a single row, rarely in 2 rows; large capitula with yellow, reddish yellow or mauve flowers, and large (1 cm and above) tuberculate fruits (achenes) with a plumose pappus. Among the diagnostic characters of infrageneric rank, flower or fruit morphology features are widely used. However, the identification of many species on the basis of herbarium material is problematic because of wide separation between flowering and fruiting phenophases and the inability to observe some characters seen only on living plants, e.g. details of the coloration of the flowers (Figs. 1–3) or stigmas. Occurrence of interspecific hybridization reported in the literature (Ownbey 1950, Ownbey & McCollum 1953, Pires *et al.* 2004, Buggs *et al.* 2008, Mavrodiev *et al.* 2008) or facultative apomixis recently found in *T. dubius* (Kashin *et al.* 2007) may affect the character set of individuals.

In most species of the genus the achenes are differentiated into a wider (seed-containing) body and a thinner beak. The length of the achenes (without pappus) varies from 1 to 5.5 cm, with varying ratio between body and beak. Some species are characterized by a very short beak in comparison with the body (*T. dasyrhynchus*, *T. gaudanicus*, *T. podolicus*, *T. pusillus*, *T. scoparius*, *T. tanaiticus*), and rarely the beak is absent (*T. dubjanskyi*, some individuals of *T. scoparius*); however, most species have developed an elongated beak that may exceed the length of the body. At its apex, below the flat structure from which the pappus bristles arise, termed the pappus disk or annulus (e.g. Nikitin 1933, Kuthatheladze 1957, Borisova 1964, Tzvelev 1989, Li 1993; Soltis 2006; Zhu *et al.* 2011), the beak is scarcely or significantly inflated. The pappus is 0.6–4 cm long, with slightly unequal rows of softly fimbriate plumose bristles.

As in some other Asteraceae (Becker 1913, Grimbach 1914, Mandák 1996), profound heterocarpy is typical of *Tragopogon*. Both extreme (outermost and innermost) fruit types drastically differ in their shape, length, colour, weight, ultrasculpture, or details of anatomy (Voytenko 1981), as well as abscission pattern (Green & Quesada 2011), although the achenes in an intermediate position on the receptacle are characterized by morphological and anatomical structure transitional between that of the outer and inner achenes (Voytenko 1981, Maxwell *et al.* 1994). The lower weight of the central achenes in *Tragopogon* correlates with a greater long-range dispersal in comparison to the outer achenes which have mostly atelechoric dissemination (Voytenko 1981).

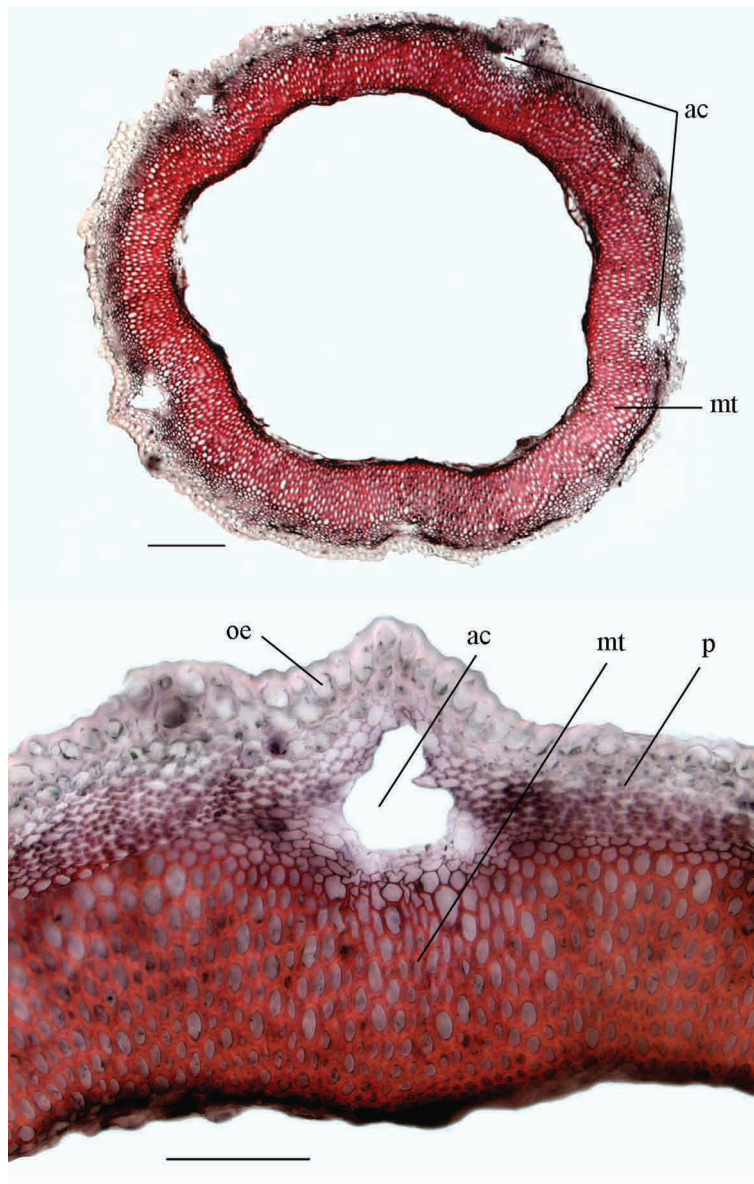


FIGURE 12. Cross section of inner achene body of *G. hybridus* (A), close-up view (B). Seed deleted. Abbreviations: ac—air cavity, mt—mechanical tissue, oe—outer epidermis, p—parenchyma. Scale bars: A—200 μ m, B—100 μ m. Voucher of specimens: see caption of Fig. 11.

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Appendix

Origin of materials

- Tragopogon abolinii* S.A. Nikitin (nomen): Tajikistan, distr. Khodjent, Mogol-tau, IV.1924, M. Popov & A. Vvedensky 10 (MW);
- T. acanthocarpus* Boiss.: Iran, prov. Mazandaran, Lar valley, VII.1974, P. Wendelbo & Assadi 13322 (W-05146);
- T. afghanicus* Rech.f. & Koie: 1) Afghanistan, Aoi Kurak, VIII.1939, W. Koelz 13798 (W-3122); 2) Afghanistan, Bamian, valley of Foladi river, VII.1974, I.A. Gubanov *et al.* 597 (MW);
- T. albinervis* Freyn & Sint.: Turkey, prov. Erzurum, Tortum Gol, VII.1960, Stainton & Henderson 6116 (W-07775);
- T. altaicus* S. A. Nikitin & Schischk.: 1) “Songaria”, [anno] 1842, A. Schrenk *s.n.* (LE);
- T. angustissimus* S.A. Nikitin: Tajikistan, Zeravshan range, VII.1931, S.A. Nikitin 454 (MW);
- T. australis* Jord.: 1) Morocco, Atlas magnum, prope pag. Asni, VI.1926, H. Lindberg *s.n.* (H); 2) Spain, prov. de Jaén, VI.1952, H. Roivainen *s.n.* (H);
- T. badachschanicus* Boriss.: 1) Badakhshan, between Khory & Osh, IX.1955, S.S. Ikonnikov 5101 (LE); 2) [Tajikistan] Kaindy river, Suyak-Mazar, VIII.1958, N.N. Tzvelev 1473 (LE); 3) Tajikistan, Alay range, Kichik-Karamyk valley, VIII.1976, G.M. Ladygina, S.S. Ikonnikov 1884 (LE);
- T. bornmuelleri* Ownbey & Rech.f.: Iraq, distr. Mosul, VII.1957, K.H. Rechinger 12028a (W-19532);
- T. borysthenicus* Artemczuk: 1) Ukraine, Aleshki, VI.1909, V. Transhel *s.n.* (LE); 2) Ukraine, Dzharylagach, VIII.1923, S.A. Dzevanovsky *s.n.* (LE);
- T. buphthalmoides* var. *humilis*: Syria, Mt. Hermon, Ein Jinna, VII.1924, A. Eig *s.n.* (HUI);
- T. capitatus* S. A. Nikitin: 1) [Kazakhstan] near Verny (Almaty), VI.1893, I. Killoman *s.n.* (LE); 2) Kazakhstan, distr. Atbasar, VI.1914, I. M. Krascheninnikov 5339 (LE); 3) Kirghizia, valley of Ala-archa river, VII.1989, T. Ostroumova 7 (MW);
- T. caricifolius* Boiss.: Iran, Tehran, Mt. Elburz, V.1975, K.H. Rechinger 52121 (W-01363);