

A new Spanish species of *Tragopogon* (Asteraceae: Lactuceae)

CONSUELO DÍAZ DE LA GUARDIA* and GABRIEL BLANCA

Departamento de Botánica, Facultad de Ciencias, Universidad de Granada, Avenue Fuentenueva s/n, E-18071 Granada, Spain

Received May 2003; accepted for publication June 2004

Tragopogon cazorlanum (Asteraceae: Lactuceae) is proposed as a new Spanish species with distribution restricted to the Baetic mountains (south-eastern Spain). Its morphological, palynological, chromosomal, biogeographical and ecological features are discussed, as well as its main relationships and differences with reference to other Spanish species of the genus. © 2004 The Linnean Society of London, *Botanical Journal of the Linnean Society*, 2004, 146, 505–511.

ADDITIONAL KEYWORDS: chorology – cytogenetics – Iberian Peninsula – palynology – taxonomy.

INTRODUCTION

The genus *Tragopogon* L. contains c.100 species distributed throughout Europe, temperate Asia and North Africa, principally in south-western to central Asia, with a number of widely introduced species (Bremer, 1994). Although some 20 species are listed in *Flora Europaea*, Richardson (1976) limited the presence in the Iberian Peninsula to only four. Blanca & Díaz de la Guardia (1996), on the other hand, listed eight Iberian species, seven previously described (*T. porrifolius* L., *T. angustifolius* Bellardi ex Willd., *T. crocifolius* L., *T. castellanus* Levier, *T. pratensis* L., *T. lamottei* Rouy and *T. dubius* Scop.) and one new species (*T. pseudocastellanus* Blanca & C. Díaz). *Tragopogon hybridus* L. has been excluded from the genus, as it is considered to belong to the monotypic genus *Geropogon* L. (Wilson, 1982; Díaz de la Guardia & Blanca, 1988a, b).

The only tetraploid Iberian species is *T. castellanus* ($2n = 24$; Díaz de la Guardia & Blanca, 1990), although *T. pseudocastellanus* also appears to be tetraploid based on the size of its pollen (Blanca & Díaz de la Guardia, 1996), given that polyploids have larger pollen grains than diploid species (Díaz de la Guardia & Blanca, 1988c).

In the Spanish mountains of Cazorla and Segura (Jaén Province) and, principally, of Alcaraz (Albacete Province), several populations of a tetraploid *Tragopogon* have recently been discovered. Based on its level of ploidy, this plant first appeared to be related to *T. castellanus*; nevertheless, it had a distinctive combination of characters making final assignment to any other species impossible.

Morphological, carpological, palynological and karyological evidence is provided here for its recognition as a distinct species.

MATERIAL AND METHODS

Most of the material used for this study was collected directly from wild populations, and the voucher specimens for each of the samples studied have been placed in GDA (Herbarium of the University of Granada). The locations from which samples were obtained are shown in the additional material examined.

For scanning electron microscopy (SEM) of material, the acetolysed pollen and achenes were directly mounted on stubs, using colloidal silver coated with gold-palladium in a vacuum evaporator and observed with a Zeiss DSM950 microscope. Microphotographs were taken of the polar and equatorial view of the pollen, as well as of the body of the achene, the apex of the beak (and annulus) and the transitional area between them.

*Corresponding author. E-mail: cdiaz@ugr.es

Pollen was acetolysed following Erdtman (1960), with modifications by Hideux (1972). The different parameters were measured under an optical microscope. Descriptions were made following the nomenclature given in Wodehouse (1935), Erdtman (1969, 1971), Sáenz (1978) and Blackmore (1982a, b).

Mature achenes from the peripheral florets of the capitulum were measured at low magnification under a stereomicroscope. The terminology of fruit-coat surface sculpturing follows Stearn (1973) and Font Quer (1979).

Mitotic chromosomes were studied using root meristems obtained from germinating achenes. These roots, pretreated with 8-hydroxyquinoline and then fixed in ethyl alcohol-acetic acid (3:1), were later hydrolysed in 1N HCl, stained in an acetic orcein solution and then flattened for light microscopy. The classification of Levan *et al.* (1964) was followed for assigning chromosome morphology, and the classification of Stebbins (1971) used to quantify karyotype-symmetry conditions.

We used IUCN (2001) red list categories and criteria to estimate the conservation status of this new species.

RESULTS

TRAGOPOGON CAZORLANUM C. DÍAZ & BLANCA *SP. NOV.*

Diagnosis: A *T. crocifolio* differt pedunculis fructiferis incrassatis (4–6 mm diam.), phyllariis 8 ligulisque dimidio brevioribus quam bracteis involucralibus; differt autem a *T. angustifolio* caulibus in tertia parte infera –1/3- floccoso-lanuginosis, basi parce ramosis aut prorsus indivisis, foliis anguste linearibus, phyllariis 8 atque achaeniis minoribus (22–27 mm longis); in super ab utroque numero chromosomatum ($2n = 24$); a *T. castellano*, denique, foliis anguste linearibus, pedunculis floriferis non incrassatis, fructiferis autem leviter incrassatis (4–6 mm diam.), atque liguli dimidio brevioribus quam phyllariis itidem differt.

Holotype: SPAIN, ALBACETE: Sierra de Segura, Cruceillas pass, between Riópar and Alcaraz, roadsides, 1250 m, 26.vi.2002, C. Díaz de la Guardia & G. Blanca (GDA 46611).

Illustration: Figure 1.

Description: Biennial to perennial. Thin caudex, fusiform, scaly at the tip. STEMS 1–3 (4), often solitary, woolly floccose on the lower third, 35–60 (70) cm, single or scantily ramose in the basal zone. LEAVES narrowly linear, numerous basal leaves of

15–25 × 0.3–0.5 cm, gradually broadening at the base to form a sheath with abundant woolly floccose pubescence; the cauline leaves (4–)6–12 × 0.4–0.6 cm, linear, subulate, glabrescent. PEDUNCLES not or hardly swollen at anthesis, reaching 4–6(–7) mm in fruit. Eight phyllaries, 22–26 × 4–6 mm in flower and 33–45(–50) × 6–9 mm in fruit, twice as long as the ligules, lanceolate, with membranous margin at the base, at times tinged black. Florets 25–40 per capitulum. Ligules 14–16 mm; limb violet or purple, yellow towards the base, 9–12 mm; tube yellowish, 5–7 mm. ACHENES 22–27 mm long (body 14–17 mm, beak 8–10 mm), slightly curved, gradually tapering towards the beak, body with 5 primary ribs, scabrous, alternating with 5 less prominent secondary ribs with less marked ornamentation (Fig. 2); prickles hooked at the tip; intercostal gaps reticulate, beak tetragonal, with winged keels, club-shaped at the tip; pappus 18–24 mm, straw-coloured, annulus woolly (Fig. 3). POLLEN (Fig. 4) belongs to the '*Tragopogon* type' described by Wodehouse (1935). Tricolporate and isopolar, with radial symmetry. Size medium to large, $P = 37–42$ (39.5 ± 2.3) μm , and $E = 44–50$ (47.0 ± 2.6) μm . Shape suboblate ($P/E = 0.80–0.84$). Polar (meridian) section subtriangular or subhexagonal. Six abpolar lacunae, two in each colpal zone and separated by two incipient equatorial crests that partially obstruct the pore zone; 3 equatorial lacunae, each occupying a mesocolpia, and 6 interapertural, two on each side of the equatorial ones in the direction of the poles. Polar zones with variable number of spines (15–20); exine thickness 4.6–5.8(–6.0) μm ; spine length 2.3–2.8(–3.0) μm .

Cytogenetic analysis: The chromosome number found in the populations studied (see additional material examined) was $2n = 24$ (Figs 5–8). The karyotype includes six pairs of medium-sized chromosomes, pair 1 subtelocentric (st) and pairs 2–6 submetacentric (sm); and another six pairs of small and metacentric (m) chromosomes (pairs 7–12). The second pair bears a satellite. The chromosomal formula is $2st + 2sm + 8sm + 12m$. Karyotype asymmetry is of the 2B type. In one of the populations studied (Figs 5, 6), pair 5 is also a carrier of a satellite.

Flowering: May–June.

Ecology: In cool, wet meadows near watercourses and on roadsides.

Etymology: After the city of Cazorla (Jaén province, Spain).

Conservation status: VU B2ac(ii), D2.

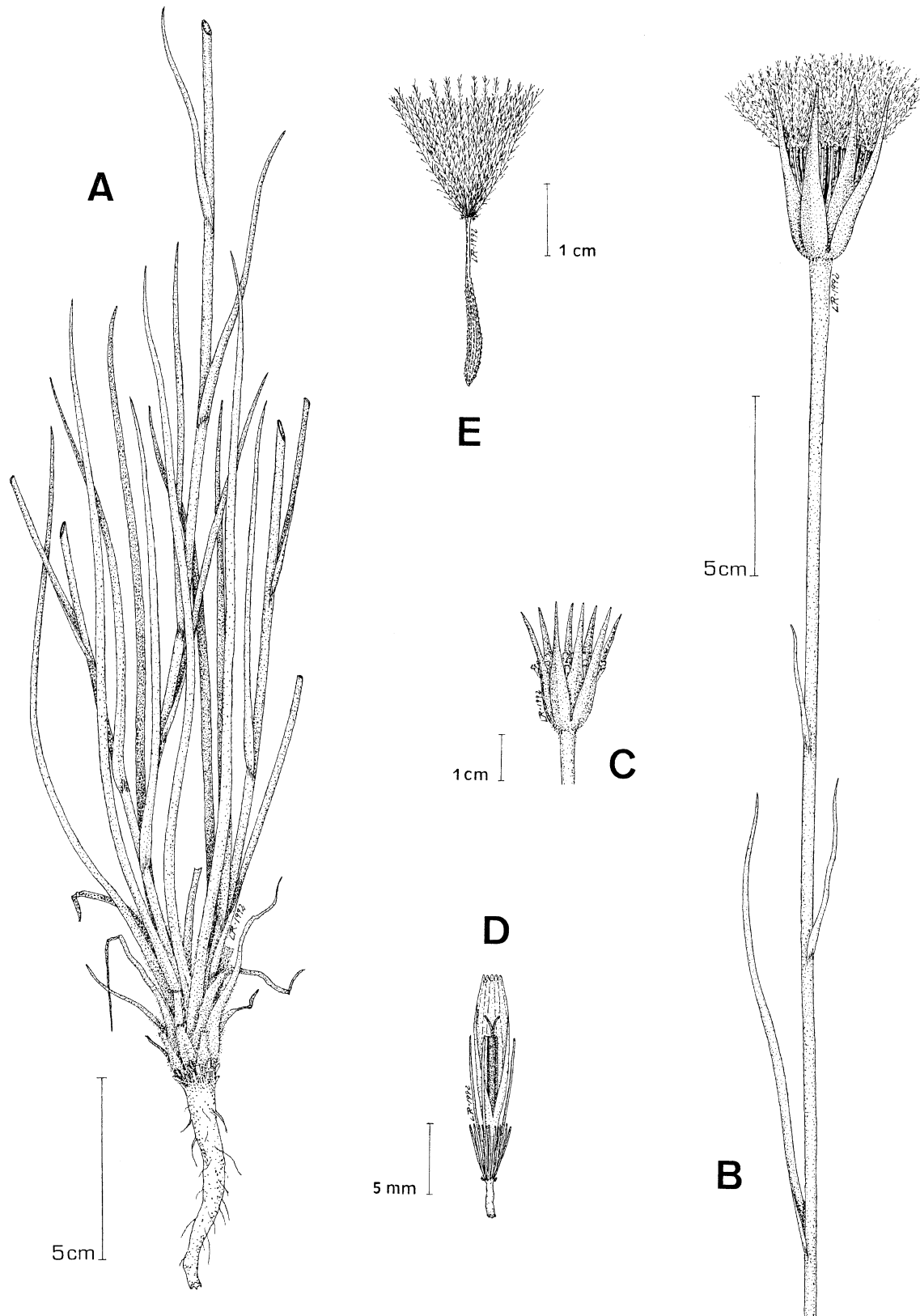
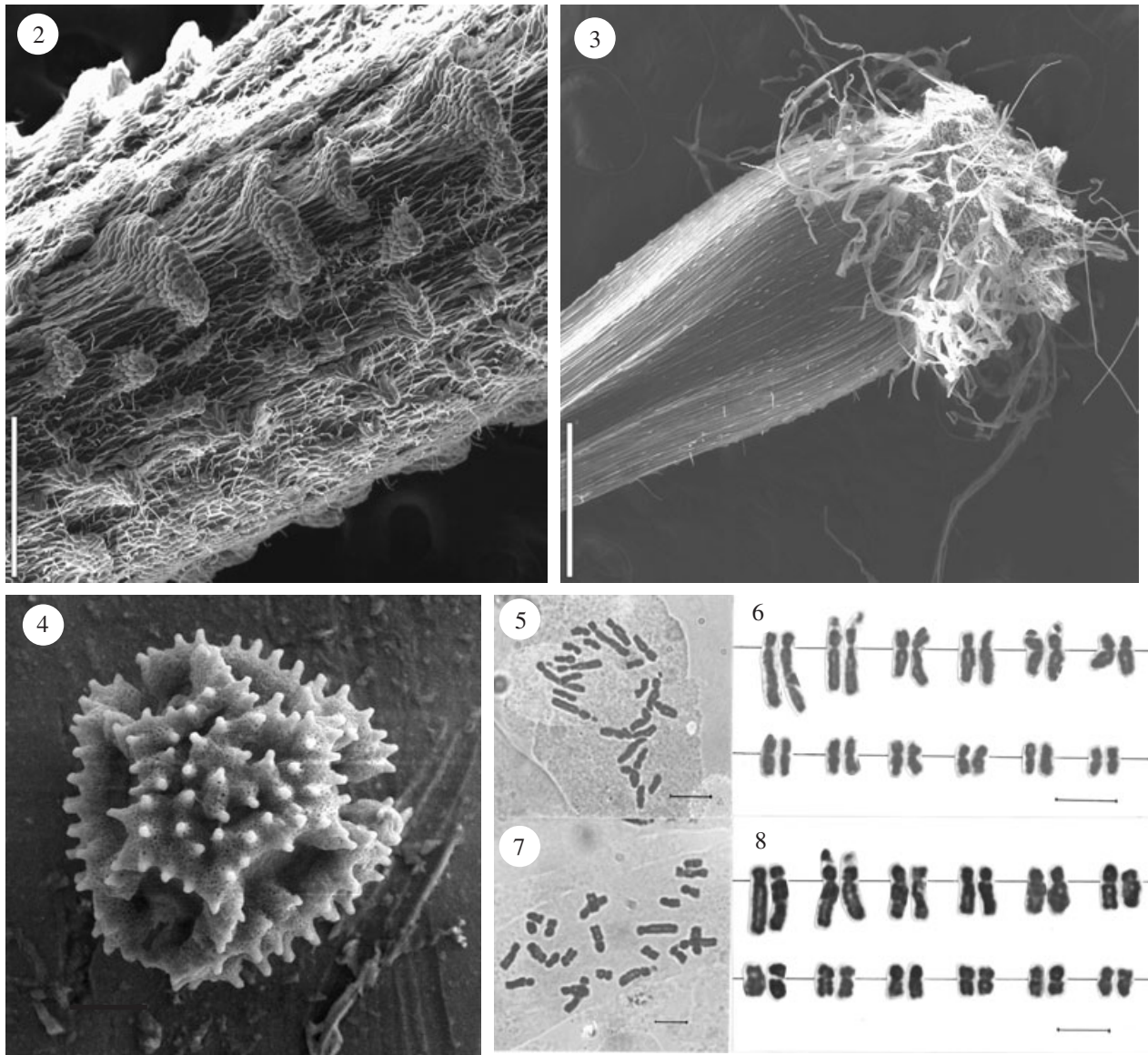


Figure 1. *Tragopogon cazorlanum* Díaz de la Guardia & Blanca **sp. nov.** (GDA 46611). A, B, habit; C, flowering capitulum; D, ligule; E, achene and pappus.



Figures 2–8. Details of *Tragopogon cazorlanum* sp. nov. Fig. 2. Body of achene, SEM. Scale bar = 1 mm. Fig. 3. Apex of beak and annulus of achene, SEM. Scale bar = 1 mm. Fig. 4. Pollen grain, polar view, SEM. Scale bar = 10 μ m. Figs 5–8. Metaphase plates and karyotypes. Scale bar = 5 μ m. Figs 5, 6. Díaz de la Guardia & Blanca GDA 46611; Figs 7, 8. Blanca & Díaz de la Guardia GDA 46607.

DISTRIBUTION AND BIOGEOGRAPHY

Tragopogon cazorlanum is known only from the provinces of eastern Jaén, south-eastern Albacete and north-eastern Granada (south-east Spain), in the Alcaraz, Segura, Cazorla and Castril mountains (Fig. 9). Biogeographically, these territories belong to the Baetic chorological province, specifically to the Subbaetic sector and Cazorlensean and Alcaracensean subsectors (cf. Rivas Martínez, 1987), in which *T. cazorlanum* can be regarded as endemic. Bioclimatically, this plant has been observed in the mesomedi-

terranean and particularly the supramediterranean stages, and under both dry and subhumid ombroclimates (cf. Rivas Martínez, 1990), although it grows better in the latter.

TAXONOMIC DISCUSSION

Tragopogon cazorlanum shares its distribution area mainly with *T. crocifolius* and *T. angustifolius*, the species closest to it and with which it can be confused. *Tragopogon cazorlanum* can be distinguished from

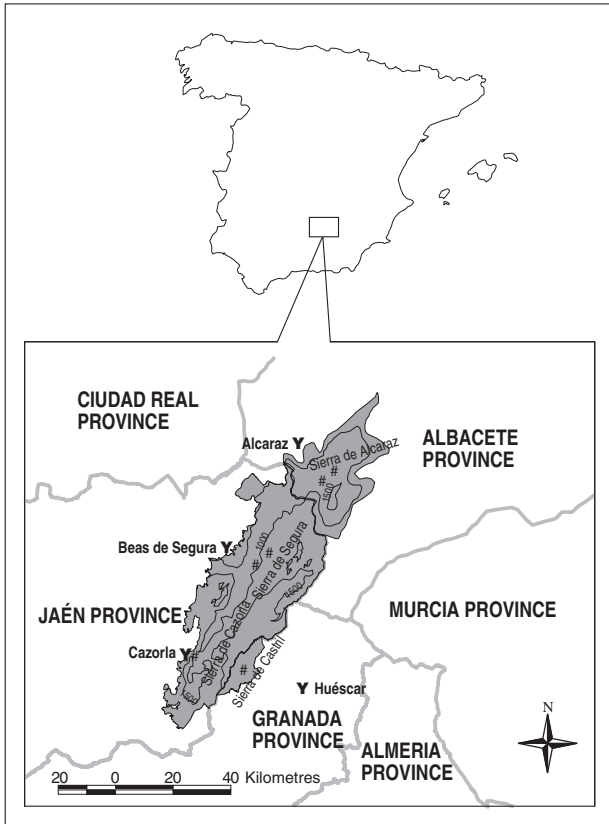


Figure 9. Distribution of *Tragopogon cazorlanum* sp. nov. in Spain.

T. crocifolius by thickened peduncles during fruiting [4–6(7) mm], by eight phyllaries, and by ligules half the length of the phyllaries. *T. cazorlanum* can be differentiated from *T. angustifolius* by the woolly floccose stems on the lower third, simple or hardly ramose in the basal zone, leaves narrowly linear, eight phyllaries and achenes smaller (22–27 mm). Also, *T. cazorlanum* is distinct from the other two species in having a chromosome number, $2n = 24$. This genetic trait is also present in another species on the Iberian Peninsula, *T. castellanus*, but *T. cazorlanum* can be distinguished by its narrowly linear leaves, peduncles not swelling at anthesis but swelling slightly at fruiting [4–6(–7) mm], and by ligules half as long as the phyllaries. Table 1 summarizes the characteristics differentiating these three species. Given the achene features pointed out by Blanca & Díaz de la Guardia (1997), *T. cazorlanum* may be distinguished from the closest species by the following characteristics: *T. angustifolius* has larger achenes (30–40 mm); the body being more than double the length of the beak in *T. crocifolius*; while *T. castellanus* has a beak sharply tapering at the tip.

The pollen type of *T. cazorlanum* is the same as in other *Tragopogon* species (Díaz de la Guardia & Blanca, 1988c), otherwise similar to *Koelpinia* Pallas (Blackmore, 1982a). With respect to pollen size, in common with the similarly tetraploid *T. castellanus* (Díaz de la Guardia & Blanca, 1988c), the values of P and E are somewhat larger than in the diploid species inhabiting the Iberian Peninsula.

KEY TO SPECIES OF *TRAGOPOGON* FROM THE IBERIAN PENINSULA

- 1. Ligules lilac, violet-reddish or purple, sometimes yellowish at the tip and/or base 2
- 1'. Ligules yellowish, sometimes dorsally reddish-orange 6
- 2. Phyllaries 8–12 3
- 2'. Phyllaries 5–7 5
- 3. Peduncles markedly swollen at anthesis; achenes 35–45 mm long *T. porrifolius* L.
- 3'. Peduncles not or hardly swollen at anthesis; achenes 23–30 mm long 4
- 4. Leaves narrowly linear; ligules 1/2 length of phyllaries; peduncles slightly swollen at fruiting (4–6 mm wide) *T. cazorlanum* C. Díaz & Blanca
- 4'. Leaves linear, ligules 2/3 length of phyllaries, sometimes the same; peduncles ≤ 7–9 mm wide during fruiting *T. castellanus* Levier
- 5. Peduncles swollen; ligules 1/2 length that of phyllaries; achenes 34–45 mm *T. angustifolius* Bellardi ex Willd.
- 5'. Peduncles not swollen; ligules 2/3 length of phyllaries; achenes 18–25 mm *T. crocifolius* L.
- 6. Phyllaries 5 (7); achenes 17–25 mm long 7
- 6'. Phyllaries 8 (12); achenes 22–35 mm long 8
- 7. Cauline leaves subulate, 0.3–0.5 cm wide; ligules 4/5 length of phyllaries or almost the same; achenes 17–22 mm long *T. pratensis* L.
- 7'. Cauline leaves linear-lanceolate, 0.6–0.8 cm wide; ligules 2/3 length of phyllaries; achenes 20–25 mm long *T. pseudocastellanus* Blanca & C. Díaz
- 8. Peduncles contracted below the capitulum during fruiting; phyllaries with reddish or blackish margin; florets yellow, with reddish-orange dorsal veins *T. lamottei* Rouy
- 8'. Peduncles gradually swollen towards the capitulum, phyllaries greenish; florets yellow *T. dubius* Scop.

Table 1. Differences between *Tragopogon cazorlanum* sp. nov. and related species

Character	<i>T. crocifolius</i>	<i>T. angustifolius</i>	<i>T. cazorlanum</i>	<i>T. castellanus</i>
Base of the stem				
branching	Simple or hardly ramose	Very ramose	Simple or hardly ramose	Very ramose
hair-covering	Woolly-floccose	Glabrous	Woolly-floccose	Woolly-floccose
Basal leaves	Narrowly linear	Linear-lanceolate	Narrowly linear	Linear, often cirrhose
Peduncles at fruiting (width, in mm)	3–4	5–8	4–6 (7)	7–9
Number of phyllaries	5 (6)	5–7 (8)	8	8 (12)
Ligules/phyllaries	2/3	1/2	1/2	2/3
Achene length (mm)	18–25	34–45	22–27	23–30
Chromosome number ($2n =$)	12	12	24	24

While most Iberian *Tragopogon* species have the chromosome number $2n = 12$ (Díaz de la Guardia & Blanca, 1988a, d; Díaz de la Guardia & Díaz de la Guardia, 1988; Blanca & Díaz de la Guardia, 1996), *T. cazorlanum* has $2n = 24$, and is thus tetraploid, as is *T. castellanus* (Díaz de la Guardia & Blanca, 1990); this latter species also coincides in chromosome morphology, which is quite uniform throughout the genus. *T. cazorlanum* is probably allopolyploid, having originated from *T. crocifolius* and *T. pratensis*, which shared the same distribution area, although further investigation is required.

Additional material examined: SPAIN: ALBACETE: Between Riópar and Alcaraz, Crucetillas pass, 1250 m, 26.vi.2002, Díaz de la Guardia & Blanca, GDA 46611; between Alcaraz and Riópar, 1200 m, 26.vi.2002, Díaz de la Guardia & Blanca, GDA 46610. JAÉN: Between Hornos and el Yelmo, 1170 m, 26.vi.2002, Blanca & Díaz de la Guardia, GDA 46608; between el Yelmo and Siles, 1150 m, 26.vi.2002, Blanca & Díaz de la Guardia, GDA 46607; Sierra de Cazorla, Linarejos, 26.vi.2002, Díaz de la Guardia & Blanca, GDA 46609. GRANADA: Sierra de Castril, pr. Rio Castril, 950 m, 20.vi.1992, Salazar, GDAC 40025.

ACKNOWLEDGEMENTS

We are grateful to P. Manuel Laínz, S. J. for the Latin description, F. Alba for drawing the distribution map and to an anonymous referee for valuable corrections and recommendations.

REFERENCES

- Blackmore S. 1982a.** Palynology of subtribe Scorzonnerinae (Compositae: Lactuceae) and its taxonomic significance. *Grana* **21**: 149–160.
- Blackmore S. 1982b.** The apertures of Lactuceae (Compositae) pollen. *Pollen et Spores* **24** (3–4): 453–462.
- Blanca G, Díaz de la Guardia C. 1996.** Sinopsis del género *Tragopogon* L. (Asteraceae) en la Península Ibérica. *Anales del Jardín Botánico de Madrid* **54**: 358–363.
- Blanca G, Díaz de la Guardia C. 1997.** Fruit morphology in *Tragopogon* L. (Compositae: Lactuceae) from the Iberian Peninsula. *Botanical Journal of the Linnean Society* **125**: 319–329.
- Bremer K. 1994.** *Asteraceae. Cladistics and classification*. Portland, OR: Timber Press.
- Díaz de la Guardia C, Blanca G. 1988a.** La posición sistemática de *Geropogon* L. (Compositae) en la subtribu Scorzonnerinae Dumort. *Lagasalia* **15** (extra): 361–367.
- Díaz de la Guardia C, Blanca G. 1988b.** El género *Geropogon* L. (Compositae: Lactuceae). *Lazaroa* **9**: 31–44.
- Díaz de la Guardia C, Blanca G. 1988c.** Palinología del género *Tragopogon* L. (Compositae: Lactuceae) en la Península Ibérica. In: Civis Llovera J, Valle Hernández F, eds. *Actas de Palinología*. Salamanca: Universidad de Salamanca, 61–67.
- Díaz de la Guardia C, Blanca G. 1988d.** Una especie poco conocida de *Tragopogon* L. (Compositae): *T. lamottei* Rouy. *Lagasalia* **15** (extra): 361–367.
- Díaz de la Guardia C, Blanca G. 1990.** *Tragopogon castellanus* Levier = *T. crocifolius* subsp. *badalii* Willk. *Anales del Jardín Botánico de Madrid* **47** (1): 253–256.
- Díaz de la Guardia C, Díaz de la Guardia R. 1988.** Estudios cariológicos en el género *Tragopogon* L. (Compositae). In: Conesa JA, Recaseus J, eds. *Actes del Simposi Internacional de Botànica 'Pius Font I Quer'*, Lleida, vol. 2, Fanerogàmia, Lleida: Institut d'Estudis Ilerdencs, 137–141.
- Erdtman G. 1960.** The acetolysis method – a revised description. *Svensk Botanisk Tidskrift* **54**: 561–564.
- Erdtman G. 1969.** *Handbook of palynology. An introduction to study of pollen grains and spores*. Copenhagen: Munksgaard.
- Erdtman G. 1971.** *Pollen morphology and plant taxonomy (Angiosperms)*. New York: Hafner.
- Font Quer P. 1979.** *Diccionario de Botànica*. Barcelona: Labor.

- Hideux M. 1972.** Techniques d'étude du pollen au MEB: effets comparés en différents traitements physico-chimiques. *Micron* **3**: 1–31.
- IUCN. 2001.** *IUCN 2001 Red List categories and criteria*, v.3.1. Gland: IUCN Species Survival Commission.
- Levan A, Fredga K, Sandberg AA. 1964.** Nomenclature for centromeric position on chromosomes. *Hereditas* **52**: 201–220.
- Richardson IBK. 1976.** *Tragopogon* L. In: Tutin TG, Heywood VH, Burges NA, Moore DM, Valentine DH, Walters SM, Webb DA, eds. *Flora Europaea* 4. Cambridge: Cambridge University Press, 322–325.
- Rivas Martínez S. 1987.** *Memoria del Mapa de Series de Vegetación de España*. Madrid: ICONA, Ministerio de Agricultura, Pesca y Alimentación.
- Rivas Martínez S. 1990.** Bioclimatic belts of West Europe (relations between bioclimate and plant ecosystems). *Folia Botanica. Matritensis* **7**: 1–22.
- Sáenz C. 1978.** *Polen y Esporas*. Madrid: Blume.
- Stearn WT. 1973.** *Botanical Latin*. London: David & Charles.
- Stebbins GL. 1971.** *Chromosomal evolution in higher plants*. London: Edward Arnold.
- Wilson FD. 1982.** A cytological basis for the separation of *Geropogon* and *Tragopogon* (Compositae: Lactuceae). *Brittonia* **34** (3): 290–293.
- Wodehouse RP. 1935.** *Pollen grains*. New York: McGraw-Hill.