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Natural triploidy in *Centaurea* and *Cheirolophus* (Asteraceae)

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Abstract

Garnatje T., Garcia-Jacas N. and Vilatersana R. 2001. Natural triploidy in *Centaurea* and *Cheirolophus* (Asteraceae). Bot. Helv. 111: 25–29.

Sporadic triploid counts have been an intriguing constant in our research on karyology of the subtribe *Centaureinae*. We present in this paper some new triploid records and a survey of the documented triploidy in the group. On the basis of these and other examples in the subtribe, a tentative hypothesis on the origin of triploidy in *Centaurea* s. l. is elaborated. Our hypothesis is that triploidy in the group is closely related to the pattern of growth in some sections of *Centaurea*. These sections, especially *Acrocentron*, grow in scattered small populations in which genetic drift may lead to incompatibility.

Key words: Asteraceae, Centaureinae, *Centaurea*, karyology, polyploidy, triploids.

Introduction

The importance of karyology in *Centaurea* was initially suggested by Guinochet and Foissac (1962) and taken up by later workers in the field, including Tonjan (1980), Garcia-Jacas and Susanna (1992), Susanna et al. (1995), Garcia-Jacas et al. (1996) and Wagenitz and Hellwig (1996). During recent years, our team has carried out a large number of chromosome counts in the subtribe (Garcia-Jacas and Susanna, 1992; Garcia-Jacas et al., 1996, 1997, 1998a, 1998b) and triploid counts have been regularly found.

Triploidy is well known in cultivated plants: triploids of high economic importance are potato, wheat, barley or rye (Hageberg and Ellerström, 1959). Natural triploids are scarce, however. They are usually found in the contact zones between diploid and tetraploid populations. This contact is often favoured by human disturbance: Barrington (1985) described a hybrid triploid between *Polystichum muricatum* and *P. polyphyllum* in a contact zone caused by alteration of natural habitats. Grant (1952) pointed out that adverse growing conditions increased the number of unreduced gametes in *Gilia*.

The only stable triploids are sterile perennials. In wild plants, sterility caused by non-apomictic triploidy makes wild triploids extremely infrequent. Only in a few genera, like

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Aster and *Delphinium*, do fertile triploids exist (Lewis and Semple, 1977). In triploids of some other species, like *Leucopogon juniperinus*, fertility is the result of semiapomixis (Smith-White, 1948). In the case of *Centaurea*, no fertile triploids are known (Fernández Casas and Fernández Morales, 1979). This paper reports some further cases in this genus and in related genera.

Material and methods

Chromosome counts were made of somatic metaphases using the squash technique. Root meristems from germinating seeds collected in the wild were used, with the exception of *Centaurea lainzii.* For this species, root tips from adult plants collected in the wild were used. Samples were pretreated with 8-hydroxyquinoline at 4 °C for 8 h. The material was fixed with Carnoy for 24 h at –20 °C. Before staining, the material was hydrolysed with 5N HCl for 1h at room temperature. It was stained with 1% acetic orcein and mounted in 45 % acetic acid. Preparations were made permanent by freezing with CO_2, dehydrating in ethanol and mounting in Canada balsam. Photographs were taken using a Zeiss Standard microscope. The preparations, the negatives and the herbarium vouchers are preserved in the Botanical Institute of Barcelona (BC).

The existence of previous chromosome counts for the studied species was checked in the usual indexes of plant chromosome numbers (cf. Garcia-Jacas et al. 1997).

Results

Centaurea L.

Sect. *Acrocentron* (Cass.) DC.

Centaurea lainzii Fernández Casas. – Spain, Málaga: Sierra Bermeja, on the way to the Reales 11 km from Estepona, 600 m, serpentines, *Garcia-Jacas and Susanna 1330*, 19.vi.1989 (BC). 2n = 3x = 30 (Fig. 1). This result agrees with Fernández Casas and Fernández Morales (1979).

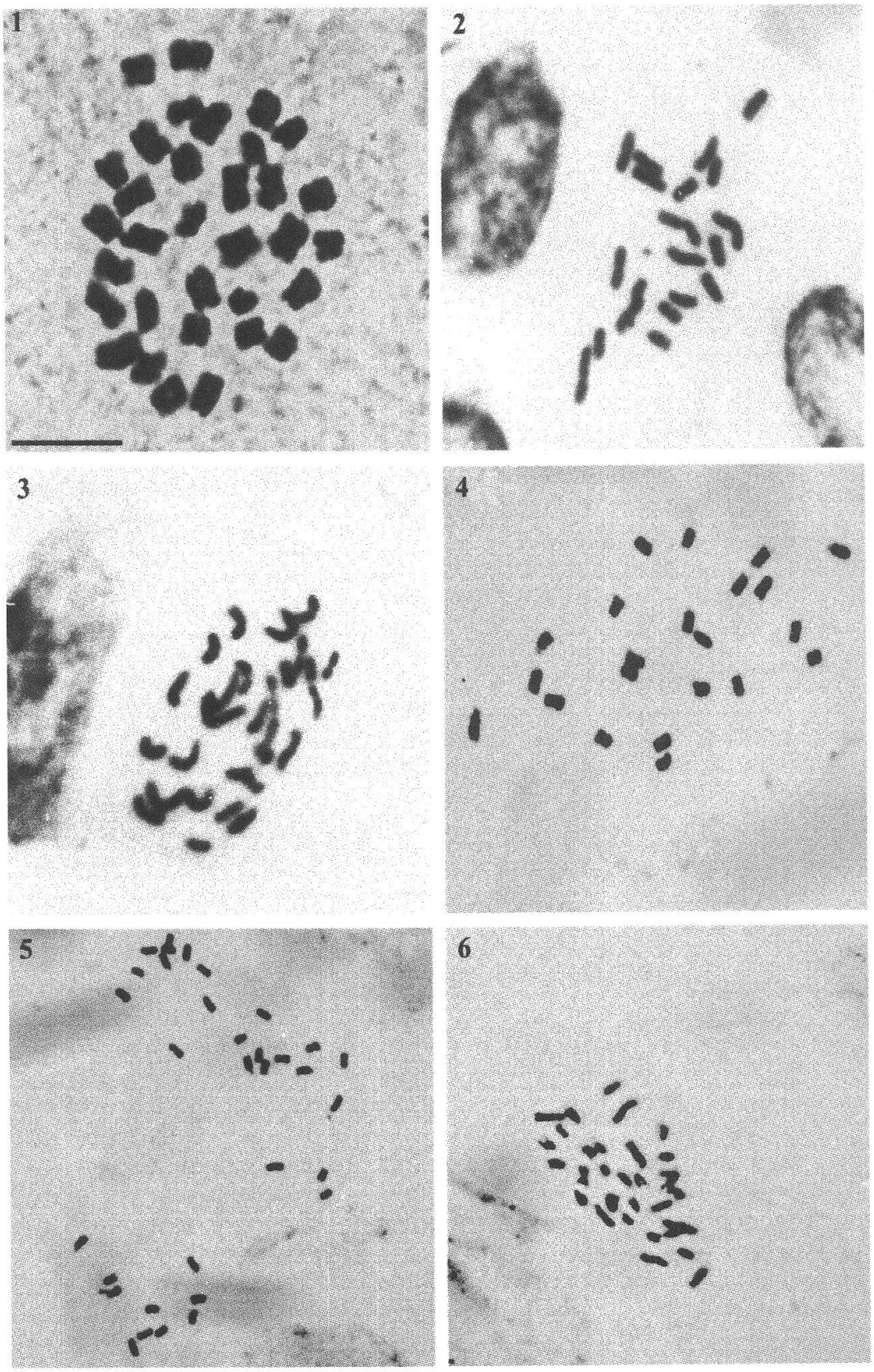
Centaurea prolongi Boiss. – Portugal, Faro: Cerro Botelho over Fonte da Murta, near Sao Bras de Alportel, 370 m, *Garcia-Jacas and Susanna 1353*, 10.vi.1990 (BC). 2n = 2x = 20 (Fig. 2). 2n = 3x = 30 (Fig. 3). The diploid level agrees with previous counts for *C. prolongi* (cf. Garcia-Jacas and Susanna, 1992). The triploid count is new.

Sect. *Seridia* (Cass.) DC.

Centaurea polyacantha Willd. – Spain, Cádiz: between Benalup and Vejer, *Romo 5382*, 12.v.1990 (BC). 2n = 2x = 22 (Fig. 4). 2n = 3x = 33 (Fig. 5). The diploid count of 2n = 22 agrees with many previous results. The triploid level, however, is new.

Cheirolophus Cass.

Ch. taganananensis (Sventenius) Holub. – Spain, Tenerife: Roque de las Ánimas (Taganana), 175 m, *Garnatje 2 and Luque*, 8.viii.1996 (BC). 2n = 2x = 30 (Fig. 6). Our result disagrees with the only other previous record for this species, a triploid count (2n = 3x = 45) by Bramwell et al. (1971).



Figures 1–6. Somathic metaphases. Fig. 1. *Centaurea lainzii* (2n = 33). Fig. 2. *C. prolongi* (2n = 20). Fig. 3. *C. prolongi* (2n = 30). Fig. 4. *C. polyacantha* (2n = 22). Fig. 5. *C. polyacantha* (2n = 33). Fig. 6. *Cheirolophus taganananensis* (2n = 30). Scale bar: 10 µm.

Discussion and conclusions

Most of known triploid counts are found in sect. *Acrocentron*, a group in which orthopolyploidy is very frequent. Most of the species of the group grow usually in small, scattered, unconnected populations (Wagenitz and Gamal-Eldin, 1985; Fernández Casas and Susanna, 1986; Garcia-Jacas and Susanna, 1992). In very small populations, genetic drift may lead to infertility and incompatibility between isolated populations of the same species. Triploids would be, then, the first step towards autopolyploidy.

In all the cases (with the only exception of *Centaurea lainzii*), besides the triploid cytotype, the diploid level is also known, which indicates that triploidy is accidental (*C. granatensis, C. prolongi* and *C. scabiosa*). Only *C. lainzii* is a stable triploid: no diploid form has yet been found in this species, known from a single large population with intense vegetative reproduction (Fernández Casas and Fernández Morales, 1979). Regarding *C. polyacantha* of sect. *Seridia*, it is a relict species which usually forms small populations in lower Andalusia and Portugal and the extreme north of Morocco, in the same way as *Acrocentron* (Susanna and Garcia-Jacas, in press). If we accept the hypothesis of genetic drift in small populations as leading to triploidy, *Centaurea polyacantha* would follow the same model as in *Acrocentron.*

Regarding the genus *Cheirolophus, C. tagananensis* is known only from a single population in Teneriffe with only a dozen individuals known. In our counts, we have always found the diploid level $2n = 2x = 30$. The triploid record in *Cheirolophus tagananensis* must have been the result of a fusion involving an unreduced gamete because no population of the same or any other species of the genus grows in the vicinity.

Resumé

Des dénombrements triploïdes sporadiques ont apparu d'une façon constante et intrigante au cours de notre recherche dans la soustribu des *Centaureinae.* Nous présentons dans cet article quelques nouveaux rapports triploïdes et une revision de la triploïdie documentée dans ce groupe. Compte tenu de ces données, une hypothèse sur l'origine de la triploïdie chez *Centaurea* s.l. a été élaborée.

Notre conclusion principale est que la triploïdie dans le groupe est fortement rattachée aux modèles de croissance dans certaines sections de *Centaurea.* Les membres de ces sections, en particulier *Acrocentron*, forment des populations petites et dispersées dans lesquelles la dérive génétique peut conduire à l'incompatibilité génétique.

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