C-bands and chiasma distribution in *Scilla amoena*, *S. ingridae*, and *S. mischtschenkoana* (Hyacinthaceae)

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Abstract: An effect of C-band pattern and polymorphism on chiasma distribution in pollen meiosis was recently demonstrated in *Scilla siberica*. A further meiotic banding study has been performed in the allies *S. amoena*, *S. ingridae*, and *S. mischtschenkoana* in order to analyze the effect, if any, of their specific C-band patterns and cytochemically different heterochromatin types on recombination. No clear evidence for a preferential formation of chiasmata adjacent to homozygous intercalary heterochromatin and no consistent reduction of chiasma frequency near strongly heterozygous intercalary heterochromatin blocks, as observed in *S. siberica*, could be found. Terminal C-band heteromorphism is suspected to cause distal chiasma defaults. The results suggest once more that there is no uniform effect of heterochromatin on crossover distribution.

The factors which govern evolutionary diversification of constitutive heterochromatin in phylogenetically related taxa are still elusive. This holds true also for the effects of heterochromatin on meiotic recombination. There are many indications in the literature that constitutive heterochromatin, which itself rarely, if ever, undergoes meiotic recombination (JOHN 1988: 69), has some influence on crossover frequency and distribution, but the evidence is inconsistent. On the one hand, a lower chiasma frequency in regions adjacent to heterochromatin is reported (MIKLOS & NANKIVELL 1976, JOHN & KING 1982, NAVAS-CASTILLO & al. 1985). On the other hand, recombination can also occur with strong preference for loci close to C-bands (JONES 1978; LOIDL 1979, 1982).

Recently we reported a C-banding analysis of pollen meiosis in *Scilla siberica*, a monocotyledonous plant species with large chromosomes (n = 6), much heterochromatin, and frequent C-band heteromorphism (BERGER & GREILHUBER 1991). We found that regions adjacent to homomorphic intercalary C-bands showed a chiasma frequency higher than in other euchromatic regions. Chiasma distribution in bivalents of chromosome variants without these C-bands was different. Strongly heteromorphic C-blocks were found to lead to reduced chiasma frequency in their vicinity.

*S. siberica* is allied to a number of other species which differ in C-banding patterns, the amount of heterochromatin, and in their cytochemical characteristics
The present study is a Giemsa C-banding analysis of pollen meiosis in three allies: *S. amoena*, *S. ingridae*, and *S. mischtschenkoana*. It was intended to investigate, as already shown in *S. siberica*, the relation of chiasma distribution to C-band pattern and polymorphism, and to gain further evidence for or against a role of C-band differentiation in crossover redistribution in these genomes.

The karyotypes of *S. amoena*, *S. ingridae*, and *S. mischtschenkoana* are well known (*Greilhuber & Speta* 1978, *DeuMLing & Greilhuber* 1982). *S. amoena* and *S. ingridae* are basically similar to each other, but *S. ingridae* shows more C-band variation. Their C-band pattern is more complex than in *S. siberica*. *S. mischtschenkoana* differs considerably from these taxa in having accumulated a different class of heterochromatin in characteristic clusters resulting in a banding style (*Greilhuber & Speta* 1978) unique within the alliance.

**Material and methods**

*S. amoena* L., *S. ingridae* Speta, and *S. mischtschenkoana* Grossh. were cultivated in the Botanical Garden of the University of Vienna (HBV). *S. amoena* is not known in the wild, our material was from the old stock in HBV. *S. ingridae* and *S. mischtschenkoana* (syn. *S. tubergeniana*) have their natural distribution in SW. Anatolia and NW. Iran, respectively. Our material was of commercial origin (Fa. M. H. Hoog, Haarlem, Netherlands).

Pollen meiosis occurs in September when the bulbs are still dormant. The whole procedure of preparation, microscopic evaluation, and graphic presentation is precisely described in *Berger & Greilhuber* (1991).

One plant of *S. amoena*, one of *S. ingridae*, and two of *S. mischtschenkoana* out of a much larger number of tested individuals were in the right stage of meiosis and provided the study with fifty bivalents of each chromosome pair per plant. Care was taken to avoid biased sampling, as described. The banded karyotypes of the plants were established from anther wall mitoses using the idiograms by *Greilhuber & Speta* (1978) and *Greilhuber* (1982) as models.

Graduation of the idiograms of *S. amoena* and *S. ingridae* was as in *Berger & Greilhuber* (1991), but in one plant of *S. mischtschenkoana*, because of a higher chiasma frequency, a larger scale resulting in one to three units per chromosome arm seemed appropriate.

The chiasma distributions are presented as summary diagrams showing how often a given arbitrary unit of the karyotype appeared bound in metaphase I. Tables 1 to 3 give detailed information on the estimated numbers of bonds (uninterrupted presumably chiasmatic conjunctions) and numbers of bound units. Mean numbers of bonds and bound units per cell at metaphase I are also included.

The bars in all Figs. represent 10 μm.

**Results**

All plants were diploid with 2n = 12, and their C-banding patterns were in agreement with previous results (*Greilhuber & Speta* 1978, *DeuMLing & Greilhuber* 1982, *Greilhuber* 1982). The karyotypes are generally similar with one metacentric and five heterobrachial pairs. One pair of nucleolar organizing regions (NORs) is found on chromosome 6 in *S. amoena* and *S. ingridae*, but 2 pairs on chromosomes 5 and 6 in *S. mischtschenkoana*. Small or prominent bands in terminal or intercalary