Asynapsis in *Zebrina pendula* Schnizl.

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During a study of meiotic chromosome behaviour in the pollen mother cells of *Zebrina pendula* Schnizl. ($n=12$), an interchange heterozygote normally characterized by rings and chains of 6, 4 or 3 chromosomes, bivalents and univalents (Venkateswarlu and Rao 1963), occurrence of asynapsis was observed at diakinesis in a single flower bud of an inflorescence. The results are presented in this paper.

Material and methods

Z. pendula, an ornamental plant, is vegetatively propagated by cuttings. It has been extensively cultivated in the Andhra University Botanical Gardens. The plants produce numerous inflorescences in all seasons of the year and the asynaptic flower bud came from material collected in mid-summer from pot cultured plants kept in the open. Acetocarmine squash technique is employed in making the preparations.

Results and discussion

In the asynaptic material the average chiasma frequency per cell was considerably low, being only 6.74 compared to 19.3 in the normal material. Chromosome associations in the asynaptic and normal material are presented in Table 1. A variable number of univalents, ranging from 10–19 per cell (Figs. 1–3) with a mean frequency of 13.23, were observed. Rod bivalents were more frequent (74.86%) than the ring bivalents (25.14%). In each of 5 out of 34 cells studied a chain of 3 chromosomes was found (Figs. 1–3). All these point to a failure of chromosome pairing or chiasma formation in the exceptional bud. The cytological differences between the asynaptic and normal material are listed in Table 2.

Although the asynaptic bud is obtained from material fixed in summer the effect of external factors like temperature in lowering the chiasma frequency to the observed level could probably be disregarded in view of the fact that the rest of the material fixed at the same time and also on different dates from the same pots showed normal chromosome associations (Fig. 4).

It is probable that a gene or chromosome mutation controlling chromosome pairing or chiasma formation would have occurred and led to the observed reduction in the chiasma frequency. Such a mutation could have arisen either earlier in the primordium giving rise to the inflorescence or later in the primordium of any one of the flowers of the inflorescence. If it is the latter case, only one flower would show asynapsis and if it is the former, all flowers in an inflorescence would be expected to manifest the character. If,

Table 1. Chromosome associations at diakinesis in the asynaptic and normal flower bud material of *Z. pendula*

Asynaptic flower bud				Normal flower bud					
Chromosome associations			Frequency	Chromosome associations			Frequency		
III	II	I		VI	IV	III	II	I	
1	1	19	1	1	1	—	7	—	1
1	2	17	1	1	—	—	9	—	6
—	4	16	5	1	—	—	8	2	3
1	3	15	1	—	2	—	8	—	1
—	5	14	8	—	2	—	7	2	1
1	4	13	1	—	1	1	8	1	1
—	6	12	12	—	1	—	10	—	12
1	5	11	1	—	1	—	9	2	7
—	7	10	4	—	1	—	8	4	3
			Total 34 cells	—	—	1	10	1	4
				—	—	1	9	3	4
				—	—	1	8	5	1
				—	—	—	12	—	29
				—	—	—	11	2	15
				—	—	—	10	4	7
							Total	95 cells	

Table 2. Differences at diakinesis between the asynaptic and normal flower bud material of *Z. pendula*

	Asynaptic flower bud	Normal flower bud
1. Average chiasma frequency per cell	6.74	19.30
2. Univalent frequency per cell	13.23	1.20
3. % of ring bivalents	25.14	69.38
4. % of rod bivalents	74.86	30.62
5. % of cells showing higher associations	14.59	46.32
6. No. of higher associations per cell when present	One only	One to two
7. Types of higher associations formed	Chains of 3 chromosomes	Rings and chains of 6, 4 and chains of 3 chromosomes
8. % of chromosomes entering into higher associations	1.83	8.86
9. Terminalization coefficient per nucleus	0.57	0.49
10. Terminalization coefficient per higher associations	0.81	0.77
11. Average no. of chromosomes per cell forming into associations	10.77	22.80

however, the mutation has taken place in the primordium even at an earlier stage than the former case, it would be expected to be revealed in all flowers

of those inflorescences arising from this common primordium. The fact that the material fixed repeatedly from different inflorescences from the same pot did not show asynapsis leads to the conclusion that the asynapsis was limited either to only one inflorescence or a single flower. There is, however, no evidence to decide between these two possibilities as the other floral buds in

Figs. 1-4. 1-3, diakinesis in asynaptic flower bud of *Z. pendula*. Arrow points to the chain of 3 chromosomes. $\times 1300$. 1, a chain of 3 chromosomes, one rod bivalent and 19 univalents. 2, a chain of 3 chromosomes, 2 bivalents (one ring and one rod) and 17 univalents. Note the interstitial chiasmata—one in the chain of 3 chromosomes and two in the ring bivalent. 3, a chain of 3 chromosomes, 4 rod bivalents (interstitial chiasma in one) and 13 univalents. 4, diakinesis in normal material of *Z. pendula*. A ring of 4 chromosomes (arrow marked) and 10 bivalents (six rings and four rods). There are 7 interstitial chiasmata. $\times 1300$.

the inflorescence were not at the same stage of development to enable scoring for asynapsis or synapsis, as the case may be. In the case of other plants with such a situation, pollen sterility in the older flowers of the same inflorescence might reasonably serve as an index for asynapsis. But in *Z.*

pendula, the pollen sterility being very high even in normal flowers (due to structural hybridity and other factors), this feature is not a dependable criterion.

Occurrence of asynapsis in only a part of a sporangium or a flower or an inflorescence is known in a few other plants also. For instance, McCollum (1958) recorded asynapsis in a few panicles of an induced tetraploid subspecies hybrid of *Dactylis* and Wagenaar (1960) noted asynapsis in a single floret of a plant in the progeny of an interspecific hybrid of *Triticum* while Vosa (1961) reported asynapsis in two cells of different anthers on the same flower in *Tradescantia*.

The occurrence of asynapsis in a few panicles, single floret or only a few sporadic cells in the microsporangium seems to be related to the time of occurrence of the mutation in the concerned meristem during the development.

Summary

Asynapsis was observed at diakinesis in the pollen mother cells of a single flower bud of *Zebrina pendula* Schnizl. ($n=12$), while the rest of the material was non-asynaptic showing rings and chains of 6, 4 or 3 chromosomes, bivalents and univalents.

Reduced chiasma frequency, high frequency of univalents and rod bivalents and low frequency of higher associations indicate a failure of chromosome pairing or chiasma formation in the exceptional bud.

A gene or chromosome mutation controlling chromosome pairing or chiasma formation occurring in the inflorescence primordium or in the primordium of a flower has probably caused the reduction in the chiasma frequency.

The above and similar occurrence of asynapsis as effecting a few cells in the sporangium or one or more flowers in an inflorescence is considered to be related to the time of occurrence of the mutation.

References

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