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The embryology of triploid F_1 hybrids between the sugarbeet and wild *Beta* species from the *Patellares* section

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Our embryological investigations on the sugarbeet x *Patellares* — species hybrids, which in 1967 [7] were limited to the diploid sugarbeet x *Beta webbiana* hybrids only, in 1968 were supplemented by analysing the diploid hybrids between the sugarbeet and *Beta procumbens*. The abberrations found in the diploid hybrids were similar, independent of the male parent (*Beta webbiana* or *Beta procumbens*). The hybrids investigated in 1968 were fully sterile, and analogical disturbances were noticed here as in previously described sugarbeet x *Beta webbiana* hybrids. These disturbances resulted in degeneration and early collapse of megaspores or disturbed embryosac formation. No developing embryos have been found in the ovules. Hence, the obtaining of backcross progeny from our diploid hybrids seems to be impossible.

MATERIAL AND METHODS

The obtaining of backcross progeny from triploid sugarbeet × *Patellares* - species hybrids is a very important point in selecting nematode resistant sugarbeet plants. As most traits of wild *Beta* species are unfavorable, the desirable type should comprise a full sugarbeet genom with some chromatine admixture of the wild species, responsible for resistance to nematodes. Incorporation of a single pair or just some fragments of chromosomes gives such a possibility as for instance in the case of introgressive hybrids of tobacco [1] and godetia [5, 6], respectively. The first important step is the obtaining of triploid F_1 progeny, which has already been realised in our Institute (S z o t a, unpublished), and the next, the producing of backcross hybrids by crossing F_1 plants with sugarbeet.

Unfortunately, all 63 seeds collected in 1967 from triploid F_1 hybrids proved to be unviable (S z o t a, unpublished). On the other hand, however, some authors have reported obtaining from such hybrids viable seeds [9] and backcross progeny (Filutowicz and Kużdowicz [8] from a hybrid between diploid sugarbeet and tetraploid *Beta patellaris*; Curtis [2]).

In 1968 embryological investigations have been carried out with an object to study the ability of our triploid hybrids to produce normal embryosacs and embryos. The buds and flowers of different ages from F_1 plants derived from the following mating combinations were investigated:

1. Sugarbeet A. Janasz A. J. 3 (4 x) × *Beta procumbens* 2 x
2. Sugarbeet A. Janasz A. J. 1 (4 x) × *Beta webbiana* 2 x
3. Monogerm sugarbeet IHAR (4 x) × *Beta webbiana* 2 x

The methods of fixing, embedding, slicing and staining the collected material were the same as we used in 1967 [7]. Photomicrographs and drawings were done with NfPK-Zeiss microscope fitted with suitable cameras.

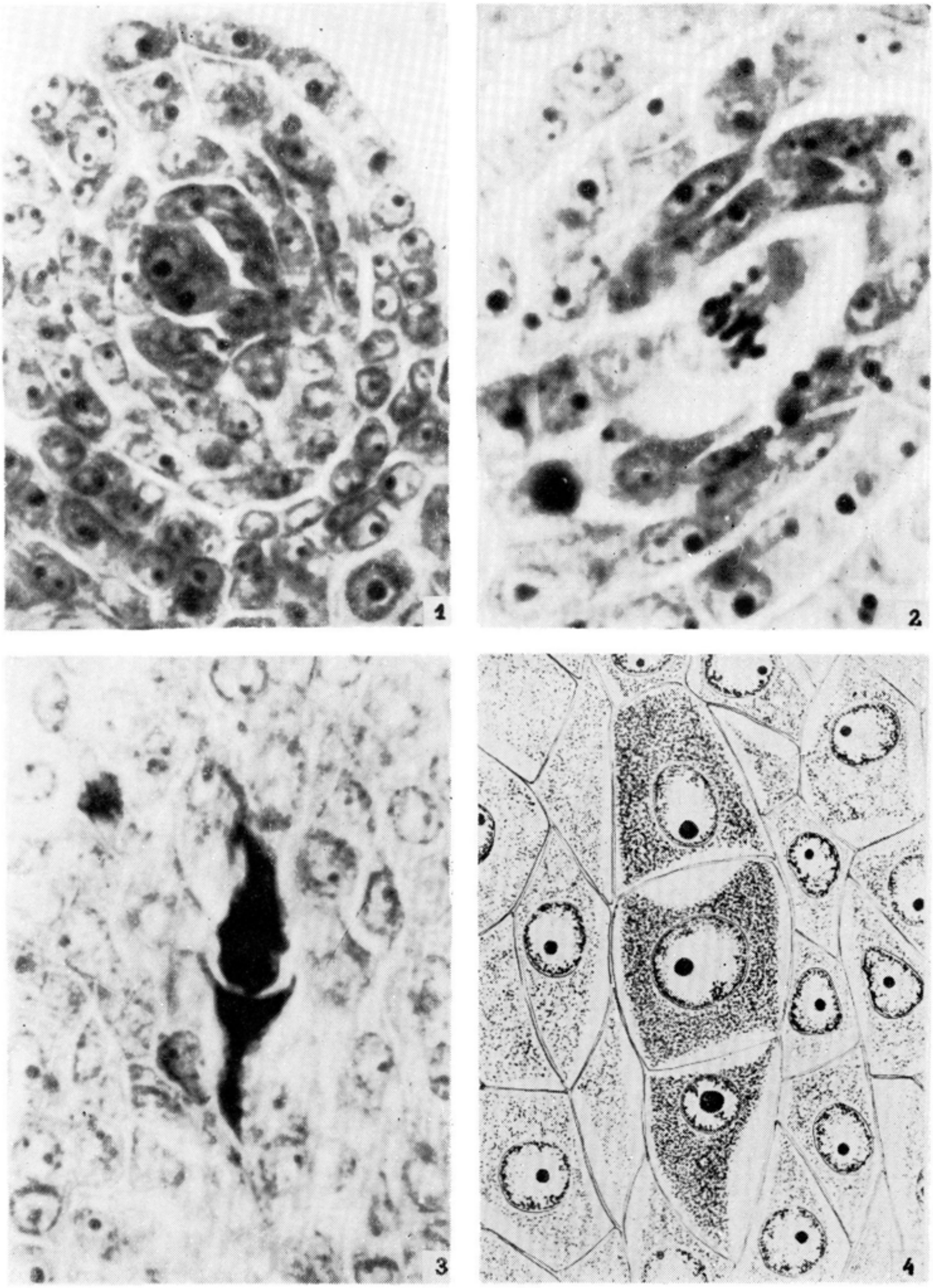
RESULTS

All three types of hybrids under investigations have shown similar disturbances in meiosis and pollen production [8]. The same holds true for embryogenesis.

In young buds normal differentiation of archesporium (fig. 1) and megaspore mother cells (fig. 2) has been observed. We have not been albe to follow the meiosis in MMC in detail, but irregularities often observed in megaspore formation seem to indicate the occurrence of similar aberrations as found in the case of PMC. In some ovules, however, the embryosacs of different age did not show any distinct signs of abnormality and/or degeneration (figs. 4, 5, 6, 9). In cultivated di- and tetraploid beets at anthesis complete embryosacs are present in the ovules, possessing egg apparatus, secondary nucleus and antipodal cells. In triploid interspecific hybrids, normal embryosacs have been found in less than 10% of ovules only (fig. 10), whereas in the remaining ones the megaspores or embryosacs of different age were abnormal or collapsed (figs. 3, 7, 8). The exact stage in which their development had been arrested was possible to ascertain only in such cases, where the degeneration was not to far advanced. In most cases, however, they were crushed and partially or completely resorbed by surrounding nucellus tissue.

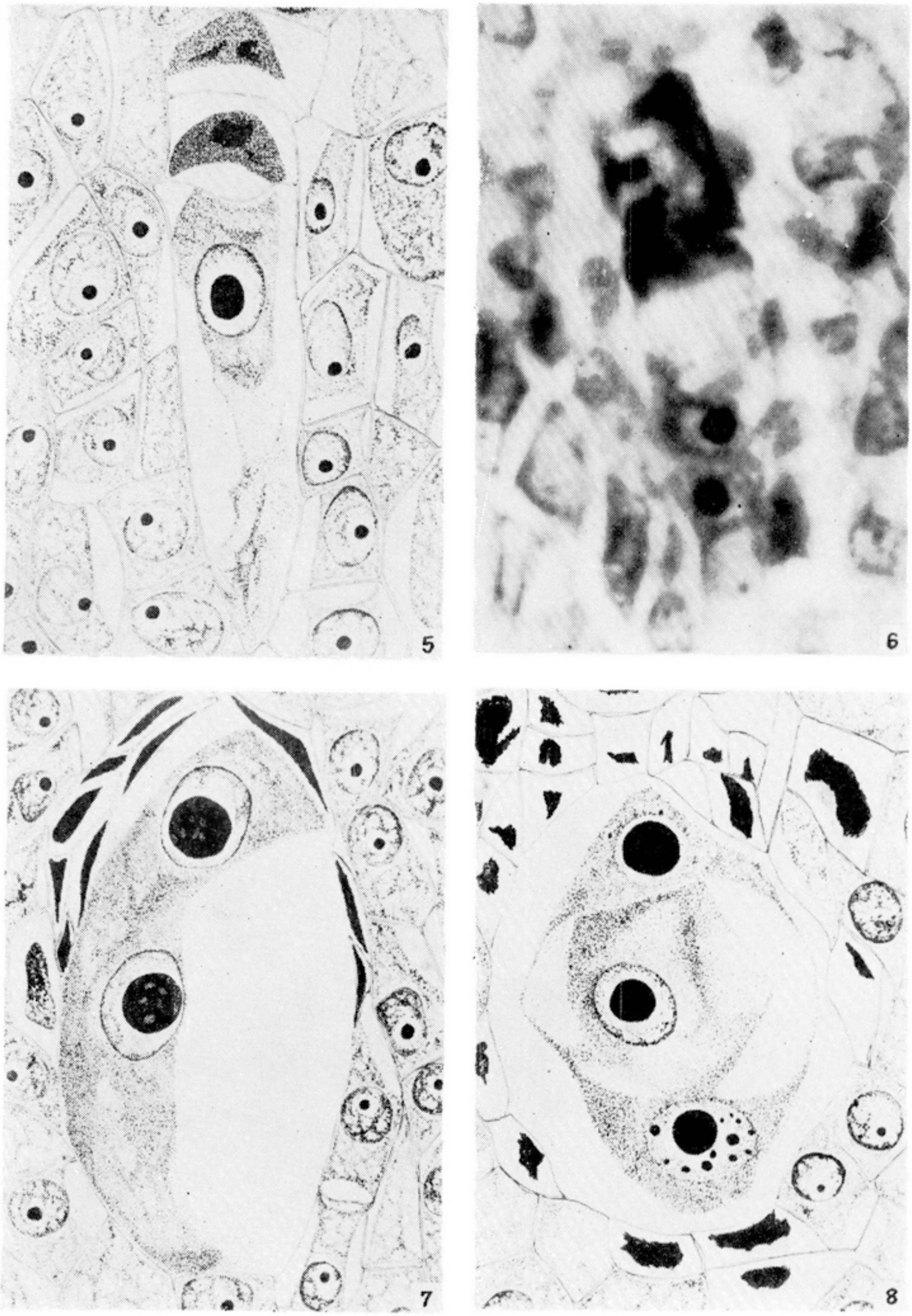
The embryosacs were often retarded in their development, which was discernible on observation of the length of the outer integuments and of the stage of microsporogenesis in the PMC of the same bud. Moreover, in some embryosacs different anomalies were observed, such as lack

PLATE I



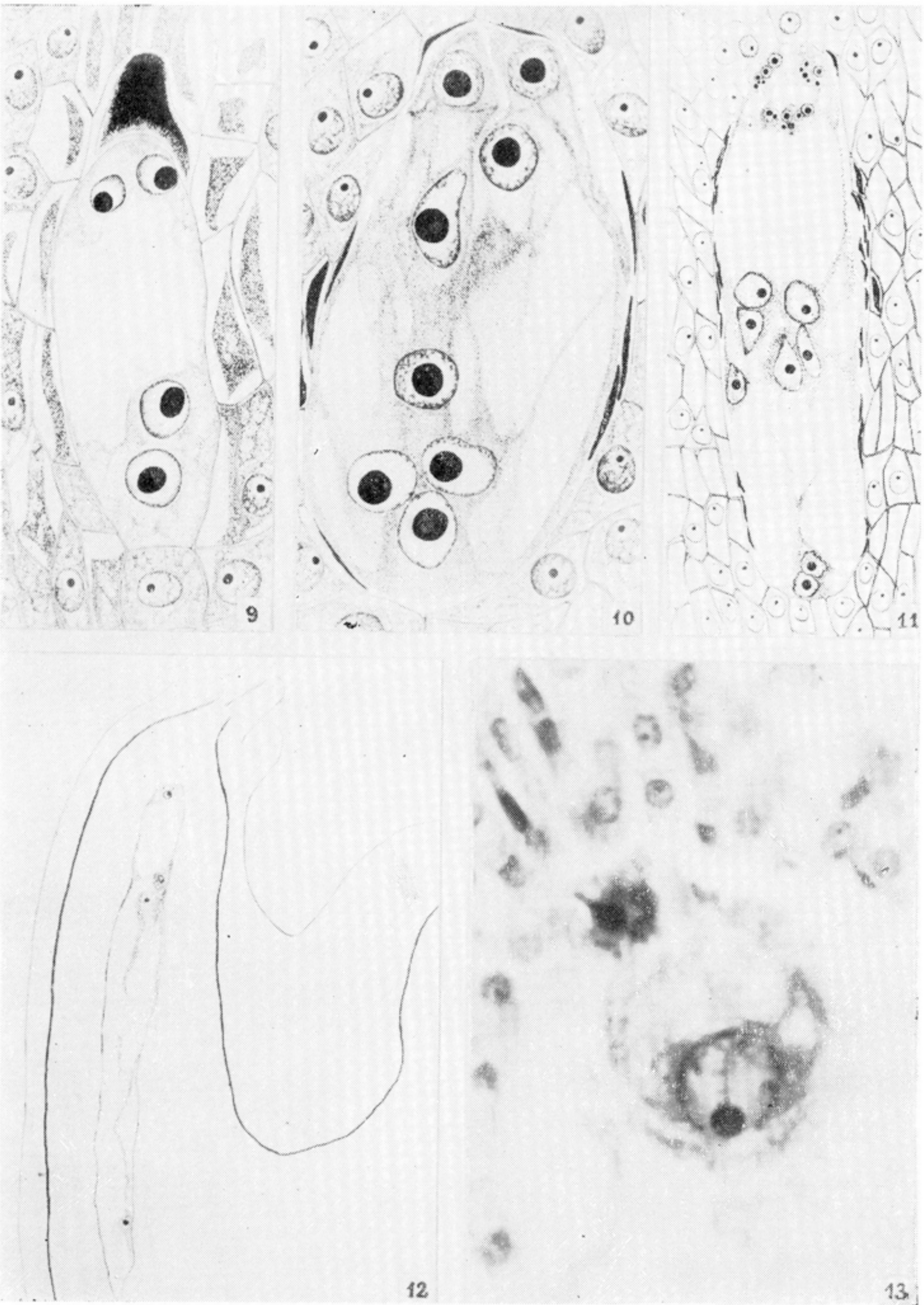
1. Archesporium in young ovule
2. Metaphase I in a megaspore mother cell
3. Degenerating dyad
4. A triad

PLATE II



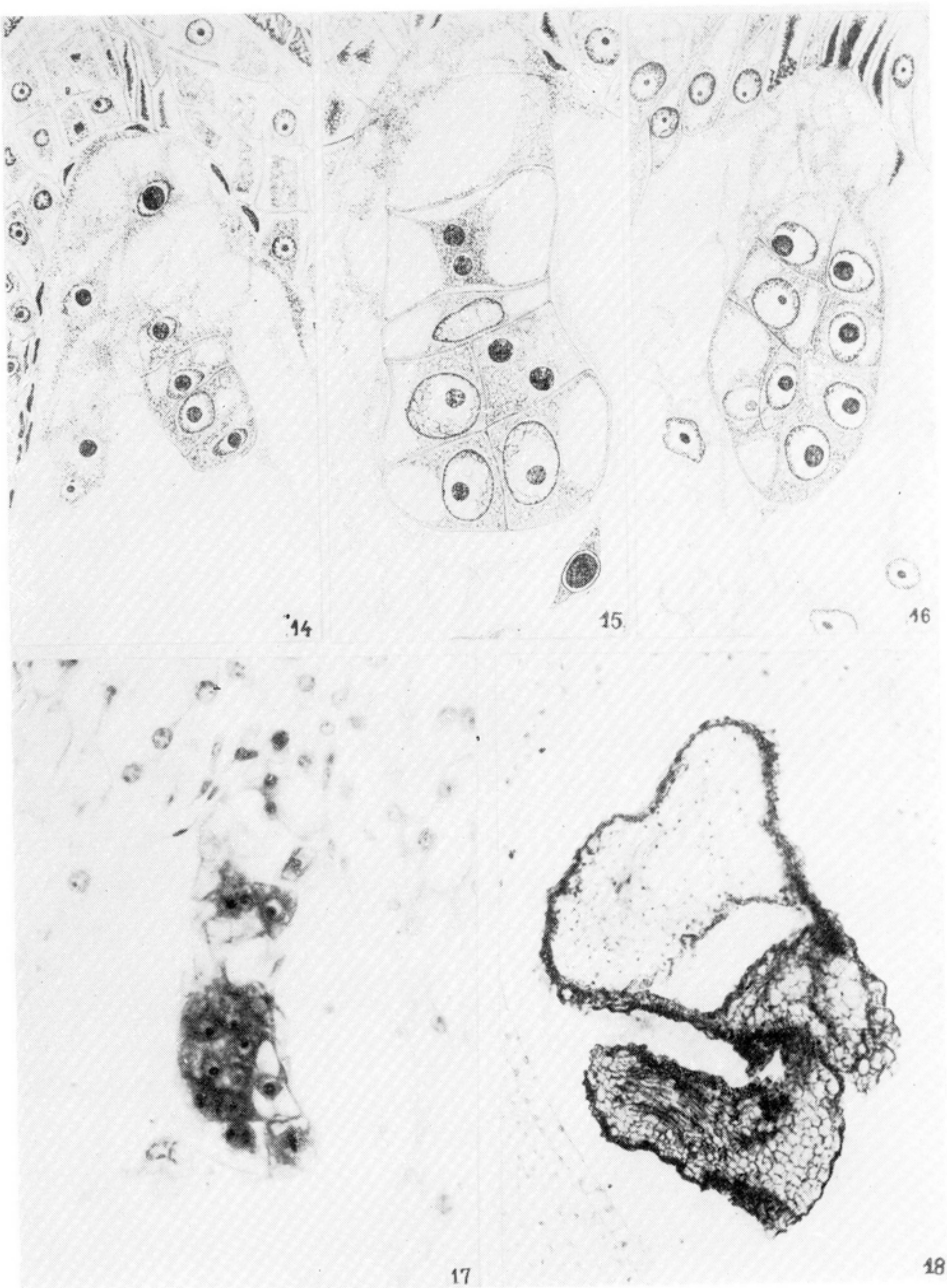
5. One-nucleate embryosac
6. Binucleate embryosac
7. Abnormal binucleate embryosac
8. Abnormal trinucleate embryosac

PLATE III



9. Normal four-nucleate embryosac
10. Normal eight-nucleate embryosac
11. Abnormal, multinucleate degenerating embryosac
12. Lack of fusion of polar nuclei
13. Fertilized egg cell

PLATE IV



14. Four-celled proembryo
15. Baton-shaped embryo
16. Abnormal egg-shaped embryo
17. Abnormal, elongated and bent embryo
18. Dead ovule

of fusion of polar nuclei (fig. 12), disintegration of the egg apparatus and supernumerary, dispersed nuclei (fig. 11) and so on.

In overblown flowers retarded and/or aborted embryosacs were also observed. In most cases, however, the ovules themselves were already dead and dried out, and at the bottom of the ovary, only some deformed remnants could be found (fig. 18). In six out over 150 older ovules checked, however, fertilized egg cells (fig. 13), small proembryos and embryos were found. The one most advanced but already collapsed had attained the baton-shaped stage and over 300 microns in lenght. The growth of the remaining five embryos was arrested earlier, at the stage of several cells. The shape of the embryos was not regular when compared with the embryos of pure species (figs. 14, 15, 16). One embryo was unusually elongated and bent at the upper end (fig. 17).

DISCUSSION AND CONCLUSIONS

As it can be seen from the above observations, the embryogenesis in triploid sugarbeet × the *Patellares* - species hybrides undergoes similar disturbances as those described in the case of diploid hybrids (Jassem and Jassem [7]. It should be stressed, however, that in triploid hybrids mature embryosacs are sometimes present, capable of being fertilized and of producing embryos and endosperm — a thing never observed in diploid hybrids. On this basis we conclude that given conditions best suited for pollination and fertilization (such as air-conditioned glass-house cabins), we should be able to collect from our triploid F_1 hybrids, at least a few viable seeds and obtain aneuploid backcross plants desirable for further breeding and selecting nematode-resistant sugarbeets with genoms containing some admixture of chromatine material from the wid species.

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Embriologia triploidalnych mieszańców między burakiem cukrowym i dzikimi gatunkami Beta z sekcji Patellares

STRESZCZENIE

Przebadano przebieg makrosporogenezy i rozwój woreczka zalążkowego u triploidalnych mieszańców między tetraploidalnym burakiem cukrowym a diploidalnymi gatunkami rodzaju *Beta* z sekcji *Patellares*. W odróżnieniu od uprzednio przebadanych mieszańców diploidalnych, u triploidów w około 10% zalążków stwierdzono obecność prawidłowo wykształconych woreczków zalążkowych różnego wieku, a w kilku starszych zalążkach stwierdzono również obecność zapłodnionej komórki jajowej, prozarodka lub zarodka. Jak dotąd, nie udało się jednak po zapyleniu pyłkiem buraków cukrowych uzyskać z naszych triploidów żywotnych nasion i introgresywnych mieszańców wstecznych. Mieszańce takie stanowiłyby cenny materiał wyjściowy do hodowli buraków cukrowych odpornych na mątwika i dlatego prace nad ich uzyskaniem będą kontynuowane.

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