THE CHROMOSOME NUMBER OF THE SWEDE, *BRASSICA NAPUS* L.

By H. W. HOWARD

School of Agriculture, Cambridge

(With Six Text-figures)

According to European observers, Karpechenko (1922), Frandsen & Winge (1932), and Catcheside (1934), the swede has the chromosome numbers $n=18$ and $2n=36$. The Japanese, Nagai & Sasaoka (1930), and U (1935), have reported that all varieties of swedes, including European ones, have $n=19$ and $2n=38$.

The swedes examined in this investigation were of three varieties, (1) an unnamed variety bought locally, (2) Darlington line, (3) Improved Green Top, both the latter being sent as flower buds by Dr V. McM. Davey from the Scottish Society for Research in Plant Breeding at Corstorphine. These last two varieties were among those examined by Catcheside.

Root tips of the first variety were fixed in a wide range of fixatives by Mr F. Earnshaw. The best results were obtained using Karpechenko's modification of Navashin, see Karpechenko (1927). They were sectioned at 15μ. Pollen mother cells were smeared and fixed by the author in La Cour's 2BE and 2B. All slides were stained by Newton's iodine gentian-violet method. All figures were drawn at a magnification of 3200.

Somatic divisions

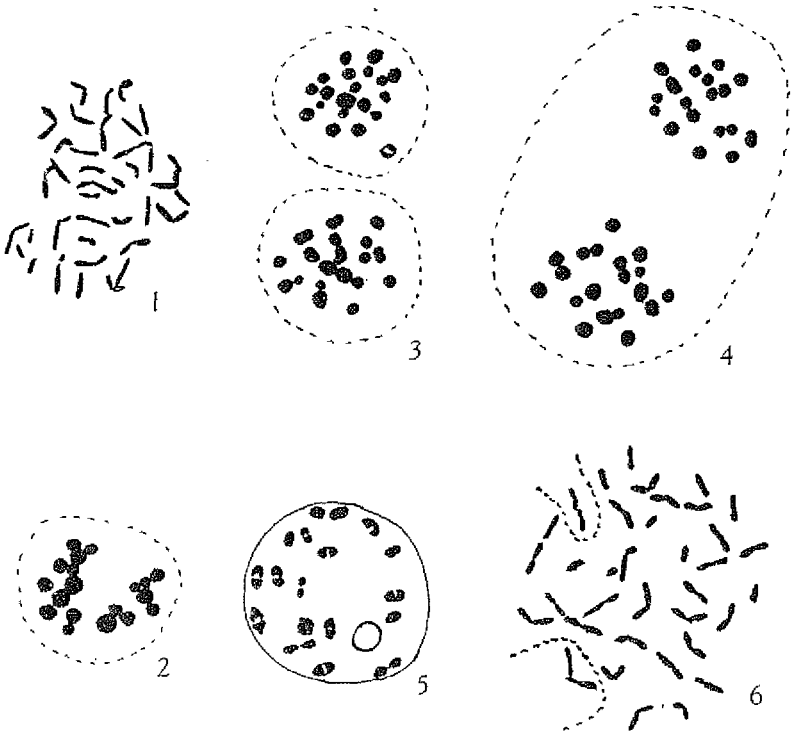
It was found difficult to obtain satisfactory fixation of somatic plates in root tips. In nearly every plate there is some clumping of chromosomes. The large differences in chromosome length, the differences in position of constrictions, the uncertainty of the constrictions being well marked, together with the clumping, make it rare to find a plate which can be counted absolutely satisfactorily.

Fig. 1 shows the best somatic plate obtained by Mr F. Earnshaw. Both he and the author were sure it contained 38 and not 36 chromosomes. Dr Catcheside showed me the slides from which Figs. 6 and 9 of his paper (1934) were drawn. The slides being 7 years old were rather faded. Unfortunately the author spoiled the section containing the plate from

which Fig. 6 of Catcheside was drawn. Fig. 6 of the present paper is a drawing of the same plate as shown in Fig. 9 of Catcheside. The two groups of two chromosomes cut off by the dotted lines represent a different interpretation of what are drawn as two single chromosomes by Catcheside; thus the plate now shows $2n = 38$.

Diakinesis

At this stage of meiosis the small size of the chromosomes and the extremely terminalized chiasmata make it difficult in some cases to decide whether two bodies are the halves of a bivalent with a single terminal chiasma seen in side view or two bivalents in end view, e.g. the two bodies at 12 o'clock in Fig. 5. In other cases the large nucleolus might hide one or more bivalents.



Figs. 1–6. For description, see text. All × 3200.

Polar views of first meiotic metaphase

In well-fixed cells these are quite satisfactory for counting. There is, however, the possibility that univalents, trivalents, or quadrivalents may

occur as well as bivalents, see Figs. 35–40 in Catcheside (1934). Secondary association is very marked at this stage, and in cells which are not too well fixed the difficulty may arise of deciding whether two bodies are two secondarily associated bivalents or the two halves of one bivalent distorted into side view. Both the above difficulties are increased by two of the bivalents being considerably smaller than the rest; they might be mistaken for univalents or, if secondarily associated, for the two halves of one bivalent. These two smaller bivalents presumably correspond to the four very small somatic chromosomes.

Fig. 2 is from a smear of a swede of variety 1. There was no reason to believe that all the 19 bodies were not bivalents. There were other cells in this smear which also showed 19 bivalents.

POLAR VIEW OF ANAPHASE SEPARATION

Only one cell was found at this stage. It occurred in a smear from variety 1 and the separating plates are drawn in Fig. 3. There is no possibility of one of the nineteen bodies in each plate being not a whole chromosome but the remains of an interstitial chiasma of a quadrivalent, cf. Fig. 44 of Catcheside (1934). Such a configuration must be very rare in the present material. The remains of the nucleolus can be seen at the top focus.

POLAR VIEWS OF SECOND MEIOTIC METAPHASE

These are satisfactory for counting, especially when both plates are in polar view as in Fig. 4. There might in some cells be the difficulty of one chromosome being distorted into side view to appear as two bodies, or in rare cases of numerically irregular disjunction having occurred at first division.

Fig. 4 is drawn from a smear of variety 2. Ten or more other plates in this smear also showed 19 as the haploid number. Smears of varieties 1 and 3 showing second metaphase polar views were also obtained and in all these plates there was no doubt that 19 is the correct haploid number.

SUMMARY

The chromosome number of three varieties of swede was found to be $n=19$ and $2n=38$. This agrees with the results of Nagai & Sasaoka (1930) and U (1935). The numbers $n=18$ and $2n=36$, reported in three other papers, are most probably incorrect.

ACKNOWLEDGEMENTS

I wish to thank Dr D. G. Catcheside for the loan of two slides, Mr F. Earnshaw for the loan of one, and Dr V. McM. Davey for sending flower buds for smearing. I also wish to thank Mr A. E. Watkins for suggesting the investigation and for help during it.

Note. Dr D. G. Catcheside has seen the cells from which the figures were drawn. He wishes to say that he agrees that they show the haploid number to be 19 and the diploid 38.

REFERENCES

CATCHESIDE, D. G. (1934). "The relationship in the swede and turnip groups of *Brassica*." *Ann. Bot., Lond.*, **48**, 601–33.

FRANDSEN, H. N. & WINGE, O. (1932). "*Brassica napocampestris*, a new constant amphidiploid species hybrid." *Hereditas, Lund*, **16**, 212–19.

KARPECHENKO, G. D. (1922). "The number of chromosomes and the genetic correlation of cultivated Cruciferae." *Bull. appl. Bot., St Petersb.*, **13**, 1–14.

—— (1927). "The production of polyploid gametes in hybrids." *Hereditas, Lund*, **9**, 349–68.

NAGAI, K. & SASAOKA, T. (1930). "The number of chromosomes in the cultivated *Brassica*." *Jap. J. Genet.* **5**, 151–8.

U, N. (1935). "Genome-analysis in *Brassica* with special reference to the experimental formation of *B. napus* and peculiar mode of fertilisation." *Jap. J. Bot.* **7**, 389–452.