Karyological Studies on a Spontaneous Haploid Mutant of *Brassica Napella* *

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In the rape or "Seiyo-Undai"¹⁾ (*B. Napella*) field, there are found in places a certain type of highly sterile individuals. Such individuals can be easily detected among the normal in the end of flower season owing to their continuous and successive blooming. In 1927 the authors collected some seeds from those sterile individuals, and the offspring-tests were made for two generations in which, contrary to expectation, no sterile plants appeared. Thus the problem has lost its interest and the authors' attention has not been paid for years to this sterile type. In the spring of 1933, however, an idea occurred to the authors, that such spontaneous, highly sterile individuals might be haploids which produce diploid offspring. Closer investigations proved this supposition to be correct. This is the first known case of haploid plants in *Brassica*. NOGUCHI's report (2) treating maternal hybrid has often been misquoted in this connection. In the rape field other types of sterility were also met with. Among those especially a type with a higher number of chromosomes than the normal attracted the authors' attention.

The haploid mutant: Plants of this type of sterility occur in the field far more than those of the other types. The leaves and flowers are obviously smaller than those of diploid in the same line. Though the plant is generally lower in height than the diploid, it may surpass the latter in height on account of its continuous development of inflorescences. The epidermal cell of the haploid was, in a few individuals examined, markedly smaller than that of the diploid. Half

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1) Some workers treat this plant under the specific name *Brassica napus*.

a day's excursion through the rape field when the flowers are passing away, will suffice to find dozens of such haploid individuals.

Karyological observations: Anthers of many haploid individuals were examined by the aceto-carmin method, ascertaining roughly that the reduction divisions were carried out in them in a similar way. The root-tips were fixed from a haploid individual and anthers were fixed from several individuals found in farmers' fields and from one found in an F_5 line¹⁾ of *B. cernua* $\times$ *B. pekinensis*. The karyological features ascertained by the paraffin method are in substance as follows: The root-tip cell contains 19 chromosomes, the gametic number of the species (Fig. 1). In the metaphase of the heterotypic division, a variable number, ranging from 0-6 or 7, of bivalents of stretched forms are found (Figs. 2-5). When no bivalent is formed, which is rather rare cases in this haploid, the distinction of meta- and early anaphase becomes obscure (Figs. 4 and 5). In most of the heterotypic anaphase some strayed univalents are found still keeping themselves around the equatorial region (Figs. 6 and 7). They soon take dumb-bell shape and often show perfect split. Fairly often the heterotypic division is suppressed resulting in one large interphase-like nucleus which later develops a single homotypic spindle with the whole number of chromosomes. Excepting such large spindles, the frequency distribution of the number of chromosomes in the homotypic metaphase was as follows.

Frequency distribution of the number of chromosomes in
homotypic metaphase

No. of chromosomes in the homotypic spindle	7	8	9	10	11	12	13	Average
Frequency	4	7	21	19	16	4	1	9.7

The second division is carried out comparatively regularly (Figs. 9 and 10). As a matter of course of such a type of reduction divisions most of the pollen-grains produced are small and shrunked, but there are found always some large perfect pollen-grains.

1) The F_1 hybrid *B. cernua* $\times$ *B. pekinensis* produced seeds by open pollination only, and the F_2 progeny contained many *Napella*-type individuals. Many lines of later generations were fixed to the *Napella*-type. The line in which the haploid was found has also been fixed to the *Napella*-type, and one normal individual in that line examined showed 19 gametic chromosomes.

Fig. 1. Somatic chromosomes of the haploid. Figs. 2-5. Heterotypic metaphase of the haploid. Figs. 6, 7. Heterotypic anaphase. Fig. 8. Two sister plates of homotypic metaphase. Figs. 9, 10. Homotypic anaphase showing four groups of chromosomes. $\times 4000$.

As one of the authors has shown in a previous paper (1), the rape (*B. Napella*) is a digenomic species which contains a and c genomes with 10 and 9 chromosomes respectively. As the haploid of the rape occurs in nature in such a high proportion as it would never be expected for that kind of mutation, one may suggest a doubt that it might be a hybrid of two monogenomic species with 9 and 10 chromosomes. In Kyushu, however, the only cultivated species of *Brassica* with 9 chromosomes is *B. oleracea*, and the artificial cross between *B. oleracea* and other *Brassica* with 10

chromosomes, repeatedly tried by the authors in last nine years, has never been successful. Moreover it will be remembered that the sterile individuals which are treated here occurred in the rape field and neither in the yard of *B. oleracea*, nor in that of other *Brassica* with 10 chromosomes.

As mentioned above, the haploid individuals of rape produce 0-6 or 7 stretched bivalents in the microsporocytes. This fact may be explained as a result of a weak affinity between the chromosomes of the two different genomes **a** and **c** which together constitute the composite genome of *B. napella*.

Literature

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- (2) Noguchi, Y. 1928. Cytological studies on a case of pseudogamy in the genus *Brassica*. Proc. Imp. Acad., 4: 617-619.