White Flower Color in Oilseed Rape (*Brassica napus* L.) Associated with a Radish (*Raphanus sativus* L.) Chromosome

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The inheritance of white flower color, transferred to oilseed rape (*Brassica napus* L.) from radish (*Raphanus sativus* L.) by way of a *Raphanobrassica* hybrid, was investigated using F1, F2 and BC generations produced from true breeding white and yellow flowered strains of oilseed rape (Sernyk and Stefansson, 1982).

All of the 59 F1 plants were white flowered, indicating dominance of white over yellow flower color. Dominance of white over yellow was further confirmed by the BCs of the F1 to the white flowered strain which produced 347 plants, all of which were white flowered. However, the F2 and BCs of the F1 to the yellow flowered strain resulted in white to yellow segregations (Table 1) which could not be fit with either a single dominant gene hypothesis (Kato and Tokumasu, 1976) or a two complementary dominant gene hypothesis (Heyn, 1979). The rare occurrence of yellow sectors in white flowers on heterozygous white flowered plants further complicated these results.

Cytological investigations of meiosis using PMCs from the white and yellow flowered strains, the white flowered F1, and selected white and yellow flowered plants from the F2 were undertaken to explain the non-Mendelian nature of the observed flower color segregations. The results of these investigations (Figure 1 and Table 2) indicated conclusively that the white flower color was always associated with an additional chromosome or pair of chromosomes. The white flowered oilseed rape strain is in fact a disomic alien addition line (2*n* = 40) containing an extra pair of chromosomes derived from radish. The white flower color in this strain is conditioned by a dominant (inhibitory) gene(s) present on this alien chromosome.

The true breeding nature of the white flowered strain and the cytological investigations both indicated that the meiotic behavior of the alien chromosome was more or less normal in the disomic condition. However, in the monosomic condition, the meiotic behavior of the alien chromosome was not normal. Cytological investigations of 120 PMCs from white flowered F1 plants indicated that the univalent alien chromosome was not aligned on the Metaphase I plate in 61 of the cells observed and thus presumably would be lost from all of the gametes produced from these 61 cells. The 59 PMCs in which the univalent alien chromosome was aligned on the Metaphase I plate could incorporate the alien chromosome into only two of the four gametes produced. These observations allowed the calculation of an incorporation rate into gametes of 24.6% for the alien chromosome from the monosomic condition.

In view of these cytological results, the flower color segregations (Table 1) were reinterpreted as data for the transmission of the alien chromosome from the monosomic condition through the female and male gametes (Table 3). The transmission through the female gametes was calculated to be 24.3%, which is close to the 24.6% rate of incorporation into gametes. Transmission through the male gametes ranged from 22.1% down to 0.7%, these reductions below the 24.6% rate of incorporation into gametes being due to certation. These transmission rates are very similar to those reported by Sears (1954) for monosomics of wheat.

From these investigations it can be concluded that relatively stable, disomic alien addition lines of oilseed rape can be produced with chromosomes from radish. True introgression of alien traits such as restorer genes for the <u>ogu</u> cytoplasmic male sterility system (Shiga, 1980) may be difficult to accomplish because of the lack of homeology between rape and radish chromosomes.

References

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Table 1

Observed segregation and chi-square tests for F2 and BC data from crosses of *B. napus* involving white (W) and yellow (Y) flower color.

Cross and time of pollination	Number of sets	Observed segregation		Single dominant gene F2 - 3W:1Y BC - 1W:1Y		Two complementary dominant genes F2 - 9W:7Y BC - 1W:3Y	
		White	Yellow	X^2	p	X^2	p
F2	12	712	1025	1,071.54	<0.005	164.36	<0.005
BC: (WxY)xY (bud)	6	124	418	159.48	<0.005	1.30	0.25-0.50
BC: (WxY)xY (delayed)	4	86	237	70.59	<0.005	0.46	0.25-0.50
BC: Yx(WxY) (bud)	4	50	250	133.33	<0.005	11.11	<0.005
BC: Yx(WxY) (delayed)	4	1	134	131.03	<0.005	42.37	<0.005

Table 2

Chromosome number of a sample of White and Yellow flowered F2 progeny

Flower color	Number of progeny with		
	19 II	19 II + 1 I	20 II
White	0	17	2
Yellow	11	0	0

Table 3

Transmission of the alien chromosome from the monosomic condition through female and male gametes in different crosses

Gamete	Cross and time of pollination	Transmission (% of gametes)
Female	F1 x Y (bud and delayed)	24.3
Male	F1 x F1 (bagging)	22.1
Male	Y x F1 (bud)	16.7
Male	Y x F1 (delayed)	0.7

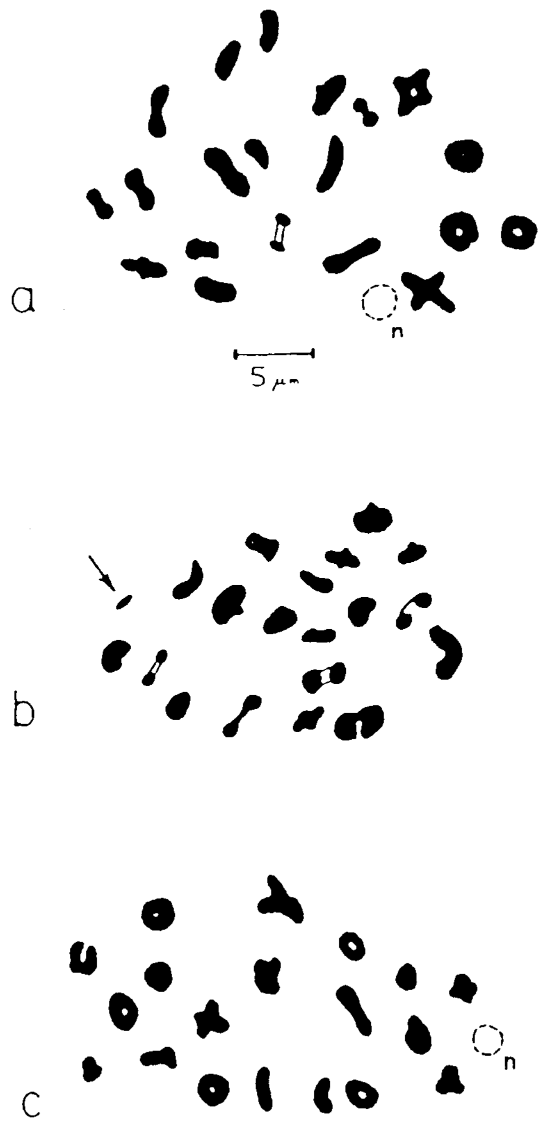

Figure 1. PMCs of B. napus: (a) white flowered strain - 20 II, (b) white flowered F1 - 19 II + 1 I (univalent is indicated with arrow), and (c) yellow flowered strain - 19 II. Nucleoli are also indicated (n).