GENETICS

'Complement Fractionation' in a Natural Hybrid between *Rubus procerus* Muell. and *R. laciniatus* Willd.

Rubus procerus Muell. and *R. laciniatus* Willd. occur sympatrically over a wide range of area in the coastal Pacific north-west of the United States. Natural hybridization between these two pseudogamous apomictic species has been shown to take place by Bammi and Olmo[1]. One such partially sterile natural hybrid (6412*A*), collected from Riverton, Oregon, proved very interesting cytologically. The present report deals with the peculiar cytological behaviour of this hybrid clone.

The chromosome analyses in this study were made from temporary squash preparations according to the alcoholic-carmine technique described by Snow[2].

All clones of *R. procerus*, *R. laciniatus* and the hybrid clone were tetraploids with 28 chromosomes in their somatic cells. Stages prior to diakinesis or metaphase I were not suitable for analyses.

Both *R. procerus* and *R. laciniatus* behave as segmental allopolyploids. Usually not more than 1–2 quadrivalents are formed at microsporogenesis. The hybrid clone (6412*A*) showed a peculiar kind of abnormality. In about 60 per cent of the microsporocytes two chromosomal plates were present, instead of the expected one, at metaphase I. These two plates behaved as independent units during the rest of the meiosis. Various other abnormalities like non-disjunction, lagging of certain chromosomes at first and second division of meiosis, separate or in conjunction with the above described abnormality, were also observed. About 1·5 per cent of the microsporocytes in *R. laciniatus* also showed more than one group of chromosome at metaphase I. The net result of the phenomenon of multiple plates at metaphase I and the behaviour of these groups of chromosomes to operate independently of each other in subsequent stages results in the production of an excess of sporads at telophase II. Table 1 shows that at telophase II, this plant had only 29–30 per cent of the cells with four sporads. This is in contrast to the clones of the parents and the hybrids, where cells with four sporads were about 97–99 per cent of the total. Almost all the rest of the cells had excess sporads.

Table 1. Frequency Distribution of Cells at Telophase II with regard to Number of Sporads per Cell in the Suspected Hybrid Clone 6412*A*

Total cells studied		Cells with sporads numbering								
	4+ Micronuclei	1	2	3	4	5	6	7	8	9
278	No. 18	1	3	8	80	42	65	12	42	2
	Percentage	6·59	0·37	1·10	2·93	29·30	15·38	23·81	4·40	15·38	0·74

Thompson[3] introduced the term 'complement fractionation' for the general phenomenon wherein "the chromosome complement is sub-divided into independently operating groups within a cell". Thompson[3], in working with the cultivated variety 'Boysen' of the genus *Rubus*, found a similar situation of sub-division of the chromosome complement into independently operating groups within meiotic cells. In her interpretation there were no definite implications as to the genetic constitution of the end-product. However, the present study goes a step further in proposing that the two sub-groups of chromosomes at metaphase I in fact belong to different genomes, namely *R. procerus* and *R. laciniatus*. This interpretation is based on the following observations.

(1) Sub-division does not seem to be a completely random process. The number of bivalents in each group at metaphase I tends to be 7 (14 being the gametic number for both *R. procerus* and *R. laciniatus*).

(2) Rarely, more than 2 sub-groups were observed at metaphase I.

(3) Each sub-group seems to have a separate spindle. This is supported by the following observations:

(*a*) Lack of synchronization of 2 groups in some cells, and (*b*) their separation in different planes in a 3-dimensional cell.

(4) Counts made at anaphase II show that chromosomes number in each group tends to be 7.

Since the frequency of this phenomenon is different in different clones, it is assumed to be genotypically controlled.

No definite conclusion as to the time or method of origin can be drawn from this work. Some indication of sub-grouping of chromosomes in somatic cells was also seen. It is probable that actual separation of genomes had taken place in the premeiotic cells.

The presence of 'complement fractionation' in the cells of an organism has many implications. It may be an indication of its obvious or concealed hybridity. It is quite conceivable that one of the resulting gametes may be functional and may take part in fertilization. This could result in the formation of unique segregants which would be expected to be rare or impossible in the normal reproductive pattern. As pointed out by Thompson[3], the separation of single genomes which form functional gametes can have value in the discovery of ancestral species of polyploids. There, of course, then exists the fascinating possibility that the genome of an ancient diploid trapped inside the constitution of a polyploid (in this case, an apomictic one) might also be released. This phenomenon might also provide a method by which the polyploid level of a species may go down.

Examples of 'complement fractionation' have so far been reported in cultivated plants of hybrid origin, for example by Thompson[3] and in tomato by Gottschalk[4], and in *Rubus* by Hull and Britton[5], that were previously subjected to colchicine treatment. This is probably the first instance where a naturally occurring plant shows this phenomenon.

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SOIL SCIENCE

Thermistor Hygrometer for determining the Free Energy of Moisture in Unsaturated Soils

In any investigation involving the movement of moisture through soils, the measurement of the free energy or total potential of the soil moisture still remains one of the chief problems. The basic requirement of any satisfactory technique for such measurement is that it should depend on some property which is uniquely related to the free energy of the soil moisture and is in no way affected by the soil type. One such property is the relative vapour pressure or humidity in equilibrium with the soil moisture as given by equation (1).

$$h = \frac{RT}{Mg} \log_e \frac{p}{p_0} \qquad (1)$$

where h = free energy (cm water); R = universal gas constant; T = abs. temp.; M = molecular wt. of water; $g = 981$ cm/sec^2; $\frac{p}{p_0}$ = relative humidity.