MEIOSIS AND FERTILITY IN CERTAIN BRITISH VARIETIES OF THE CULTIVATED POTATO
(SOLANUM TUBEROSUM L.)

by

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INTRODUCTION

In contrast to the relatively small amount of research work which has been done on the somatic chromosomes of the cultivated potato (Solanum tuberosum L.), the meiosis and pollen sterility have been studied by a number of research workers, among whom are STOUT and CLARK 1924, FUKUDA 1927, LONGLEY and CLARK 1930, HEYN 1930, ROBYN 1930, BLEIER 1931, MEURMAN and RANCKEN 1932, and MÜNTZING 1933.

Although STOUT and CLARK did not carry out their investigations cytologically, they have contributed several important observations concerning the pollen sterility of the potato varieties grown in America, and on the relative fertility of four other tuber-bearing species of Solanum. Their most significant conclusion is that the non-blooming habit of the potato and the early abscission of the buds and flowers are directly controlled by the environment. They also state that very few of the cultivated varieties produce any appreciable number of viable pollen grains, which in consequence restricts the number able to act as male parents. The pollen in the anthers of the fully mature flowers of any one variety was found to be very constant in quantity, range of abortion, general character, and viability.

It was not until about two years later that any attempt was made
to obtain a more detailed knowledge of the pollen development of the potato and to find an explanation of the phenomena already observed by the practical breeder. In 1926 Stow (1926) undertook a cytological study of meiosis in the potato and, as a result of experiments, concluded that environmental influence, chiefly temperature, is responsible for the irregularities of meiotic behaviour. Stow points out, however, that the abnormality of the meiotic division is variable according to each variety, which means that the nature of the plant itself must be taken into consideration as well as such environmental factors as temperature.

Fukuda (1927) in 1927 made a more detailed cytological study of meiosis, and the many ways in which abortive and irregular pollen grains are produced. He arrived at two conclusions about which there has since been much discussion, as later research workers have found reason to disagree with them. They were, firstly, that in some varieties, instead of there being only twenty-four bivalents on the first metaphase plate there are forty-eight separate chromosomes, and secondly, that the cultivated potato of today had only one Solanum species as its ancestor.

Smith (1927), Vilmorin and Simonet (1927) and Longley and Clark (1930) agree with Fukuda's first conclusion, while other workers have different explanations for the origin of the metaphase plates of the pollen mother cells which show forty-eight chromosomes. All are of the opinion that the potato is a tetraploid, and that it is descended from at least two Solanum species. Bleier does not regard the cultivated potato as a tetraploid, but as a diploid. Longley and Clark (1931) in 1930 studied the chromosome behaviour of many cultivated varieties of the potato, and of several wild tuber-bearing Solanum species. The wild Solanum species differed with respect to their haploid chromosome numbers, these being twelve, eighteen, twenty-four or thirty-six; those which had eighteen as their haploid number showed very irregular meiotic behaviour. Of the thirty-seven cultivated varieties which they studied, only a few had regular chromosome behaviour and produced an appreciable amount of pollen; the majority showed types of irregular meiotic behaviour which resulted in the formation of abortive pollen grains. They conclude that abnormal chromosome behaviour is responsible for the unfruitfulness of the potatoes, though environmental factors may influence its degree.