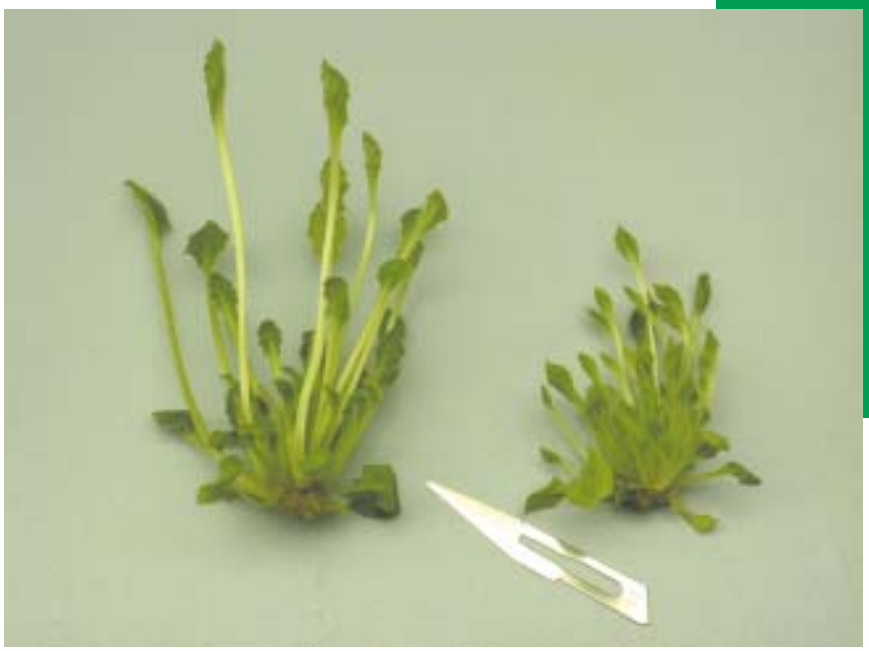
DOUBLING OF CHROMOSOME NUMBERS

EDITION OF SBW INTERNATIONAL BV

IN THIS FLYER

Breeding and doubling of chromosomes

Breeding takes place through crossing (hybridisation) and selection. The breeder aims to join the good characteristics from 2 different plants in their offspring through hybridisation. He aims to select the offspring of plants which shows the best combination of qualities from both parents plants. This process depends entirely on the production of offspring: in other words the formation of viable seed. The breeder has a problem if no seed is formed. This problem can sometimes be solved by doubling the number of chromosomes from one of the parent plants.



Gerbera
Left: tetraploïd
rights: diploïd

When can it be used?

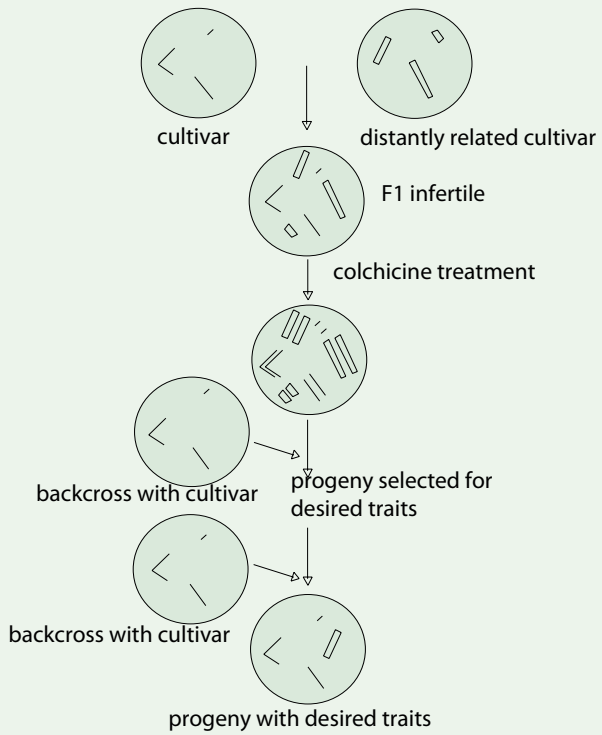
The inability to realize offspring from hybridisation may have many reasons. Some reasons can be eradicated by doubling of chromosomes. If one of the parent plants is sterile and the sterility is due to an uneven number of chromosomes then doubling of the chromosomes will often result in a fertile parent plant. If the ploidy level of the parent plants differs too much there may be no viability of the seed or all the offspring will be sterile and thus further hybridisation is impossible. This happens when for example diploid and tetraploid plants are crossed. A tetraploid parent which can be crossed with a diploid parent plant can be obtained by doubling the number of chromosomes in the diploid parent plant. The offspring will then always be tetraploid. It is also of interest to develop tetraploid plants because they are often more robust than diploid plants.

How is it executed?

The cell division involves various phases. In the first phase the number of chromosomes per cell is doubled following which the chromosomes are divided between the two cell halves. These are then essentially separated by a new cell wall. By means of treating the dividing cells with specific chemicals the chromosomes will be prevented from dividing over the two halves and there will be no formation of a new wall. As a result of this a cell with the double number of chromosomes is created. Cell division and regeneration can be achieved by removing the chemicals thus creating a new plant in which every cell contains twice the number of chromosomes. Due to the fact that the chemicals used can have an effect on dividing cells of other organisms as well, the safe use of the chemicals is vital. Because of this it is essential that this procedure takes place in a well-equipped laboratory where the chemicals can be used safely.

Doubling of chromosomes in tissue culture

It appears from the above that the technique for doubling of chromosomes only works on dividing cells which are provisionally treated with chemicals. By tissue culture a such like process is easy to time and measure. This can take place all year round. Furthermore, tissue culture offers the possibility to obtain sufficient dividing cells in artificially made wound surfaces or shoots. Following treatment the plant consists of cells, some of which have a single number of chromosomes and some of which have twice the amount of chromosomes. Cells with an abnormal number of chromosomes or with twice the doubled amount of chromosomes can also be found in the treated plants. From these cells plants can be obtained by means of regeneration or normal vegetative propagation. This is easy to realize in tissue cultures. These plants are selected for a doubled number of chromosomes. This is generally performed with the aid of a flowcytometer which determines the relative DNA-level in each cell nucleus. In this manner plants with a double number of chromosomes can be separated fromthose with a single number of chromosomes, or any mixture of both. Only plants with a complete doubled number of chromosomes will be propagated and distributed.



Haploids

With cross-breeders and self-pollinators it often takes 5 generations or more before there is complete homozygote present in the genes. For the breeder working with this it may be important to produce di-haploid plants. These plants are completely homozygote and can be used to produce hybrid cross-breeds for example. It is possible to get mono-haploid plants from anthers. After doubling of the chromosomes of these mono-haploids, homozygotes with recessive properties will be reached quite quickly and this is important for hybridisation.

Further

SBW International has extensive experience in doubling of chromosome numbers in plants based on time controlled treatment of plants in tissue culture. Conditions for chromosome doubling in tissue culture is that there is a good procedure for propagation via tissue culture for the crop concerned. The plants are introduced into tissue culture and propagated to 250, these are treated with 4 different concentrations of colchine or oryzalin. After the treatment the plants that result from the three propagation cycles are inspected for size, a selection of 200 plants are screened with a flow cytometer and the plants that have a doubled number of chromosomes are then propagation to 10 plants before they are distributed. From these 10 plants SBW International will conserve some in vtiro for possible follow up experiments or another production order.

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