# Distant Hybridization

## Distant hybridization

Crossing between two different species of the same genus or two different genera of the same family is called distant hybridization and such crosses are referred to as distant crosses or wide crosses. Wide crossing or distant hybridization has been used in the genetic improvement of some crop plants. It is an effective means of transferring desirable genes into cultivated plants from related species and genera. Distant crosses are more successful in more closely related species or genera than in less closely related species or genera.

## Types of Distant Hybridization

**(1) Interspecific hybridization**

**(2) Intergeneric hybridization**.

## Interspecific hybridization

Crossing between two different species of the same genus is termed interspecific hybridization or intra-generic hybridization. Such crosses are called interspecific crosses and progeny of such cross is called interspecific hybrid. Interspecific hybrid was first developed by Thomas Fairchild in 1717 between sweet William and carnation species of Dianthus (*Dianthus barbatus* x *D. canyophyllus*)

## Main features of interspecific hybridization

**1.** It is used when the desirable character is not found within the species of a crop.

**2.** It is an effective method of transferring desirable genes into cultivated plants from their related cultivated or wild species.

**3.** Interspecific hybridization is more successful in vegetatively propagated species like sugarcane and potato than in seed propagated species.

**4.** Interspecific hybridization leads to introgression which refers to transfer of some genes from one species into the genome of another species.

**Interspecific hybridization gives rise to three types of crosses, viz.**

**(a) Fully fertile:** Interspecific crosses are fully fertile between those species that have complete chromosomal homology. Chromosomes in such hybrids have normal pairing at meiosis and as a result the $F_1$ plants are fully fertile.

**Fully fertile interspecific crosses have been observed between some species in cotton, wheat, oats and soybean**

**Cotton:**

There are four cultivated species of cotton viz. *Gossypium hirsutum*, *G. barbadense*, *G. arboreum* and *G. herbaceum*. The first two New World species belong to tetraploid group (2n = 52) and the last two Old World species to the diploid group (2n – 26). Crosses between tetraploid species *G. hirsutum* and *G. barbadense* and between diploid species *G. arboreum* and *G. herbaceum* are fully fertile.

*G. hirsutum* (2n = 52) x *G. barbadense* (In = 52) → $F_1$ plants are fully fertile.

*G. arboreum* (2n = 26) x *G. herbaceum* (2n = 26) → $F_1$ plants are fully fertile.

**Wheat:**

The hexaploid wheat (2n = 42) has several species. Interspecific crosses between common wheat (*Triticum aestivum*) and club wheat (*T. compactum*) are fully fertile.

*Triticum aestivum* (2n = 42) x *T. compactum* (2n = 42) → $F_1$ plants are fully fertile.

**(b) Partially fertile**

Interspecific crosses are partially fertile between those species which differ in chromosome number but have some chromosomes in common. In such situations, the $F_1$ plants are partially fertile and partially sterile.

**Partially fertile interspecific crosses have been reported in wheat, cotton and tobacco**

**i. Wheat:**

In wheat, there are three types of species, viz. diploid (2n = 14), tetraploid (2n = 28) and hexaploid (2n = 42). The cross between common wheat (*Triticum aestivum*, 2n = 42) and durum wheat (T. durum, 2n = 28) are partially fertile. In both these species chromosomes of A and B genomes are common and as a result the $F_1$ hybrids are partially fertile. In $F_1$ there are 14 bivalents and 7 univalents during meiosis. There is occasional seed set in this cross.

**ii. Cotton:**

In cotton, there are two types of species, viz. diploid (2n = 26) and tetraploid (2n = 52). The cross between American cultivated cotton (*G. hirsutum*, 2n = 52) and American wild diploid (*G. thurberi*) are partially fertile, because these two species have chromosomes of D genome in common. Meiosis in $F_1$ leads to formation of 13 bivalents and 13 univalents. There is occasional seed set in this cross.

**(c) Fully sterile in different crop species**.

Interspecific crosses are fully sterile between those species which do not have chromosomal homology. In such species, chromosome number may or may not be similar. The lack of chromosomal homology does not permit pairing between the chromosomes of two species during meiosis.

As a result, the $F_1$ plants are fully self-sterile. Such hybrids can be made self-fertile by doubling of chromosomes through colchicine treatment. Fully sterile F hybrids have been reported in tobacco, wheat, cotton, Brassica, Vigna and several other crops.

**II. Intergeneric Hybridization:**

Intergeneric hybridization refers to crossing between two different genera of the same family. Such crosses are rarely used in crop improvement because of various problems associated with them.

**The main features of intergeneric crosses are given below:**

1. Intergeneric hybridization is used when the desirable genes are not found in different species of the same genus.

2. This method is rarely used in crop improvement programmes and that too for transfer of some specific characters into cultivated species from allied genera.

3. Intereneric hybridization has been generally used in asexually propagated species.

4. $F_1$ hybrids between two genera are always sterile. The fertility has to be restored by doubling of chromosomes through colchicine treatment.

5. Intergeneric hybridization was used by some workers to develop new crop species.

**Some examples of intergeneric hybridization are given below:**

**i. Wheat-Rye Cross:**

The first intergeneric cross was made in the family Gramineae between bread wheat (*Triticum aestivum*, 2n = 42) and rye (*Secale cereale* 2n = 14) by Rimpau around 1890 in Sweden. The

$F_1$ was sterile which was made fertile through colchicine treatment. The amphidiploid (2n = 56) was named as Triticale.

This combines yield potential and grain quality of wheat and hardiness of rye. Triticale is the best example of the practical achievements of intergeneric hybridization. Now Triticale is commercially grown in countries like Canada and Argentina. Several improved varieties of Triticale have been released for commercial cultivation. Research work on Triticale is in progress at CYMMIT, Mexico.

**ii. Radish Cabbage Cross:**

Intergeneric cross between radish (*Raphanus sativus*) and cabbage (*Bassica oleracea*) of the family Cruciferae was made by Karpechenko in 1928 in Russia. The main objective was to combine root of radish with leaves of cabbage. The $F_1$ was sterile doubling of chromosome number by colchicine treatment resulted in development of fertile amphidiploid which was named as Raphanobrassica by Karpechenko. But the new species thus developed had roots like cabbage and leaves like radish, which was a useless combination.

**References**


- www.biologydiscussion.com
- Kaneko Y, Bang SW (2014) Interspecific and intergeneric hybridization and chromosomal engineering of brassicaceae crops. Breed Sci 64:14–22


[The information, including the figures, are collected from the above references and will be used solely for academic purpose.]