Extra chromosomal inheritance

For M.Sc 2nd semester student.   Kumari Sona Rani, Assistant professor,dept.of Botany, S.Sinha college Aurangabad

The extrachromosomal DNA present in the cytoplasm and not on chromosomes which follows the non-Mendelian pattern of inheritance is known as extrachromosomal inheritance."

Criteria for extrachromosomal inheritance:

The extrachromosomal DNA follows a non-mendelian pattern of inheritance

Unlike the common Mendelian segregation pattern is not observed in the extrachromosomal DNA because it does not have the centromere it can not segregate, unlike the normal nuclear DNA

Their own machinery for protein synthesis:

Unlike nuclear DNA, the organelle DNA or the extrachromosomal DNA has its own replication and transcription machinery. It synthesised their won DNA.

Maternal inheritance:

The extrachromosomal DNA inherited from the maternal side.

The segregation is observed in somatic cells rather than germ cells, unlike nuclear inheritance.

Examples:

Carl Correns in 1908, first reported non-mendelian inheritance in *Mirabilis Jalapa* plastid DNA. Another extrachromosomal inheritance was reported by *M M. Rhoades* in 1933. He postulated that inheritance of male sterility in maize is governed by maternal inheritance and it becomes one of the greatest discoveries in science.

Another important point that makes extrachromosomal DNA even unique is maternal inheritance. It inherits from mother to their offspring which means that only female individual from the entire population can inherit cytoplasmic DNA.

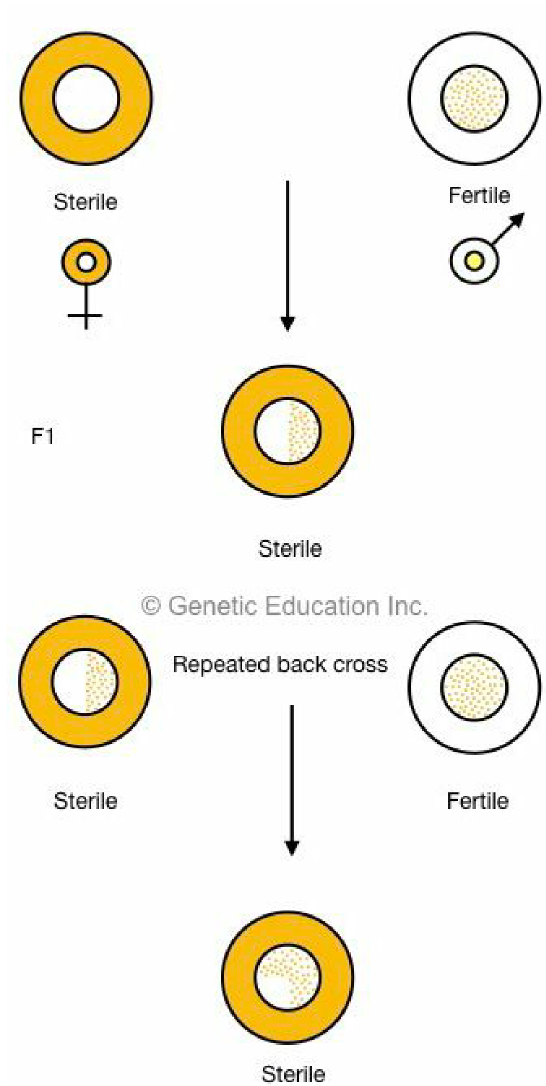
One theory suggests that female reproductive cell (ovum) is bigger, contain more cytoplasm and more organelles than male reproductive cells. This would be expected to influence non-mendelian inheritance or maternal inheritance.

One of the classical examples of maternal inheritance is :

Cytoplasmic male sterility in maize.

Here nuclear genes do not play any significant role rather, the sterility is inherited through egg cytoplasm from generation to generation. Here nuclear genes do not play any significant role rather, the sterility is inherited through egg cytoplasm from generation to generation.

When a male sterile plant is crossed with a normal fertile plant, all the F1 plants remain sterile. When all F1 sterile plants are backcross with a normal fertile plant, until all chromosomes from the male sterile line are exchanged to male fertile, the sterility persists in the progeny.



The image represents the inheritance of cytoplasmic male sterility in maize.

Generally, male-sterile lines are denoted as ***tcs,*** T (Texas), C (Cytoplasmic), S (Sterility). It was believed that T (Texas) cytoplasm is associated with susceptibility against several types of disease like leaf blight disease and yellow blight disease in maize.

This result indicates that chromosomal nuclear DNA does not have any significant role in male sterility (particularly in maize). Furthermore, most of the cytoplasm and organelles are inherited from the maternal side. From the scientific findings, it is confirmed that the sterility is inherited from the cytoplasm.

This discovery becomes a crucial milestone in crop improvement. Hybrid sterile maize plant becomes more popular as the corn of maize developed uniformly. The hybrid seed becomes more popular for mass production of maize.

Though maternal inheritance may be extrachromosomal or chromosomal, it is one of the miracle events in nature. Here genetic compositions of maternal side influence several phenotypes of offspring.

In some organism, not only maternal inheritance rather the genotype of the maternal side has great influence on the phenotype of offspring. Here phenotype of mother does not have any role in the development of phenotype in offspring.