## **Quadrant II – Transcript and Related Materials**

Programme: Bachelor of Science (Third Year)
Subject: Botany
Paper Code: BOC 108
Paper Title: Cytogenetics & Plant Breeding
Unit: 03
Module Name: Maternal effects in snail -shell coiling
Module No: 17
Name of the Presenter: Mrs. Deepti Naik

## Notes:

## Maternal effects in snail -shell coiling:

- ✓ Inheritance due to genes located in cytoplasm Or hose phenotypes that are controlled by nuclear factors found in the cytoplasm of the female are said to express a **maternal effect**. Those phenotypes controlled by organelle genes exhibit **maternal inheritance**. So it is concluded that the character of only one parents (female) is transmitted to the progeny.
- ✓ DNA contained in mitochondria or chloroplasts determines the phenotype of the offspring. These phenotypes arise due to the source of organelles—only from the egg—such that there is only a maternal influence on phenotype. Substance which produce the maternal effect in the progeny are found to be transcriptional products (mRNA, rRNA &

tRNA). Maternal genes are manufactured during oogenesis and exist in the ooplasm of unfertilized egg. These transcriptional products of maternal genes produce phenotypic effect during early cleavage and blastulation. Maternal or parental genes of the zygote remain engaged in mitotic replication or duplication of DNA. This is referred as extranuclear or extra-chromosomal or maternal or uni-parental inheritance.

Shell Coiling in snail (*Limnaea peregra*)

- ✓ A. Sturtevant (1923) showed the characters of coiling *L. Peregra* The shell is spirally coiled and it exhibits two types of coiling. Shell coiled to right-hand is said to be Dextral (S<sup>+</sup> S<sup>+</sup> or S<sup>+</sup> S). Shell coiled to left-hand is is said to be Sinistral (SS). Genes are inherited according to Mendelian's law but the action of gene combination was visible in the next generation. The F₂ females of either cross (right coiler) when mated with males of any genotype produce at an average right coilers and left coilers in 3: 1 ratio. But 3: 1 ratio appears in F₃ and not in F₂. If F₂ males are mated with homozygous right coiling females, there is no segregation and all their progenies are right coilers, but if they are mated with homozygous left coiling female's only left coilers are produced.
- ✓ In the cross dextral ♀ x sinistral ♂ all the F, progeny have dextial coils implying that dextral is dominant over sinistral. However, in the F<sub>1</sub>, x F<sub>1</sub>, cross (i.e., inbreeding), all the F<sub>1</sub> snails are also dextral. The reciprocal cross Sinistral coiling female X Dextral coiling male, All F1 progenies have sinistral coiling pattern but in F2 generation all progenies have dextral coiling pattern. However, in F3 generation 3 dextral and 1 sinistral types of coiling observed.

- ✓ This indicates that the inheritance of coiling direction in depends on the genotype of female parent and not on its own genotype. The F1 generation undergoes progeny from both the crosses had the same genotype S<sup>+</sup> S, but they showed the different phenotypes. The phenotype of offspring by the mother's genotype for coiling. When F1 undergo for self fertilization the F2 offspring from both the crosses, irrespective of their own genotypes, showed the same phenotype (Dextral). The true nature of inheritance of coiling is indicated when each F2 individual undergoes for self fertilization to produce F3. In F3 generation 3 dextral and 1 sinistral types of coiling observed and therefore this pattern of inheritance is also called as delayed Mendelian inheritance.
- ✓ It is clear then that the paternal (male) genotype is not crucial in determining the phenotype of the offspring. It becomes clear when it is assumed that the genes for left coiling pattern (S<sup>+</sup>) and that the phenotypic expression of individuals is determined by the genotype of their mothers.
- ✓ Further investigations suggest that coiling depends upon the early cleavages in the zygote. If the spindle is tilted to left of the median line of zygote, the successive cleavages will produce a spiral to left and if the orientation of spindle is tilted to the right of the median line of zygote a dextral pattern will follow. The spindle orientation is governed by the genotype of oocyte from which the egg develops. However, the exact mechanism of spindle orientation is not known.