Dynamic Plant

Genetics & Genetic Engineering

Gregor Mendel
Augustinian Monk
From Austria (now Czech Republic)
Studied mathematics & botany.
Studies in 1850’s
Studies garden pea

Fig. 11-2, p. 170

Genetics

The study of inheritance and variation and the factors controlling them.
Different areas of study include:

> Mendelian genetics *
> Population genetics
> Molecular or biochemical genetics

Figure 13_03

The Language of heredity – in the DNA

DNA is the molecule that is contained within chromosomes.
Complex polymer, carries code for how to make all traits.
Composed of nucleotides:
- A base
- A sugar
- A phosphate group

Fig
Before a flower makes gametes the DNA makes copies of itself i.e. replicates.

Medel’s original crosses

Monohybrid Crosses

When only one gene is monitored in a cross between a male and a female. E.g. flower color.
Di-hybrid Crosses

A genetic cross where **two traits** are monitored simultaneously.
Possible results:
If both parents are true breeding e.g. GGTT x ggtt then all will be hybrids.
If both parents are hybrids e.g. AaBb then the genotypic outcome will be **9:3:3:1**.
Epistasis

When one gene has the ability to markedly influence action of another gene. May deactivate the other gene.

Polygenic Effects

Many traits are the Results of several genes.

Examples:
- Wheat grain color
- Plant height
- Fruit size

Environmental Influences

Genes can be expressed differently depending upon external influences.
- Temperature
- Elevation
- Soil acidity
- Stress

Artificial Selection

Breeding programs for agricultural applications are based on Mendelian genetics.

Limitations:
- Time consuming
- Cannot be precisely controlled.

Bananas

Parthenocarpic: Fruits develop from unfertilized ovaries.
- Has no seeds!
- Propagated by division of basal shoots --- asexually.
Bio-engineering

- Applied biology using molecular genetics.
- Seeks to change DNA in a precise way to “select” desired traits.

1) May use genes from other species.
2) Can be precisely used to “design” plants that are more resistant to stress.
3) Disease resistance.
4) Can be used for plants that do not reproduce sexually.

Current GM crops

Some but by no means all crops of:
- Canola (Rape Seed)
- Soybeans
- Corn
- Bananas
- Rice
- Industrial Hemp

The Controversy

Potential Applications
- Improve nutritional quality of foods. E.g. Golden Rice.
- Produce medicines including vaccinations incorporated into foods.
- Disease/pest resistance.
- Increased yields.
- Less need for herbicides.

Concerns
- Does it prolong the issue of overpopulation?
- Should GM foods be labeled and the consumer given a choice?
- Unknowns – could it affect pollinators? Can cross contamination occur?
- Toxic effects on non-target species.
- Allergens

Central Dogma

1) DNA
2) Transcription (occurs in nucleus)
3) Translation/reading of code- to make proteins (occurs at site of ribosomes).