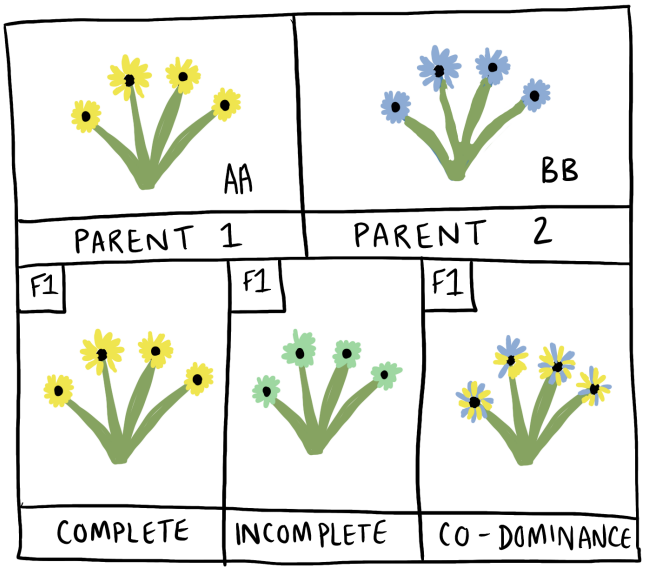
Week 2b

Dominance

- The phenotype displayed, from the interaction of two alleles of a gene in the heterozygote.
- Dominance is the result of the biochemical action of the alleles
- There are three types of dominance relations
    - Complete dominance
        - F1 is the same as the dominant allele
        - No difference between the heterozygote and homozygous dominant
    - Incomplete dominance
        - The heterozygote is intermediate between the two homozygotes.
        - Also, known as dosage effect which is a result of gene dilution
    - Co-dominance
        - The heterozygote shows both character states simultaneously
        - Good example is blood types – A and B are co-dominant with each other, but are complete dominant to O



Test cross

- A cross where individuals are mated to the homozygous recessive
- The important property that these crosses have is that;
    - The phenotypic ratio in the progeny is the same as the genotypic ratio in the gamete from the other parent.
- Another way to determine the genotype is to self-cross
    - Homozygous cross homozygous = all homozygous
    - Heterozygous cross heterozygous = all different

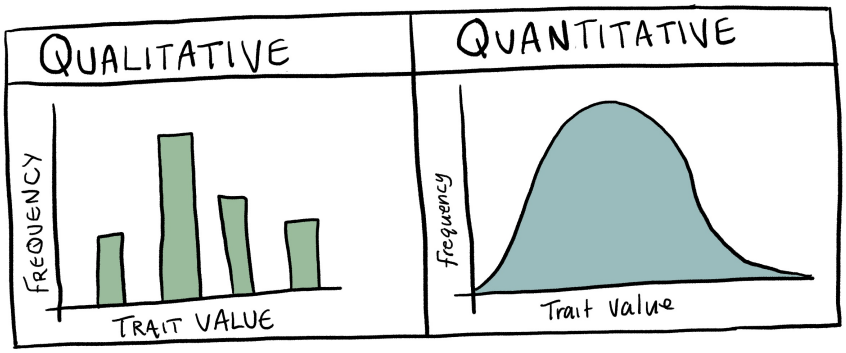
Pleiotropy

- Pleiotropy occurs when one gene is used for several seemingly unrelated purposes

Week 3b

Quantitative vs Qualitative traits

- Qualitative traits
  - Inheritance is simple
  - One or few genes
  - Distinct classes – classified, counted
  - Independent of environment
  - E.g. Barley row-type, disease resistance
- Quantitative traits
  - Inheritance is complex
  - Larger number of genes – polygenic
  - Continuous distribution – measure, calculated
  - Expression influenced by environment
  - E.g. plant height, plant yield



Multigene/Polygenetic inheritance

- Multiple-gene hypothesis; Many genes, each individually behaving, contribute to the phenotype in a quantitative way
  - A simple example of additive effect (incomplete dominance) with genes controlling plant height
    - Each dominant allele means +1 increment in height
    - AA = +2
    - Aa = +1
    - aa = 0
  - With increased phenotypes controlling the variation, plus an environmental effect, one cannot classify phenotype classes, or therefore genotypes. One therefore has to measure the traits
- Number of genotypes is equal to 2n+1, where n = number of gene pairs

Breeding Hybrid Varieties

What are hybrids?

- Crossing between species – interspecific hybrids
- Crossing within a species (F1 hybrid varieties)
    - The cross between two different homozygous lines to produce a F1 hybrid that is heterozygous
- Can be for cross-pollinated crops or self-pollinated.

Hybrid varieties

- Grain crops that are commonly hybridised for better vigour and yield
    - Cross pollinated species; corn, sunflower
    - Self-pollinated species; sorghum, rice and canola
- Hybrid varieties have a yield advantage over non-hybrid varieties
- Uniformity in F1 generation
- May have improved tolerance of abiotic and biotic stresses in the field
- Have advantages in vegetable crops e.g. tomato – yield increases, uniformity
- Breeding companies' – ability to sell new seeds every season

Hybrid varieties in the cropping industry

- Major move toward development of hybrids over last 5-10 years
- Private funded rather than publicly
- 5% to 20% yield advantage over non-hybrid varieties
- >50% of cultivars marketed are hybrids
- The proportion of hybrids increases each year
- Hybrids have been developed to combine traits including genes for herbicide tolerance and multiple disease resistance genes
- There is minimal interest by companies in the developments of new Open Pollinated lines

Hybrid varieties – issues

- Hybrid seed is more costly than open-pollinated varieties due to high cost of seed production.
- Hybrid seed needs to be bought each year to attain the same potential performance – otherwise you are using crossed seeds.
- If hybrid is harvested and re-sown, there is likely to be a significant reduction in performance in the F2 hybrid seed.
- This can include;
    - Reduced heterosis
    - Loss of uniformity
    - Potential segregation for undesirable traits
    - Partial loss of disease resistance.