

Hardy -Weinberg Extension:

Background:

When there are two alleles of a gene in a population, the frequencies are described as:

$$p + q = 1$$

Where **p** is the frequency of the dominant allele in the population and **q** is the frequency of the recessive allele.

A population is said to be in Hardy- Weinberg equilibrium when 5 conditions are met:

- No mutations
- No gene flow (no immigration /emigration)
- Large population size (no genetic drift)
- No selective forces
- No non-random mating

When Hardy-Weinberg equilibrium is met the following equation is true:

$$p^2 + 2pq + q^2 = 1$$

Where **p²** represents the frequency of the homozygous dominant genotype, **q²** represents the frequency of the recessive genotype and **2pq** is the frequency of the heterozygous genotype.

By using the data collected in Part A of this exercise, it is possible to determine the frequencies of the unknown genotypes in the clover population, as long as it is in Hardy-Weinberg equilibrium.

1. Inspect the class data from Part A of this investigation. Calculate the number of plants that are recessive for the production of the cyanide-sugar compound, (cc). Any data you have with genotypes (eccc, or E_cc)

of plants recessive for cyanide- sugar _____

2. Calculate the percentage of the population that is recessive for cyanide-sugar compound production by dividing the previous answer by the total number of plants in the class data.

% of clover population that is recessive (cc) for cyanide-sugar production _____

3. The percentage of the population that is recessive for a trait is the q² value in the Hardy Weinberg equations.

For your population, q² = _____

4. Calculate the frequency of the recessive allele (c), by taking the square root of the q² value.

q = _____

5. Using the relationship, $p + q = 1$, calculate the value of p, the allele frequency of the dominant allele (C) for cyanide -sugar production.

p = _____

6. Once you have calculated values for p and q, use $p^2 + 2pq + q^2 = 1$ to determine the percentage of the population that is homozygous dominant for cyanide-sugar production and the percentage of the population that is heterozygous for the trait.

p^2 (CC) = _____ $2pq$ (Cc) = _____ q^2 (cc) = _____

7. Repeat the above steps to determine the frequencies of the alleles for the production of linamarase, and the genotype frequencies for the homozygote and heterozygote genotypes for that trait.

of plants recessive for linamarase (ee) = _____

% of clover population that is recessive (ee) for linamarase production _____

q^2 = _____

q = _____

p = _____

p^2 (EE) = _____ $2pq$ (Ee) = _____ q^2 (ee) = _____

8. Compare the frequencies of the alleles for both traits. Describe any differences or similarities you observe.

9. Explain how natural selection would contribute to the observed allele frequencies in your clover populations.