Phosphine resistance genetics – Students

Inheriting resistance to phosphine

The genetics of phosphine resistance in insects is not completely understood by scientists. To try and understand what is happening in insect pest populations, scientists use computer modelling systems to create a virtual environment (complete with virtual grain pests!) and change the conditions to see how the insect population responds.

For the purpose of our simple model, we will assume that resistance to phosphine is inherited by a recessive single gene.

Monohybrid cross

Single-gene inheritance can be studied by performing monohybrid crosses.

In this situation, a dominant allele: given the symbol **S** produces a susceptibility to phosphine gas, and its recessive allele: **s,** produces resistance to phosphine gas.

Each insect in the population will have a pair of alleles, one inherited from its mother and the other inherited from its father.

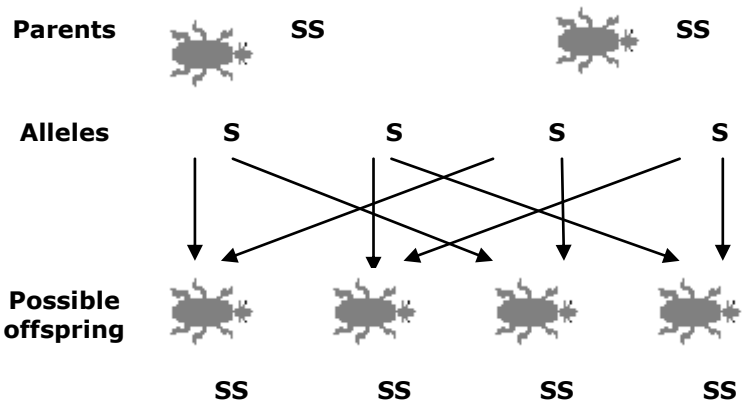
Insects can be homozygous susceptible **SS,** which means that phosphine gas will kill all of them quickly. They can also be homozygous resistant **ss,** which makes them highly resistant to phosphine and unlikely to die. They can also be heterozygous susceptible **Ss**, which makes them susceptible to phosphine but a small number that may survive a fumigation will be capable of passing on their resistant gene.

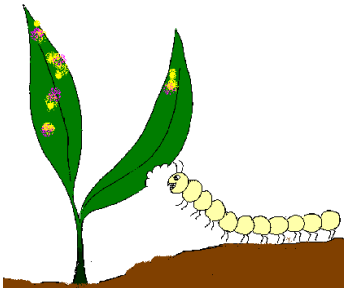
SS – highly susceptible

Ss - susceptible

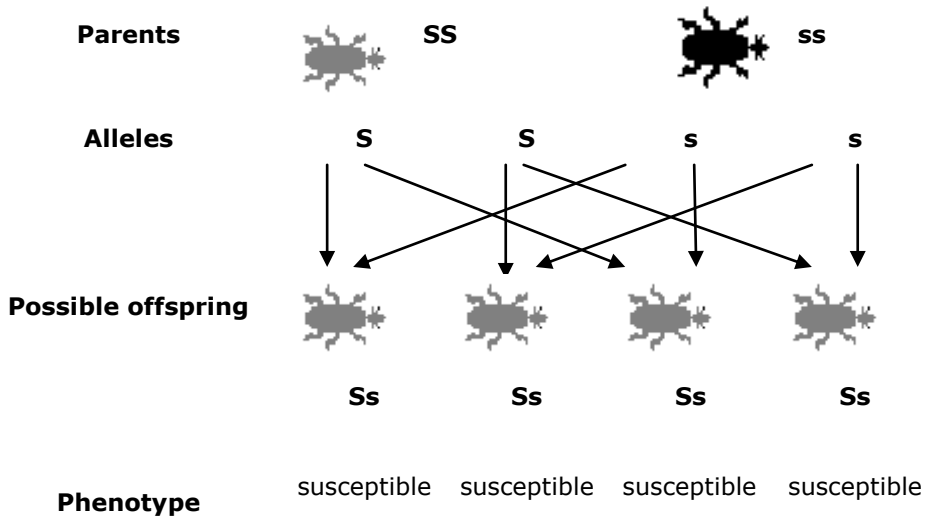
ss - resistant

1. Homozygous susceptible x homozygous susceptible



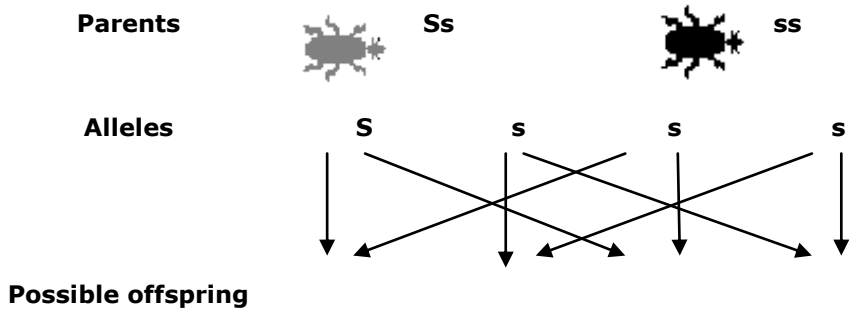


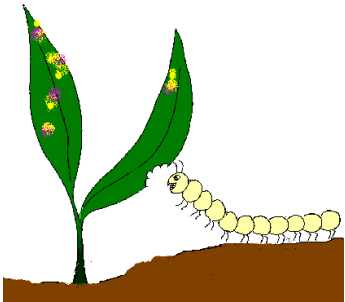
2. Homozygous susceptible x homozygous resistant



Complete the following monohybrid crosses

3. Heterozygous susceptible x homozygous resistant

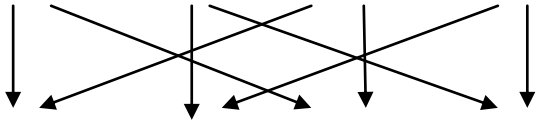




4. Heterozygous susceptible x heterozygous susceptible

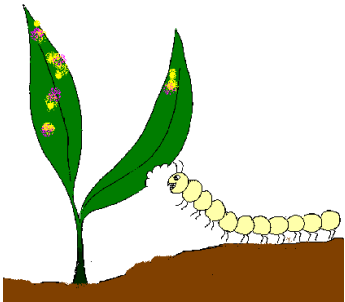
Parents  **Ss**  **Ss**

Alleles **S** **s** **S** **s**



Possible offspring

Phenotype



Population dynamics:

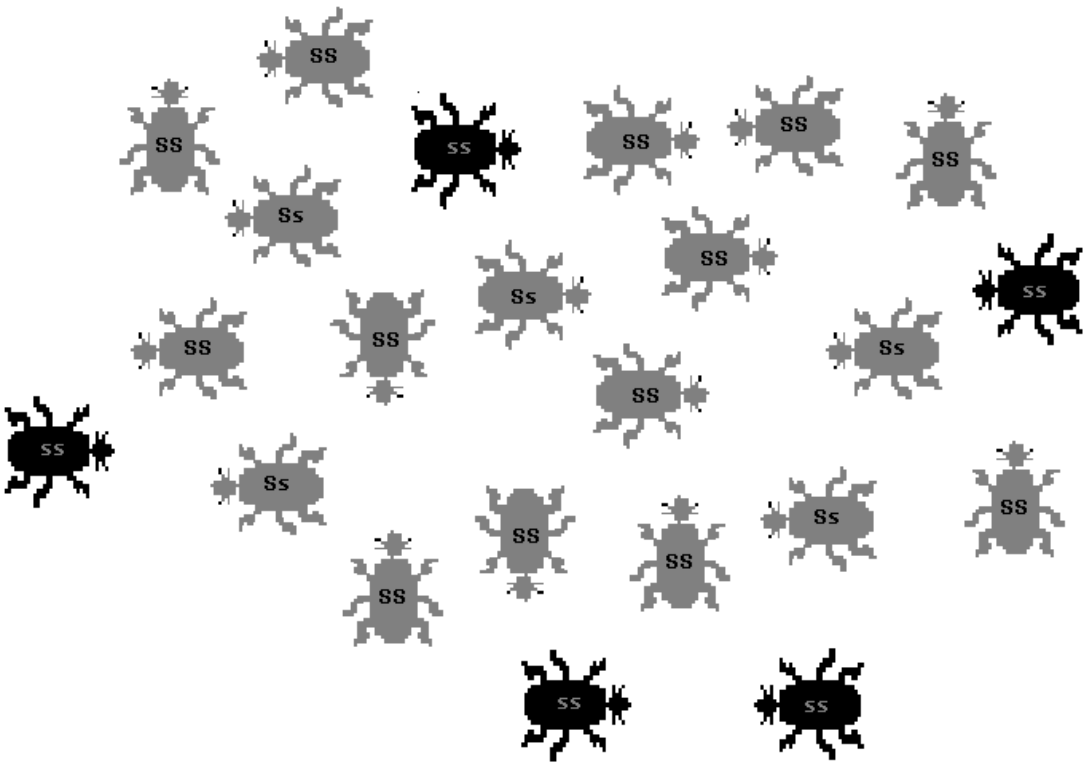
The diagram below shows an imaginary population of weevils undergoing changes as it is subjected to an 'event'. The two phases represent a progression in time. The weevils are either;

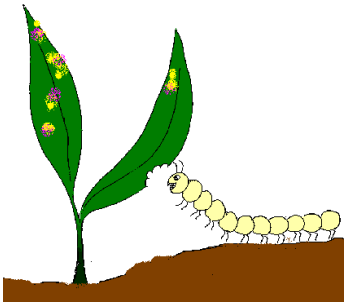
- **SS –** highly susceptible (all will die)
- **Ss –** susceptible (some might survive), or
- **ss -** resistant

1. Initial gene pool

Calculate the frequencies of the allele types and allele combinations by counting the actual numbers, then working them out as percentages.

	Allele types		Allele combinations		
	S	s	SS	Ss	ss
No.					
%					

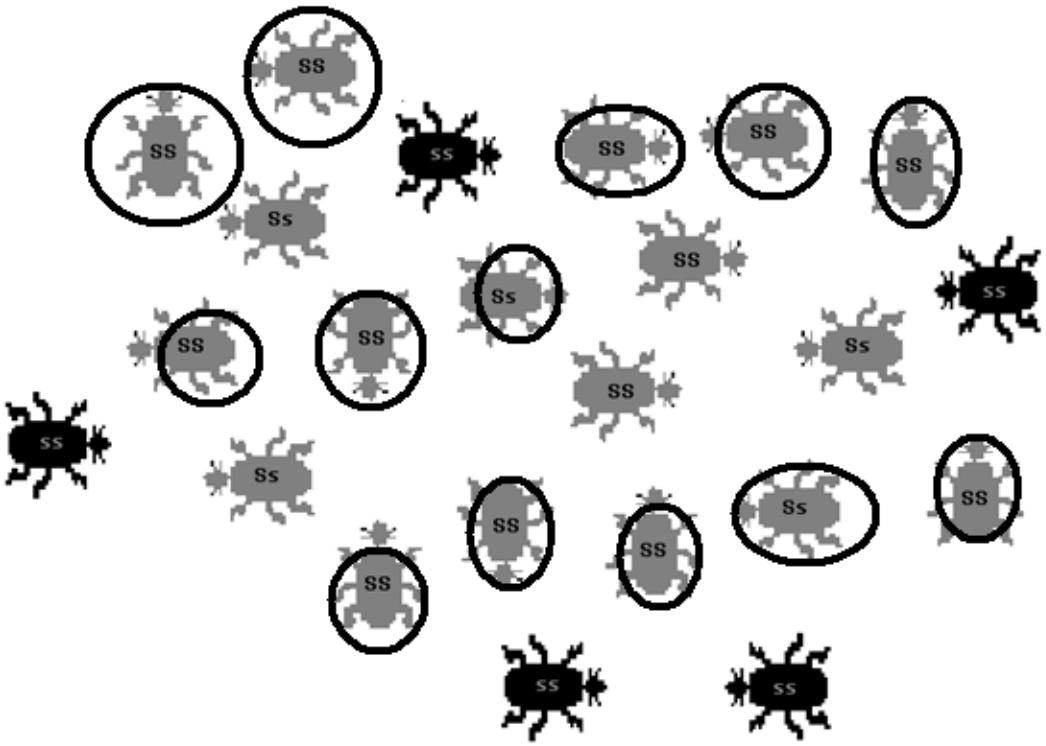




1. After fumigation

In the same gene pool, a phosphine fumigation has occurred. Unfortunately it was undertaken in an unsealed silo. All the SS weevils died, some of the Ss weevils died and all ss weevils survived. Dead weevils have been circled. Calculate the frequencies of the allele types and allele combinations by counting the actual numbers, then working them out as percentages.

	Allele types		Allele combinations		
	S	s	SS	Ss	ss
No.					
%					



Questions

1. We have been treating the resistant gene as a recessive allele, what would happen if it was a dominant allele?