Management of Diseases

Integrated management

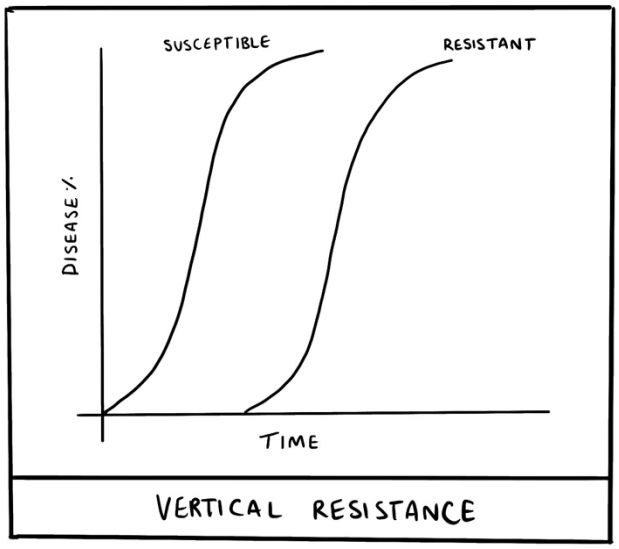
- Integrated management involves selecting a range of effective chemical and non-chemical control strategies, based around the life cycle of the crop and disease.
- Advantages
    - Whole-farm approach to managing disease – including fungicide resistant weeds
    - Does not rely exclusively on fungicides
    - Flexible and suits the enterprises' priorities
- Disadvantages
    - Need to identify the fungi
    - Information about biology and control strategies must be available

Fungicide resistance

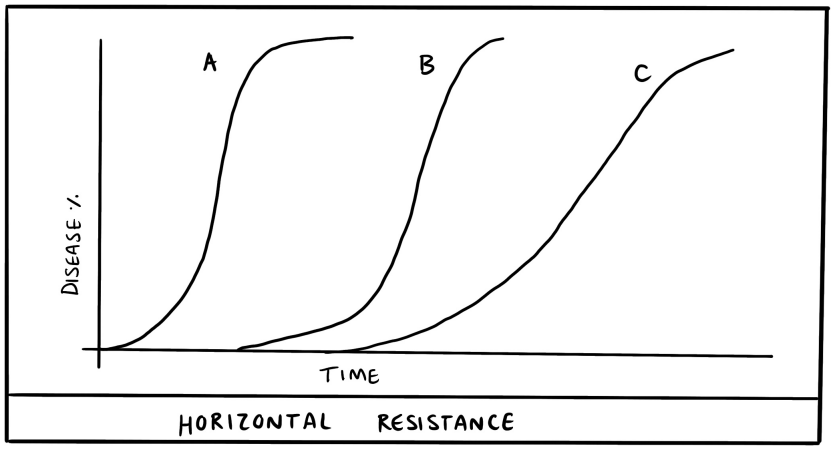
- Development of fungicide resistance:
    - A few individuals in the fungi population are naturally resistant to certain types of chemicals
    - When the chemical is used, it controls almost all of the fungus in the population
    - Survivors are resistant to the action of the chemical and build up the next population.
    - Applying the same fungicide with the same mode of action repeatedly, enables the resistant population to multiply
- Why does resistance develop?
    - Genetic differences
        - Mutation
        - Introduction of new genetic sources
        - Sexual reproduction allows for the new combination of alleles.
    - Selection pressure
        - Intensive use of fungicides
        - Partially effective control
        - Continued use of a fungicide
- Control of fungicide resistance:
    - Farm level
        - Minimise the use of fungicides with compromised resistance.
    - Groups
        - Alternate fungicide groups – except Group M
        - Use mixtures of fungicide groups
        - Do not use the same fungicide groups sequentially
        - Limit the number of times a fungicide group is applied in a season
    - Application
        - Ensure correct application – follow label instructions
        - Use higher label rates

Effect of vertical vs Horizontal resistance on epidemics

- Vertical resistance involves the high resistance of a plant to a single race or strain of a pathogen.
- The ability of the plant to have this resistance is generally the result of one or a few genes with major effects.
- The resistance is generally high; However, as the plant ages, the resistance breaks down or weakens – thus the pathogen can infect.
- This results in disease occurring later in the season. Vertical resistance will delay the onset of the epidemic.

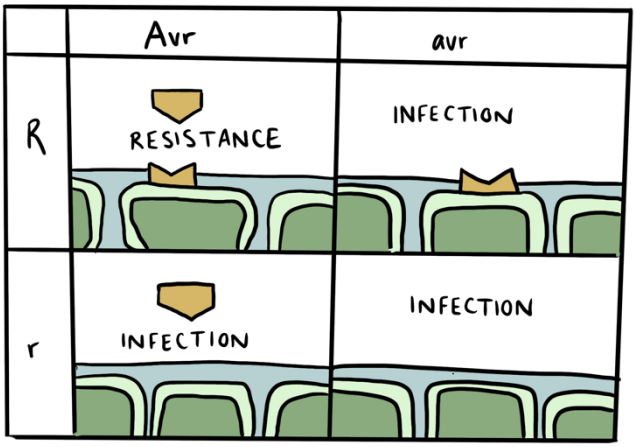


- Horizontal resistance involves the resistance of a plant to all races of a pathogen. The resistance is generally at a lower level than vertical resistance.
- The ability of the plant to have this resistance is controlled by many genes with a polygenic effect (affected by more than one gene.)
- The plant is resistant to all races of a pathogen, therefore, unlike vertical resistance if one strain of the pathogen overcomes resistance, the whole crop won't suffer. Consequently, horizontal resistance results in a decrease in the progression of the epidemic. It reduces the angle of the slope.
- In the below diagram;
    - A = No horizontal resistance
    - B = Some level of horizontal resistance
    - C = Considerable horizontal resistance



Gene for gene hypothesis

- A theory developed by Flor in 1995 to explain the relation between rust (*Melampsora lini)* and flax.
    - The theory that was developed stated that for each genetic locus in the host controlling resistance and susceptibility, there is a specific and related locus in the pathogen which governs virulence and avirulence.
- Resistance is usually dominant to susceptibility
- Avirulence is usually dominant to virulence
- Incompatibility (host resistance) is determined by two dominant genes.
    - One is a plant gene called the resistance (R) gene.
    - The other is a pathogen gene called the avirulence (Avr) gene.
        - The Avr gene encodes a protein which is specifically recognised by the host genotypes – which have the matching resistance gene (R).
    - Incompatibility = host resistance, occurs when the host plant is able to recognise the pathogen. Thus meaning that the pathogen avirulence protein (encoded by avirulence genes) is recognised by the host plant resistance gene product.
    - In the diagram below:
        - R-, Avr – this means that the host has the resistance gene. Additionally, the pathogen has the matching gene, which the host identifies. Thus resistance occurs.
        - r, Avr – this means that the host doesn't have the gene which identifies the pathogen. The pathogen has the gene which the host has the potential to identify, but it doesn't therefore infection occurs.
        - R, avr – this means that the host has the gene to identify the pathogen, and thus have resistance. However, the pathogen doesn't have the gene which encodes for the protein that the plant can recognise. Thus, infection occurs.



        - r, avr – the host doesn't have the genes to allow the identification of the pathogen. And the pathogen doesn't have the gene which allows for identification.
- Gene-for-gene relationship applies in all host-pathogen pairs, where race-specific resistance occurs.
- Gene-for-gene relationship is found in many host-pathogen situations – but not always as clear cut as flax/flax rust
- Every host resistance has an R gene and there is a matching virulence gene for that.