Sclerotinia population dynamics: A force to be reckoned with

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Crop farmers often suffer enormous yield losses because of *Sclerotinia sclerotiorum*. Research has been conducted on its population dynamics to give insight into its genetic structure and population distribution across the world. This research may help oilseeds farmers to better understand and manage this formidable foe.

Genetic structure

A population is a group of individuals who share a common gene pool and originate from a limited geographic area. Fungal strains are classified as a set of isolates that cannot be identified as distinct from each other and can be differentiated from other isolates. The gene pool changes as these individuals adapt to their local conditions. The goal of population genetic studies is to describe the changes, determine their causes, and understand their consequences for the individuals, population and community of which they are a part.

The genetic structure reflects the evolutionary history and potential of the population. Multiple environmental changes can affect the genetic structure of fungal populations. These include, but are not limited to, the following factors:

- Host availability.
- Geographic location and climate.
- Timing of agricultural practices such as planting.
- Frequency and concentration of fungicide and fertiliser applications.
- Irrigation.
- Crop rotation and timing of infection.
- Disease initiation.

Consequently, the genetic structure of a population is not always reflected in the geographical distribution of the individuals involved. Understanding the genetic structure of a fungal pathogen's population assists in the evaluation and improvement of disease management strategies.

A primary use of this tool is in plant breeding and the incorporation or manipulation of host crop genetics to withstand pathogen infection. The ultimate goal is the development of resistant or tolerant cultivars that will combat disease development and spread while still producing acceptable yields.

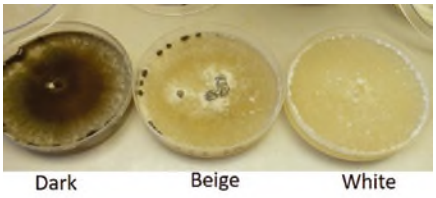
Population research

Population studies have been conducted to give insight into the genetic structure of *S. sclerotiorum* populations across the world. To date, only a preliminary study of 77 *S. sclerotiorum* isolates has been conducted in South Africa. Extensive research on more than 950 isolates across eight of the nine South African provinces is underway at the University of the Free State's Department of Plant Science to resolve the genetic structure of this population. Isolates are collected from fields across South Africa and pure cultures are made. From these isolates, DNA is extracted and compared.

The results are analysed with specialised statistical software. *S. sclerotiorum* is a homothallic fungus, meaning it has male and female reproductive structures on the same thallus and thus a significant amount of self-fertilisation takes place.

The homothallic nature of this pathogen suggests a limited amount of gene flow and therefore low levels of genetic diversity; however, the preliminary study indicated significant levels of genetic diversity. This may be due to environmental pressure on the pathogen forcing change to survive in areas not previously occupied by the pathogen, resulting in a more diverse gene pool.

The population is mostly clonal, which shows that the population has been around for a considerable time (*S. sclerotiorum* was first identified in South Africa in 1979). Additionally, genetic diversity suggests



The growth and patterns of three Sclerotinia sclerotiorum isolates showing different mycelial colour and sclerotia formation.

that variation in pathogen aggressiveness might occur within the population. The results are incorporated into a pre-breeding programme in the greenhouse, where further evaluations are done. Promising lines are planted in the field for evaluation under natural conditions and selection for further studies can then be made.

Resistant genes

In the preliminary study, no association can be found between the pathogen's aggressiveness and location or host. This indicates that the *S. sclerotiorum* population in South Africa is uniform and forms part of a worldwide population. This could be an advantage for breeders as sources of resistance are available in other countries; these genes could be incorporated into local cultivars and assist in the development of cultivars that have sustainable resistance across all regions.

Constant monitoring of the genetic structure provides critical information about potential new pathogen genotypes that may evolve and are better adapted to certain areas or are more pathogenic than currently known. Although these techniques are considered costly, monitoring the genetic structure and the application/addition/incorporation of resistant or tolerant genes to our local cultivars, could provide a sustainable management option to an integrated pest control programme.

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