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Monitoring plant pathogens: Lessons from Covid-19

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The year 2020 was a year concerned with plant health. It was also a year in which the world saw unprecedented challenges due to the Covid-19 pandemic. With this in mind, one is reminded of the saying: "Medicine can cure you one day, but plants can save your life every day".

As a healthy and affordable staple of diets around the world, potatoes can and do indeed save our lives daily. For this reason, food security remains one of humanity's more pressing needs.

During the past year, we have all become aware of the importance of surveillance as a means of preventing or keeping track of pandemics. Therefore, even as we focus on the challenges brought about by the coronavirus, it is important not to lose sight of plant disease outbreaks caused by various plant pathogens and pests.

This article highlights the importance of closely observing these pathogens. It will also draw from and make analogies to the lessons learned from navigating the Covid-19 pandemic.

Vigilance is vital

There are a few examples from history of plant pests and pathogens that have led to major crop losses. One such example is wheat stem rust caused by *Puccinia graminis f.sp tritici*. This pathogen has caused a great deal of devastation for many years, and through the concerted efforts of plant pathologists and breeders, wheat varieties that are resistant to the pathogen have been developed.

The short period of 'peace' was disrupted by the emergence of a new, highly virulent race of stem rust, Ug99, in Uganda. This new race rendered many wheat varieties susceptible to stem rust and since 1998, it has spread throughout East and Southern Africa. Since 2013, there have been mounting concerns about the spread of Ug99 in Europe as well.

The second example is that of the fall armyworm, *Spodoptera frugiperda, J.E. Smith*. The fall armyworm, which mainly affects grain and cotton crops, is a relatively new pest in Africa, having originated from South America. It first emerged in 2016 in West Africa and has now spread to large parts of the Southern African region, including South Africa.

> As is the case with the coronavirus, there are many factors that influence the successful isolation and identification of pathogens.

Another recent outbreak of concern is locusts, which have been threatening food security in much of East Africa and South Asia since the 2019/20 season. It is the worst invasion these countries have experienced in decades.

Like other crops mentioned, potato crops come with their own challenges regarding pests and pathogens. Some of the leading global threats to potato production include the infamous late blight caused by *Phytophthora infestans*, bacterial wilt caused by *Ralstonia solanacearum*, and zebra chip, which emerged in 2000 and 2008 in America and New Zealand, respectively.

Other pests of significance include *Meloidogyne chitwoodi* and *M. enterolobii*, the latter first reported in potatoes in 2013. Additional pests include the Colorado potato beetle and the tomato leaf miner (*Tuta absoluta*).

While some of these do not currently pose a threat to the South African potato industry, a lesson that we should learn from the Covid-19 pandemic is to constantly stay alert. Surveillance remains an important part of staying vigilant.

Figure 1: Tubers showing symptoms of soft rot.

Figure 2: A rotten tuber.

Figure 3: The stem of a potato showing blackleg.

Pathogens wreak havoc in Europe

In the past, *Pectobacterium carotovorum* had been a major cause for concern to potato growers in most parts of Europe. In recent times, there have been two newly emerging soft rot pathogens – *P. brasiliense* and *Dickeya solani*.

In South Africa, the major cause of potato soft rot (*Figures 1 and 2*) and blackleg (*Figure 3*) is *P. brasiliense*. In Europe, there are now growing reports of these diseases causing major losses in potato crops.

Another emerging problem for potato growers around the world is the distinctly aggressive *D. solani*. For this reason, it will be the focus of the remainder of this article.

D. solani

The first isolations of *D. solani* were initially from the hyacinth, an ornamental plant. It is believed that from there the pathogen crossed over to potato plants. This speculation was later strengthened by the interception of hyacinth tubers infected with *D. solani* that were imported from the Netherlands to China.

The first report of this pathogen in potatoes was from Poland in 2005 from tubers that had been obtained from the Netherlands. Since then, *D. solani* has spread like wildfire in much of Europe, Asia, and some parts of South America (*Figure 4*). Israel has reported losses of up to 30%, while Finland has reported losses of up to 50% resulting from *D. solani* infection.

Most of these losses are due to the downgrading of potato tubers. For example, in the Netherlands, downgrading due to *D. solani* leads to losses of as much as €30 million annually. From studies conducted

Figure 4: Reports of *D. solani* around the world.

Red dots: Presence of D. solani. Blue dots: Intercepted and contained.
Black, brown, and grey dots: Reported but localised, or only a few occurrences.

thus far, it is clear that the risk of the spread of *D. solani* is tied to the worldwide trade of latently infected tubers.

Challenges in South Africa

In South Africa, soft rot pectobacterium presents a major challenge to potato production. Several surveys have been conducted in the country and to date, *Pectobacterium brasiliense* is the most prevalent, causing complications for many potato growers. Apart from *P. brasiliense*, there have been reports of *P. wasabiae* (now known as *P. pamentieri*), *P. carotovorum*, and *D. dadantii*.

The question is whether these species are all there is. As is the case with the coronavirus, there are many factors that influence the successful isolation and identification of pathogens.

For example, to ascertain whether there were any corona-positive individuals and to determine the prevalence of infections, governments worldwide did not merely rely on infected patients walking into hospitals. Instead, as we saw at the start, teams were sent out to conduct mass testing programmes. In the same way, for us to know whether there are occurrences of *D. solani* or any other pathogen, frequent testing and surveillance systems must be in place.

Secondly, in the early stages of Covid-19, there were many issues regarding the lack of testing kits as well as the poor accuracy of the results from such kits. Similarly, the outcome of our testing for plant pathogens is influenced by the quality of our testing systems, including the types of selective media that the bacteria must be cultured on, the primers that are used for polymerase chain reaction (PCR), and the overall effectiveness and accuracy of the PCR.

With this in mind, we suggest the use of metagenomics – a more robust method that does not require the culturing of bacteria. Using metagenomics, small amounts of possible new pathogens can be identified. To confirm the occurrence of a pathogen in the country, metagenomic analysis needs to be followed up by isolation (using selectively cultured media) and confirmation using biochemical and molecular techniques.

Early detection is key

It is important that the lessons learned from the Covid-19 pandemic heighten our sense of urgency about the possible emergence of new, highly virulent plant pathogens. As we have learned from the coronavirus, preparation in the form of early detection and prevention of a full-blown pandemic is better for all.

In addition, continuous surveillance, detection, and mitigation of important plant pathogens and pests can save millions of rand within the agricultural sector.

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