# The importance of plant health as a key to sustainable crop production in South Africa

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The South African population has grown from 40.5 million in 1996[1] to 56.6 million in 2020[2] and it is estimated to reach 73 million by 2050[3]. This unprecedented population growth escalates the demand for human food and animal feed and impels increased crop productivity in future.[4] Concurrently, crop production contributes to biodiversity loss, deforestation, desertification, soil degradation and climate change. As the population grows, and agricultural production intensifies, the question is whether it is possible to boost crop production while conserving natural resources and the environment.[3]

Crop productivity is directly related to crop health; thus, it stands to reason that improved plant health will contribute to greater crop productivity, but exactly what is a healthy crop? Healthy crops are those for which the biotic and abiotic factors that cause injury to plants are minimised, and which receive sufficient water, nutrition and light, as needed for photosynthesis and healthy growth. Such plants are less susceptible to pests and diseases and can reach their full genetic yield potential.[5]

For several reasons there is a gap between the current crop health attained in our agricultural systems and the potential for cultivating healthy crops. The growth and productivity of a crop are reliant on the health of the *whole production system*, yet the thought processes around the present inputs into crop cultivation systems remain *segmented*. Inputs on soil health, nutrition, irrigation and crop protection are given to producers by different service providers, who are often also salespersons for products or technologies. The reality, however, is that the crop production system is an *integrated system* in which all the variables related to the crop interact and essentially contribute either to a healthy or to an unhealthy crop.

So, if the production system is viewed as a holistic system, how could we achieve absolute optimal plant health? Take soil for example: when plants are exposed to prolonged wet soil conditions, they are more prone to infection by soil-borne diseases.[5] The management of such a disease therefore cannot rely on the application of a crop protection agent alone, and the cause of the problem, which is long-lasting exposure to wet soil, should also be addressed.[6] Crop health is therefore the result of the best and timely interventions, and these often need to take place concurrently and comprise a variety of components in the production system. There is an ongoing dynamic among soil, water, nutrition and protection of the crop (against pests and diseases). If any of these are neglected, then the health of the crop could be compromised.

So how do we support better plant health in commercial crop production in South Africa? We need to strengthen capacity in *detection, accurate identification* and *quantification* of plant health problems. Saline water, for instance, causes the yellowing of leaves in crops, but so do nutritional deficiencies and certain microbial infections. The application of products (nutritional or agrochemical) in this instance will not help the crop to recover. It is therefore important to understand – and address – the underlying causes in crop diseases. Moreover, if biological agents are found to be responsible for poor plant health, agrochemical intervention is only needed if the pest or disease incidence is above a certain economic threshold. The concept of a 'threshold' refers to the magnitude of the pest or disease population. If the population is smaller than the threshold value, the application of crop protection agents is not economically justifiable[5] as the input costs of the control measures will exceed the monetary benefit likely to arise from the given control measure.

In commercial agriculture in South Africa, there is a strong focus on *preventative measures* for controlling plant diseases by agrochemical spray applications in the absence of the pest or disease, but in anticipation of its presence or arrival. In these systems, strengthening the detection, identification and quantification of specific risks may allow for tailor-made intervention which could reduce reliance on agrochemicals.

In some instances, the climate may not be suitable for the occurrence of a specific organism, or the cultivated variety of the crop may have an inherent resistance to a given organism. So, it remains important to know to what extent a certain pest or disease creates a risk in the production unit and how crucial the management of that specific risk is.

With this knowledge at hand, producers could save money, effort and time, and reduce chemical inputs that are harmful to the environment. In South Africa, the plant protection community needs to be strengthened to support producers with reliable information about the plant health risks that crops face. The prospect of precision detection and identification technology, such as electronic noses, will allow for accurately informed crop protection intervention.[7] Such precision diagnoses will also allow meticulous spray applications on segments of the production unit where the target organism was identified at perfectly timed intervals.[8]

Furthermore, there are various drivers that will determine which pests and diseases may come to dominate certain geographical areas, including:

1. biological shifts, as the displacement of one organism by agrochemical products makes way for another[9],
2. the changing climate's effect on pathogens and pests[10] and the crop host[11],
3. the genetic composition of current and future cultivated varieties[12], and
4. the impacts of the continued evolution of cultivation practices, including the influence of the Internet of things on cultivation practices and crop production.[13]

Future solutions in crop health therefore cannot be seen to be a standard recipe that is applied year after year. The challenge of crop health remains a *dynamic challenge* best addressed with *scientific knowledge*.

Contemporary plant health management approaches also tend to focus on day-to-day operational efforts. Decisions are mainly made in terms of which chemical active ingredients to apply to the crop. The long-term strategic outlook on the environmental impact of the use of these chemicals on non-target organisms (such as insects useful for biological control) and the long-term impact on the environment and a sustainable planet for humans are not properly considered, despite substantial evidence that it is possible to use less pesticide and simultaneously increase crop yields.[14]

Finally, end-point monitoring and evaluation of the success of plant protection efforts are generally lacking, and in order to better manage the risks to crop production and crop health, the true measurement of the impact of the application of certain measures will go a long way in supporting the future use of a technology or product. There is currently a void in terms of the *measurement of the impact of given pests and diseases* on certain crops. Improved access to real-world knowledge could support more appropriate and targeted management of plant health risks in our systems and enhance crop production in future.

## References

1. Lehohla P. South African statistics, 2004/05 [document on the Internet]. c2005 [cited 2020 Oct 13]. Available from: https://www.statssa.gov.za/publications/SAStatistics/SAStatistics2004.pdf
2. Statistics South Africa. Midyear population estimates [webpage on the Internet]. c2020 [cited 2020 Oct 01]. Available from: http://www.statssa.gov.za/?p=13453
3. Von Bormann T. Agri-food systems: Facts and futures: How South Africa can produce 50% more by 2050 [document on the Internet]. c2019 [cited 2020 Oct 13]. Available from: http://www.southernafricafoodlab.org/wp-content/uploads/2019/06/WWF_Food-Report_round2_WEB2.pdf
4. Pandey D. Agricultural sustainability and climate change nexus. In: Contemporary environmental issues and challenges in era of climate change. Singapore: Springer; 2020. p. 77–97. https://doi.org/10.1007/978-981-32-9595-7_4
5. Gullino ML, Albajes R, Nicot PC, editors. Integrated pest and disease management in greenhouse crops. Urdorf: Springer International Publishing; 2020. https://doi.org/10.1007/978-3-030-22304-5
6. Lamichhane JR, Dürr C, Schwanck AA, Robin MH, Sarthou JP, Cellier V, et al. Integrated management of damping-off diseases: A review. Agron Sustain Dev. 2017;37(2):10. https://doi.org/10.1007/s13593-017-0417-y
7. Wilson AD. Non-invasive early disease diagnosis by electronic-nose and related VOC-detection devices. Biosensors. 2020;10(7):73. Available from: https://doi.org/10.3390/bios10070073
8. Skolik P. Sensor based pre-symptomatic detection of pests and pathogens for precision scheduling of crop protection products [doctoral thesis]. Lancaster: Lancaster University; 2020. https://doi.org/10.17635/lancaster/thesis/868
9. Juroszek P, Racca P, Link S, Farhumand J, Kleinhenz B. Overview on the review articles published during the past 30 years relating to the potential climate change effects on plant pathogens and crop disease risks. Plant Pathol. 2020;69(2):179–193. https://doi.org/10.1111/ppa.13119
10. Trebicki P, Finlay K. Pests and diseases under climate change; its threat to food security. In: Yadav SS, Redden RJ, Hatfield JL, Ebert AW, Hunter D. Food security and climate change. Chichester: John Wiley & Sons Ltd; 2019. p. 229–249. https://doi.org/10.1002/9781119180661.ch11
11. Raza A, Razzaq A, Mehmood SS, Zou X, Zhang X, Lv Y, et al. Impact of climate change on crops adaptation and strategies to tackle its outcome: A review. Plants. 2019;8(2):34. https://doi.org/10.3390/plants8020034
12. Li C. Breeding crops by design for future agriculture. Journal of Zhejiang University Science B. 2020;21(6):423. https://doi.org/10.1631/jzus.B2010001
13. Villa-Henriksen A, Edwards GT, Pesonen LA, Green O, Sørensen CA. Internet of Things in arable farming: Implementation, applications, challenges, and potential. Biosyst Eng; 2020;191:60–84. https://doi.org/10.1016/j.biosystemseng.2019.12.013
14. Pretty J, Bharucha ZP. Integrated pest management for sustainable intensification of agriculture in Asia and Africa. Insects. 2015;6(1):152–182. https://doi.org/10.3390/insects6010152