automated spore monitoring networks for disease management and biosecurity

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Pests and diseases account for up to 40% of global crop losses, with projections suggesting this could double under changing climatic conditions, threatening global food security.[1] Yet despite considerable progress in understanding pathogen biology, plant disease management has not fundamentally changed in the past 50 years. [1] The industry continues to rely on calendar-based fungicide applications that do not account for whether disease-causing inoculum is actually present. Research demonstrates that timing applications based on actual spore detection consistently reduces fungicide use by up to 75% without compromising produce quality.[2,3,4] The barrier to widespread adoption has been straightforward: growers have lacked access to timely, economical methods for obtaining real-time pathogen data.

BioScout has developed a solution addressing this challenge. Our autonomous spore monitoring system combines active air sampling, automated light microscopy, and machine learning to detect and quantify airborne fungal spores based on morphological characteristics, delivering near real-time pathogen data (<24 hours) directly to farmers and biosecurity agencies through cloud-based dashboards.

Preliminary results indicate a strong correlation ($r^2 = 0.82$) between automated spore counts and DNA-based pathogen quantification methods, while delivering actionable data weeks sooner. Case studies from commercial deployments demonstrate effectiveness in guiding targeted spray decisions, reducing unnecessary applications, and informing product selection based on actual pathogen presence. Several ongoing field trials are testing the efficacy of incorporating these data into disease management programmes, with promising preliminary results to be presented at this conference. The technology offers complementary benefits to DNA-based methods: providing rapid turnaround for immediate decisions, whilst DNA approaches remain superior for detailed pathogen characterisation and resistance monitoring.

Regional monitoring networks unlock transformative potential for disease surveillance. Fungal disease is fundamentally a social problem—spores respect no property boundaries—warranting social solutions. Australia's broadacre surveillance network and an emerging New Zealand viticulture network exemplify this scalability. These networks enable early detection of pathogen migration and exotic incursions, creating positive externalities where data benefits entire growing regions and enables coordinated biosecurity responses. Network findings to date will be presented at this conference.
This approach represents a paradigm shift toward data-driven disease management, offering significant potential for agricultural productivity improvements and enhanced biosecurity preparedness.

References

1. Beckerman, J.; Palmer, C.; Tedford, E.; Ypema, H. *Phytopathology* **2023**, *113*, 694-706.
2. Carisse, O.; McCartney, H.A.; Gagnon, J.A.; Brodeur, L. *Plant Dis.* **2005**, *89*, 726-733.
3. González-Fernández, E.; Piña-Rey, A.; Fernández-González, M.; Aira, M.J.; Rodríguez-Rajo, F.J. *J. Agric. Sci.* **2020**, *158*, 88-98.
4. Dhar, N.; Mamo, B.E.; Subbarao, K.V.; Koike, S.T.; Fox, A.; Anchieta, A.; Klosterman, S.J. *Plant Disease* **2020**, *104*, 82-93.