ISSCT Germplasm & Breeding Section Webinar
by
Chair ISSCT Germplasm & Breeding Section
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Sugar Research Australia

This webinar, organized by the ISSCT Secretariat in collaboration with the ISSCT Germplasm and Breeding Section, on 7 July 2026, under the theme *Strategies for Accelerated and Precision Breeding* featured three presentations. It was chaired by Dr. George Piperidis, and was attended by 37 participants from 18 countries.

SRA predictive breeding technologies

Dr. Sijesh Natarajan from Sugar Research Australia (SRA) presented his research on the integration of drone-based phenotyping and genomics across multiple stages of the SRA sugar cane breeding programme to improve selection efficiency and genetic gains. He explained how sugar cane's complex genome and challenging phenotyping make traditional breeding inefficient, with long breeding cycles of 12-14 years and information arriving late in the pipeline. He detailed the implementation of drones and genomics across different stages of the selection pipeline, and reported prediction accuracies ranging from 0.55 to 0.83, while machine learning approaches achieved 6.5% greater genetic gains than conventional selection methods.

The programme has been scaled up to deploy drones across six breeding stations, conducting approximately 150 flights annually across 50 field trials. Genomics was identified as the technology with the greatest potential to increase genetic gains, although practical implementation is currently focused on Stage 2 clonal assessment trials.

Sensors in sugar cane breeding programmes

Dr. Anna Hale from USDA-ARS presented her work on evaluating small sensors and gadgets in the introgression breeding programme, drawing an analogy with alchemy and cautioning against expecting quick technological solutions to complex breeding challenges. She discussed the challenges and benefits of using the Fieldbook app for digital data collection and portable meters for assessing cold tolerance, highlighting the need for a "bifocal strategy" that combines visual assessment with measurements of latent traits. While some technologies showed potential to improve the breeding efficiency, their successful implementation faced challenges related to technician adoption and practical applications in the field.

However, they can provide valuable information when properly calibrated and integrated into existing breeding programmes.

Greenhouse to field performance study

Dr. James Todd from USDA-ARS presented a pilot study investigating the potential of greenhouse phenotyping to predict seedling performance. He found that while greenhouse ratings could identify poor-performing families, there was a surprising negative correlation between greenhouse vigour and field selection rates. One possible explanation is that greenhouse material included a more diverse and wilder materials that require more selective breeding in the field. The study also revealed some predictive potential of spectral analysis for root growth and identified relationships between greenhouse growth and field height measurements. However, some limitations were observed in the correlation between field measurements and

drone-derived measurements. Further greenhouse measurements are planned, together with follow-up assessments of performance in first-line trials, to further evaluate the potential of these approaches for breeding selection.

Panel Discussion

The discussion explored the application and future potential of emerging phenotyping technologies in sugar cane breeding programmes, with particular emphasis on drone-based phenotyping, handheld Near Infrared (NIR) technology, and genomic selection.

Drone-based phenotyping was identified as the most promising technology for improving the efficiency, speed, and cost-effectiveness of data collection. Its application during the grand growth stage (approximately 4–8 months), supported by multiple flights, was highlighted to improve prediction of breeding traits such as vigour and biomass. However, panellists noted that drones cannot fully replace visual selection, particularly for traits such as sugar content that are not readily captured through aerial measurements. The importance of reliable ground-truth data for calibrating and validating drone-derived measurements was also emphasised, while satellite imagery was identified as a potential future complement.

Handheld and micro-NIR technologies were also discussed as useful tools for rapid assessment of sugar-related traits. Final validation is underway for potential use in first-line trials, though more work is needed to validate its use with degraded sugar. Routine application of micro-NIR over approximately two years has also demonstrated its effectiveness for measuring sucrose content across different regions of the stalk, particularly at the seedling and first clonal stages.

Looking further ahead, the potential for combining genomic selection with high-quality phenotyping to accelerate genetic gains were highlighted. Data collection efficiency, accuracy, and the integration of multiple technologies were identified as key drivers of future progress. Other potentially underutilised technologies, including harvester yield monitors and NIR systems, were also identified as having potential applications in breeding, including cold-tolerance assessment.

Overall, the discussion indicated that no single technology is likely to replace conventional breeding approaches. Instead, the greatest benefits are expected from integrating complementary technologies—particularly drones, NIR, genomics, and conventional visual assessment—to generate more accurate and comprehensive data while reducing the cost and labour associated with field evaluation.