9th International Strawberry Symposium: Breeding and Genetics

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The 9th International Strawberry Symposium was held in Rimini, Italy, in May this year, as a virtual conference, including virtual field tours, technical days and berry school. There were several streams of presentations, including breeding and genetic resources, cultivation systems, world production, pest and disease management, plant nutrition, sustainable systems, soil fumigation and fruit quality. This article will focus on the breeding and genetics presentations from the symposium.

Genetics

Updates on new variety releases were given by researchers from breeding programs around the world, including NIAB-EMR in the UK, the breeding programs in Spain and Italy, and UC Davis (5 varieties of which will be available in Australia in coming seasons). The new varieties from UC Davis were covered on PAGE 72 in the Spring 2021 edition of the Australian Berry Journal. If anyone would like details about varieties from the other breeding programs, please contact me.

Several presentations focused on the potential of wild strawberry species as sources of new traits to introduce into cultivated strawberry, particularly disease resistance traits.

Aaron Liston, from Oregon State University, gave a Plenary talk on the origin of the cultivated octaploid strawberry, *Fragaria x ananassa*. *Fragaria x ananassa* is a hybrid between the North American *F. virginiana* and the South American *F. chiloensis* which occurred around 300 years ago, and as an octaploid it potentially has four separate ancestral genomes. He described his studies to determine the original diploid ancestors of the cultivated strawberry, and their practical applications in plant breeding. Knowing the ancestral species of a polyploid plant such as *F. x ananassa*, and the conditions to which those species are adapted, can help identify potentially useful genetic traits to incorporate into breeding programs, in particular in adaptation to a changing climate.

Continuing this theme, Jia Jun Lei from Shenyang Agricultural University in China, described the classification of 5 wild tetraploid Fragaria species in China with potential for use in breeding, that were not previously investigated. China has more wild strawberry species than any other country, with 14 out of the 25 recognised species. These species may be a useful source of disease, pest or stress resistance genes, now that they have been identified and described.

Bruno Mazzetti from Ancona in Italy presented work on backcrossing the cultivated strawberry, *F. x ananassa*, with the wild species *F. virginiana* subsp. glauca, to broaden the gene pool to obtain new pre-breeding material with improved plant and fruit characteristics. They are particularly interested in disease resistance, fruit quality and bioactive compounds, and aimed to determine how many backcross generations were needed to incorporate novel traits into *F. x ananassa* without compromising the characteristics expected in commercial production such as yield, high sugar content and high fruit firmness. It was determined that four backcross generations were needed to reach the production and fruit quality levels of commercial varieties, when backcrossing with wild species to introduce new traits.

Another body of work looking at the genetic potential of wild strawberry species was presented by Klaus Obricht, from Germany. After more than 300 years of breeding and cultivation, negative domestication effects can be seen in the loss of aroma from volatile compounds and disease and stress resistance in commercial cultivars. While the parents of *F. x ananassa*, *F. chiloensis* and *F. virginiana*, are more resistant to pathogens than *F. x ananassa* and have rich aroma profiles, this group in Germany is looking at the potential of other wild species of strawberry, which also have important properties that could be utilised in breeding, particularly Asian and Eurasian species. These wild species are generally not octaploid like *F. x ananassa* (that is they have different numbers of chromosomes), so using them in crosses is more complicated involving artificial ways of doubling chromosome numbers and tissue culture. They have successfully used these species in crosses, opening up a more diverse range of breeding possibilities for the future.

Breeding for disease resistance

Many of the presentations focused on breeding for increased pest and disease resistance, with groups utilising a range of technologies for screening for disease resistance. It was mentioned by several speakers that the genetic diversity is low in cultivated strawberries, particularly in public breeding programs as pointed out by Steve Knapp from UC Davis, and many breeding programs have had to go back to ancestral species to bring in more diversity. The frequency of disease resistance alleles is also generally low in these populations. Researchers are looking for genes that confer resistance to particular diseases, or genetic markers that can be used to screen seedling populations.

Ronald Tapia, from the University of Florida, presented work on predicting powdery mildew resistance in strawberry. The use of genetic markers for specific traits has the potential to accelerate variety selection in breeding programs, however, powdery mildew resistance is complex, and influenced by more than one gene, so cannot be predicted by a single genetic marker. The Florida group are using a method called Genome Wide Prediction (GWP) to screen for resistance, which utilises a number of genetic markers, spread across the whole genome.

These markers are then used on a population of individual plants where the resistance to powdery mildew and the genetic makeup of the plants is known, in order to 'train' a prediction model. This prediction model can then be used on an unknown population of plants to screen for resistance. They have shown that this approach can be a cost effective and efficient way to screen seedling populations in a breeding program for complex traits, such as powdery mildew resistance.

In his presentation on the NIAB-EMR breeding program in the UK, Adam Whitehouse spoke about their work in selecting for disease resistance utilising a multi-disciplinary approach. They are using molecular methods to identify markers associated with resistance to a number of diseases such as *Phytophthora* crown rot, *Verticillium* wilt and powdery mildew, as well as developing screening methods using drone-based imaging systems in the field. They are also investigating gene editing technology, although this can only be used in research for validation of candidate genes at present, as it is considered genetic modification in Europe.

F1 hybrid strawberry breeding

ABZ Seeds in the Netherlands have been producing F1 hybrid strawberry seeds since 1976. F1 hybrid seed is produced from two inbred lines, resulting in seeds that are genetically identical, as opposed to seed from regular crosses that show genetic variation. While many of the cultivars produced by ABZ Seeds are for the home garden market, they also breed for commercial production, and several of their lines are available in Australia.

Previously released cultivars from ABZ Seeds were bred specifically for protected cropping, however, they are now producing cultivars for open field production as well. All of their cultivars are day neutral.

If you would like more information about any of the presentations please contact me on 0408 416 538 or ido@vicstrawberry.com.au