

Australian Strawberry Breeding Program Update

Temperate end of season report, and subtropical and Mediterranean update
BS17000: National Strawberry Varietal Improvement Program (2017-2022)

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The Australian Strawberry Breeding Program (ASBP) works to develop new strawberry varieties specifically adapted to Australia’s three major production climates: temperate, subtropical, and Mediterranean. The new varieties must have superior production traits for profitability for growers, and excellent quality to drive repeat purchases in consumers.

ASBP has completed our trials for the temperate production region over the challenging 2021/22 summer season, and 2022 trials for all three regions have recently been planted. This article outlines our breeding activities over the last six months for each region, as well as a summary of some of our advances for the temperate region.

Our breeding program pipeline consists of four stages of trialling: seedlings, early-stage clones, advanced-stage clones, and on-farm trials. These are summarised in Figure 1.

Every year we choose specific combinations of parents to cross-pollinate and create thousands of seedlings, each genetically unique. These seedlings are visually assessed in seedling trials for one season in their targeted production region. The seedlings that display desirable fruit and plant architecture characteristics throughout the season are clonally propagated for replicated ‘early-stage’ clonal trials the following year.

Lines in the early-stage trials are harvested and assessed weekly for yield, average fruit size, flavour, bruise resistance and many other traits. Breeders Jodi and Katie use quantitative genetics analyses to select the best performing lines for a second year of evaluation in ‘advanced-stage’ trials. Comprehensive evaluations are again conducted weekly, with the best material selected and supplied to fruit growers for ‘on-farm’ trials. Feedback and data from the growers at this stage is particularly useful and helps drive the selection of lines, if any, for commercialisation. These four trial stages are conducted concurrently each year in each production region.

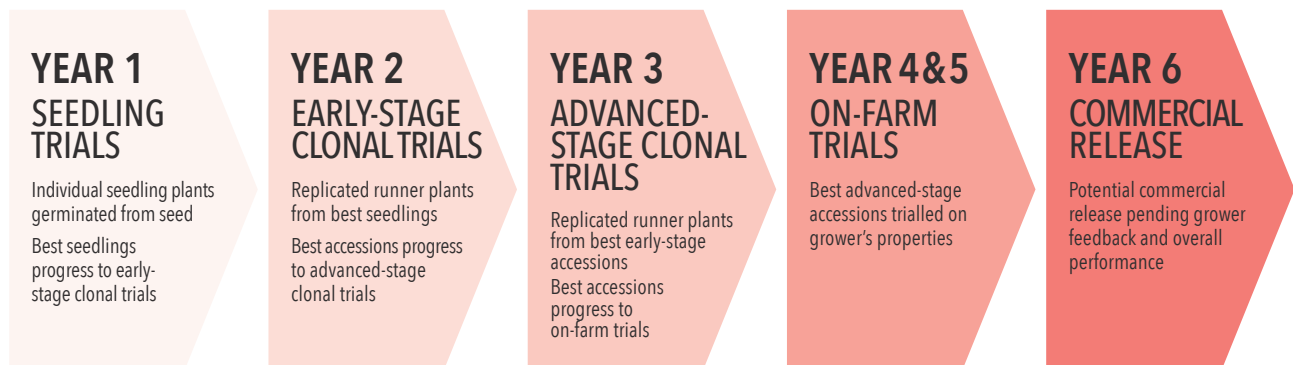


Figure 1. ASBP breeding pipeline showing trial stages. These trials are run every year in each region.

Temperate breeding trials

Our temperate breeding trials have now finished for the 2021/22 season. Plants were evaluated in Wandin, Vic (Figure 2) and Applethorpe, Qld from October 2021 to March 2022.

Overall, we're seeing excellent improvements in this population across a number of traits since we took leadership of the temperate program in 2015. Two major breeding targets for this region have been increased; fruit size and more consistent fruit size across the season. Our economic modelling has indicated that these traits are critical in reducing cost of production, resulting in fewer picks (and therefore less time) needed to fill a punnet. Fruit size consistency in particular has historically been problematic in commercial temperate varieties and is one of the main reasons for higher costs of strawberry production in temperate regions compared with other areas.

“ Since 2015 we've made substantial gains in both average fruit size and size consistency in the temperate breeding population.

Average fruit size in our trials over time is shown in Figure 3. We've achieved an increase from a mean of 17.5 g across all trialled accessions in 2015 to 23.8g in 2021. In a commercial setting this would be a substantial boost to profit per plant.

Fruit size consistency – and improvements in plant architecture that support this – are also showing substantial gains (Figure 4). In particular, selection for non-branching flower trusses has made a major impact in this area, and improvements in this trait were observed first-hand by growers at our Wandin field day in March 2022.

In our 2020/21 temperate trials, we assessed a total of 12,600 seedlings at Wandin and 1,400 at Applethorpe, with 51 selected for early-stage trials in 2022/23 (Table 1). Of the 67 early-stage accessions assessed last season at Wandin, 18 have been selected for further trialling in 2022/23, as well as 21 of the 39 advanced-stage clones. Ten elite accessions were also evaluated by ten growers in Victoria, Tasmania, South Australia, Western Australia, and temperate Queensland to assess their on-farm performance.



Figure 2. The Wandin 2020/21 seedling and clonal trial. © State of Queensland, through the Department of Agriculture and Fisheries. Photo credit: Jodi Neal.

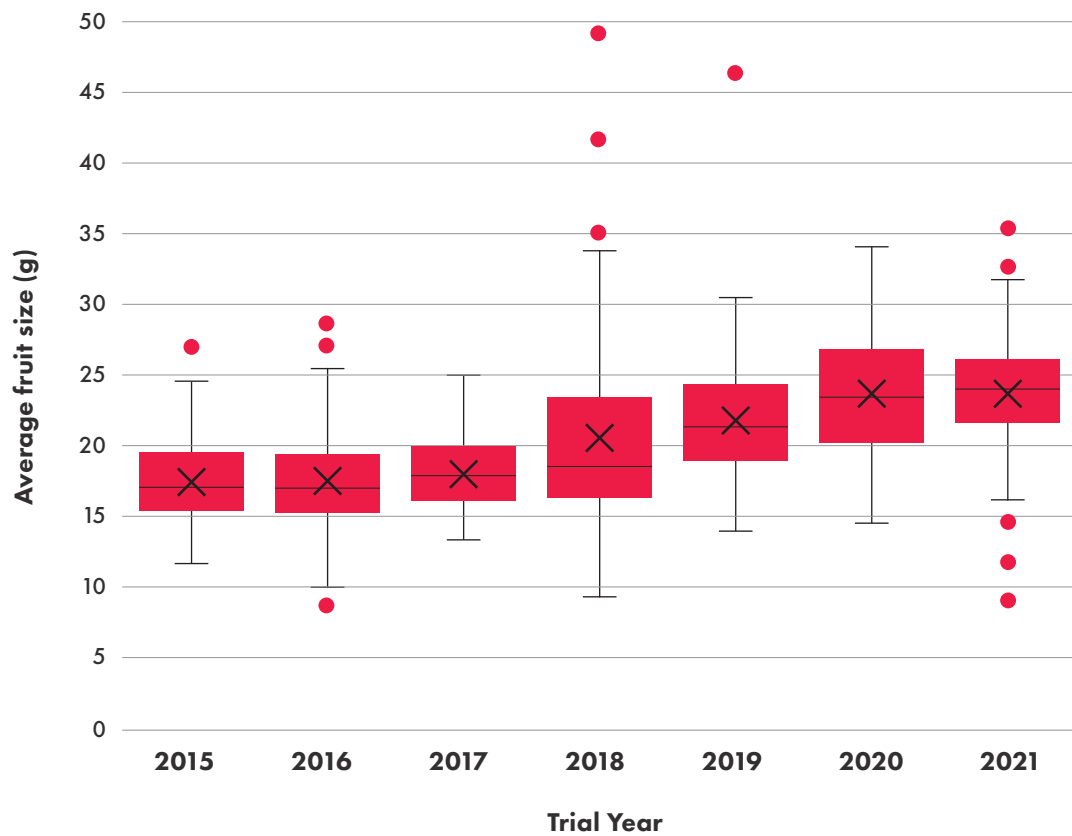


Figure 3. Average fruit sizes of all accessions in temperate clonal trials since 2015. "X" indicates mean trial fruit size.



Figure 4. Temperate accession in late January 2022 showing consistent fruit size and mostly unbranched trusses.

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Temperate trials for the 2022/23 season were planted in Wandin and Applethorpe in April 2022. Plant numbers are summarised in Table 1.

Table 1. For each production region in 2022/23: the number of seedlings being assessed, and the number of clonal accessions tested in early, advanced, and on-farm trials.

| Region | Location | Seedlings | Early clones | Advanced clones | On-farm clones |
|---------------|------------------|-----------|--------------|-----------------|----------------|
| Temperate | Wandin, Vic | ~14,000 | 51 | 39 | 16 |
| | Applethorpe, Qld | 1,302 | 0 | 0 | |
| Subtropical | Nambour, Qld | 16,495 | 136 | 42 | 11 |
| | Bundaberg, Qld | 2,723 | 0 | 0 | |
| Mediterranean | Bullsbrook, WA | 1,781 | 23 | 10 | 7 |
| | Nambour, Qld | 448 | 0 | 0 | |

Subtropical breeding trials

Our subtropical trials are conducted across Maroochy (Nambour) and Bundaberg Research Facilities, Qld. The 2022 seedling trial consists of 2,723 plants at Bundaberg and 16,495 plants at Nambour (Figure 5), with a total of 138 families being assessed across both sites (Table 1). This year's subtropical clonal trial was planted in mid-March at Nambour and contained 136 early-stage and 42 advanced-stage clones. This year, we have two Bundaberg growers participating in the on-farm trials for the first time. A total of 11 elite accessions will be assessed in five on-farm trials, and feedback from growers will be used to decide if any accessions will be commercialised.

Mediterranean breeding trials

The ASBP is working with a grower in Bullsbrook, WA to trial material in the Australian Mediterranean strawberry production region around Perth. The Mediterranean trials this season consist of 1,781 seedlings, 23 early-stage clonal accessions, and 10 advanced-stage accessions (Table 1, Figure 6). A small number of Mediterranean seedlings were planted at Nambour as they weren't established enough to be transported to WA. Due to transport and survival issues in previous years, clonal copies of seedlings have been maintained in the tissue culture laboratory at Nambour for propagation of selected individuals at the end of the season.

One of the guiding principles of our breeding work is to foster the exchange of ideas, so please contact Jodi Neal (jodi.neal@daf.qld.gov.au or 07 5381 1352) if you would like more information. We value your thoughts and appreciate your feedback for the project team.

Acknowledgements

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We thank the contributions by the Temperate and Subtropical Reference Groups and Mediterranean industry members who have helped guide the program, the Industry Development Officers, and all other industry members who provide feedback, advice, and support.

We are also extremely grateful to all the fruit producers in all states who have trialled, collected data on, and given feedback on our on-farm accessions. This has helped us make more informed and better commercial judgments.

The Australian Strawberry Breeding Program team members include Jodi Neal (project lead), Maddy Betts (laboratory technical officer), Sandro Donazzon (Wandin field assistant), Mitchell Gates (laboratory assistant), Apollo Gomez (pathologist), Joanna Kristoffersen (genetics and virus indexing), Hui-Chen Lai (WA technical officer), Pierick Martin (Nambour field assistant), Dale McKenna (Nambour field technical officer and hydroponics), Alan McWaters (Applethorpe technical officer), Alan Noon (Wandin field assistant), Katie O'Connor (breeding and genomics), Michelle Paynter (virus indexing, tissue culture, and pathology), Sandy Shaw (Wandin field assistant), Karen Spencer (Wandin operations manager), Matthew Webb (genomics), and Louella Woolcock (Nambour field and glasshouse operations manager).



Figure 5. 2022 Subtropical seedling trial being planted at Maroochy Research Facility.

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Figure 6. 2022 Mediterranean trials at Bullsbrook, WA. Far right row: early- and advanced-stage clonal trial. Other rows: clonally duplicated Mediterranean seedlings. A clonal copy of each seedling is maintained in tissue culture at Nambour. © State of Queensland, through the Department of Agriculture and Fisheries. Photo credit: Jodi Neal



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