Australian Strawberry Breeding Program Update: Temperate end of season report, subtropical & Mediterranean trial update

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BS17000: National Strawberry Varietal Improvement Program (2017-2022)

The Australian Strawberry Breeding Program (ASBP) is conducted across Australia's three major production climates: temperate, subtropical, and Mediterranean. The aim of the ASBP is to breed strawberry varieties that are specially adapted to each of the three regions, and to commercially release selections to industry that are highly profitable for growers and have superior quality to meet consumer preferences.

Four selections are in the process of being commercially released as new varieties and should be available in small numbers from plant propagators next season. These include two new temperate varieties (Figure 1), one subtropical variety, and a specialty pale pink variety. More information will be made available about these in the near future.

Figure 1. Plants of one of the two new temperate ASBP varieties to be named and commercially released soon. © State of Queensland, through the Department of Agriculture and Fisheries. Photo credit: Karen Spencer.

We have now also completed our 2020/21 trials for the temperate production region over the summer season, and the new subtropical and Mediterranean trials have recently been planted. This article covers our breeding activities for each region over the last six months, including an update on our breeding trials and progress in developing new varieties.

For those not familiar with our breeding pipeline, our program comprises of four trial stages: seedlings, early-stage clones, advanced-stage clones, and on-farm trials. Every year we carefully select parents to cross-pollinate and create thousands of genetically unique seedlings. These seedlings are assessed in their targeted production region in field trials for one season.

The most promising seedlings are identified as those with desirable fruit and plant architecture characteristics, and these are clonally propagated via runners and planted into replicated 'early-stage' clonal trials. Plants in the early-stage trials are evaluated every week for many traits, including yield, average fruit size, flavour, and bruise resistance, and the best performing plants are selected for a second year of evaluation in 'advanced-stage' trials.

Detailed assessments are again conducted weekly, and the best material is again selected and distributed to fruit growers for 'on-farm' trials. Input and comments from the growers at this stage are extremely valuable and helps us identify selections that may be suitable for commercialisation.

These four stages of trials are conducted in each production region each year. Following is a summary of our recent progress in each production region.

Temperate breeding trials

The temperate breeding trials were evaluated from October 2020 to February 2021 in Wandin, Vic. The trial at Applethorpe, Qld was unfortunately unable to be conducted in 2020/21 due to drought, but after some recent rains it will be going ahead again in the 2021/22 season.

We're especially pleased with the overall performance of the temperate selections this season, with strong yields, more consistent fruit sizes, and good flavour. In this past season, over 14,000 seedlings were assessed at Wandin, and 71 of these were selected to progress to clonally-replicated early-stage trials in the coming season (Table 1). Out of the 110 early-stage selections assessed last season, 38 have been selected for further evaluation in 2021/22, as well as eight of the 29 advanced-stage clones.

Nine elite selections were also assessed on nine growers' farms across the temperate regions of Victoria, Tasmania, South Australia, Western Australia, and Queensland to determine their performance on-farm. Two new temperate varieties have been chosen for commercial release (Figure 1), and detailed information on these will be published in a future issue. (See Table 1).

Subtropical breeding trials

The ASBP subtropical trials are conducted at Maroochy (Nambour) and Bundaberg Research Facilities, Qld. This year's subtropical clonal and seedling trials were planted at Nambour in mid-March, and the seedling trial at Bundaberg in early April. This season, we are evaluating around 8,100 seedlings at Nambour (Figure 2A) and 5,800 at Bundaberg (Figure 2B).

We will also be evaluating 163 early-stage and 32 advanced-stage selections at Nambour (Table 1). Ten elite selections will be assessed in five on-farm trials across south-east Queensland and Bundaberg, from which results will be used to make decisions regarding commercialisation.

Mediterranean breeding trials

The Australian Mediterranean strawberry production region is centred around Perth, WA. In 2020, the trial was planted at Nambour due to COVID-19 interstate travel restrictions which meant we couldn't travel to assess the plants. This year we're pleased to have been able to move our trials back to Bullsbrook, WA (Figure 3B). The Mediterranean trials this season contain around 1,800 seedlings, 41 early-stage clonal selections, and 2 advanced-stage selections (Table 1). In previous years, the transport of elite seedling selections from WA to Nambour for clonal propagation was not successful, and many of the plants died following transit. Instead, this year each seedling has been clonally duplicated and individually labelled (Figure 3A), and a copy has been kept in the tissue culture laboratory at Nambour for subsequent propagation of selected individuals.

Disease resistance trials

In addition to our annual breeding trials across the country, we also conduct routine disease resistance experiments for advanced selections from all production regions. These trials guide which varieties are best for commercial release and help to increase disease resistance levels in our breeding population by informing cross-pollinations for production of subsequent generations.

Table 1. For each production region in 2021/22: the number of seedling genotypes being assessed, and the number of clones tested in early, advanced, and on-farm trials.

Region	Seedlings	Early clones	Advanced clones	On-farm clones
Temperate	~15,000*	71	38	8
Subtropical	14,091	163	32	10
Mediterranean	1,787	41	2	2

* At the time of writing the temperate seedling trial at Wandin was in the process of being planted and final numbers were not available.

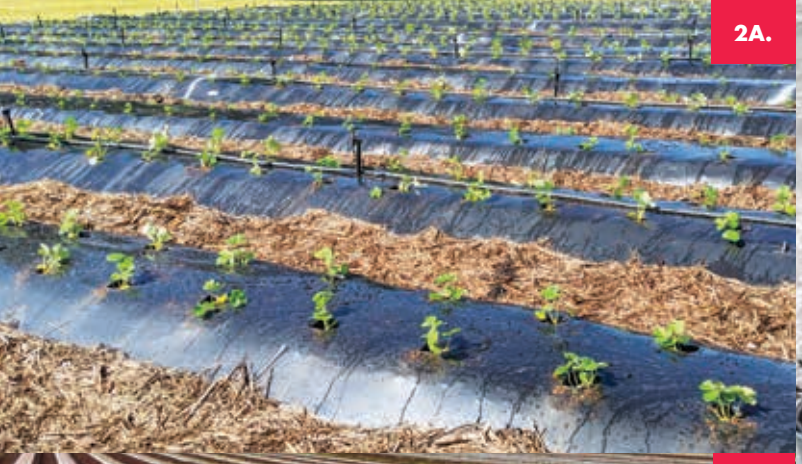

Figure 2. 2021 Subtropical breeding trials: (A) seedling trial at Maroochy Research Facility, Nambour; (B) planting the seedling trial at Bundaberg Research Facility. © State of Queensland, through the Department of Agriculture and Fisheries.
Photo credit: (A) Katie O'Connor; (B) Dale McKenna.

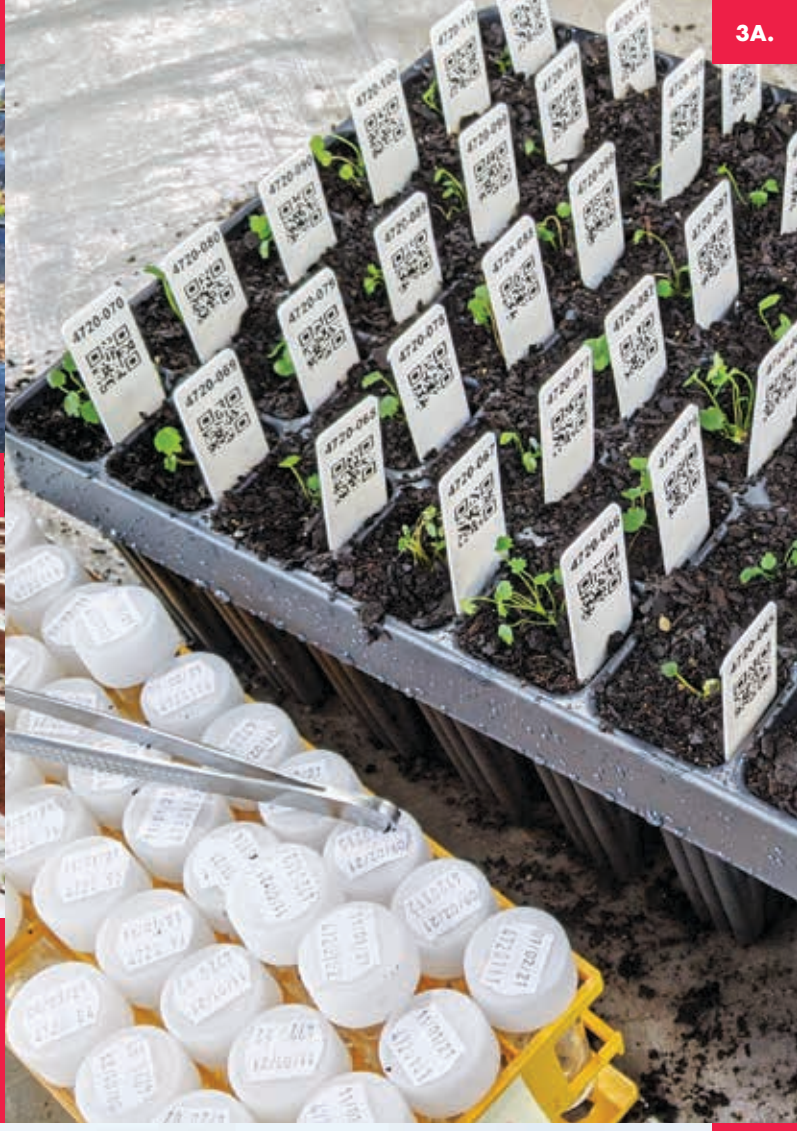

Figure 3. 2021 Mediterranean trials: (A) Clonally duplicated Mediterranean seedlings being planted out from tissue culture and individually labelled. A clonal copy of each seedling is maintained in the laboratory at Nambour. (B) Mediterranean seedlings and clones planted out at Bullsbrook, WA. © State of Queensland, through the Department of Agriculture and Fisheries.
Photo credit: Figure 3A – Katie O'Connor, Figure 3B – Dale McKenna.

Figure 4. Plant pathologist Apollo Gomez assessing the *Macrophomina phaseolina* (charcoal rot) resistance screening experiment at MRF. © State of Queensland, through the Department of Agriculture and Fisheries.
Photo credit: Katie O'Connor.

Currently, we're screening 15 advanced selections for resistance to *Macrophomina phaseolina* (charcoal rot). Over the coming months we will also screen around 30 selections for resistance to each of *Colletotrichum* and *Fusarium*. In these trials we artificially inoculate multiple potted plants of each selection with the disease and monitor them for up to six months for severity of symptoms and plant death (Figure 4).

We also routinely screen for resistance to powdery mildew. This trial is conducted at Nambour on substrate (tabletops), where powdery mildew is allowed to naturally spread and infect the trial plants. We then assess both leaves and fruit for severity of symptoms multiple times across the season.

This year our powdery mildew the trial comprises 264 seedlings, and 13 commercial and advanced-stage clones from all three major production regions. A summary of findings from our previous powdery mildew experiments was published in the Autumn 2021 Australian Berry Journal.

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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 selections. 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 assistant), Clinton Buck (Nambour field assistant), Janine Conway (laboratory technical officer), Apollo Gomez (pathology), Sue Hibbit (Wandin field assistant), Lien Ko (virus indexing and pathology), Dale McKenna (Nambour field technical officer and hydroponics), Allan McWaters (Applethorpe technical officer), Alan Noon (Wandin field assistant), Katie O'Connor (breeding and genomics), Michelle Paynter (virus indexing, tissue culture, and pathology), Karen Spencer (Wandin operations manager), Matthew Webb (genomics), and Louella Woolcock (Nambour field and glasshouse operations manager).

One of the guiding principles of our breeding work is to foster the exchange of ideas, so please contact Jodi Neal if you would like more information.

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We value your thoughts and appreciate your feedback for the project team.