Genetic Gain in the Australian Strawberry Breeding Program

Gains in yield and fruit size over the past 9 years:
An update from the project 'Australian Strawberry Breeding Program (BS22000)

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The Australian Strawberry Breeding Program (ASBP) has been hard at work to produce more profitable varieties with improved fruit quality. By focusing on the unique needs of Australia's strawberry growers, the program has made measurable progress in developing varieties that deliver higher yields, larger fruit, and better resilience to environmental challenges. These improvements not only increase grower profitability but also ensure consumers continue to enjoy strawberries that look and taste excellent.

This article highlights the genetic gains (improvement) achieved in the subtropical (Bundaberg and South-East Queensland) and temperate (southern states, Albany region of WA and Stanthorpe region of QLD) breeding nodes of the ASBP and shows how these advancements are directly benefiting growers. Our Mediterranean breeding node has significantly expanded in recent years. As a result, genetic gain for this region will be presented at a later time, once more years of data are available.

What is Genetic Gain, and Why Does It Matter?

Genetic gain refers to the measurable improvement in desirable traits within a breeding population over time. In plant breeding, it's a key indicator of progress, showing how effectively a program is enhancing traits that matter most to growers and consumers. By tracking genetic gain, we can quantify improvements in areas like yield, fruit size, and quality, ensuring that each new generation of plants outperforms the last.

For growers, genetic gain translates into tangible benefits: higher productivity, better fruit quality, and improved resilience to challenges like disease and weather extremes. These gains are the result of rigorous selection processes, where only the best-performing plants are chosen as parents for the next generation of seedlings.

The graphs presented in this article show how the performance of strawberry accessions in our breeding program have improved over time.

- The **vertical axis** represents the trait being improved (e.g., yield, fruit size), while the **horizontal axis** shows the year each plant was selected as a seedling
- **Each dot represents the performance** of an individual accession from that year
- The line on the graph is a **trend line,** summarising the overall progress made across our entire breeding population
- The **slope of the line** indicates the rate of genetic improvement over time in direct relation to the trait (i.e. a slope of 1 indicates a gain of 1 unit per year)
- A **steeper slope** indicates greater genetic gain
- The **dotted horizontal lines** represent the performance of other industry varieties for comparison with the general breeding population
- **Note:** *Red Rhapsody*-ASBP was selected by ASBP as a seedling in 2010, and *Stella*-ASBP in 2017

Subtropical Node: Strong Gains Across Key Traits

The subtropical breeding node of the ASBP has delivered significant genetic gains in traits that directly impact grower profitability. Since 2016, the program has achieved consistent year-on-year progress in several key areas:

- **Total yield:** An increase of 19 grams per plant per year (equivalent to an additional berry per plant each year), ensuring higher overall productivity (Figure 1)
- **Season average fruit size:** A gain of 0.7 grams per fruit per year, through consistent improvements across the growing season (Figure 2)
- **Average fruit size in August:** An increase of 0.7 grams per fruit per year, particularly valuable during hot weather when punnet prices tend to decrease

In addition to these yield and size improvements, the subtropical population has shown increases in shelf life since 2016 and higher levels of fruit glossiness. This means that fruit stays fresher for longer, reducing waste and increasing marketability. Yield and Brix (or total soluble solids, sweetness) are usually negatively correlated; however, despite our excellent gains in yield across the season, there has been no significant decrease in Brix.

The higher early-season yield of *Stella*-ASBP (30g per plant in May) compared to *Red Rhapsody*-ASBP (12.5g) translates to approximately $0.25 gain per plant due to more punnets packed[1]. Furthermore, the higher yield per plant and average fruit weight of *Stella*-ASBP in August compared to *Red Rhapsody*-ASBP (+98g and +0.53g, respectively) equates to approximately +$0.81 per plant[2]. These significant gains are an indication of the program's focus on delivering real-world, profitable benefits to strawberry growers.

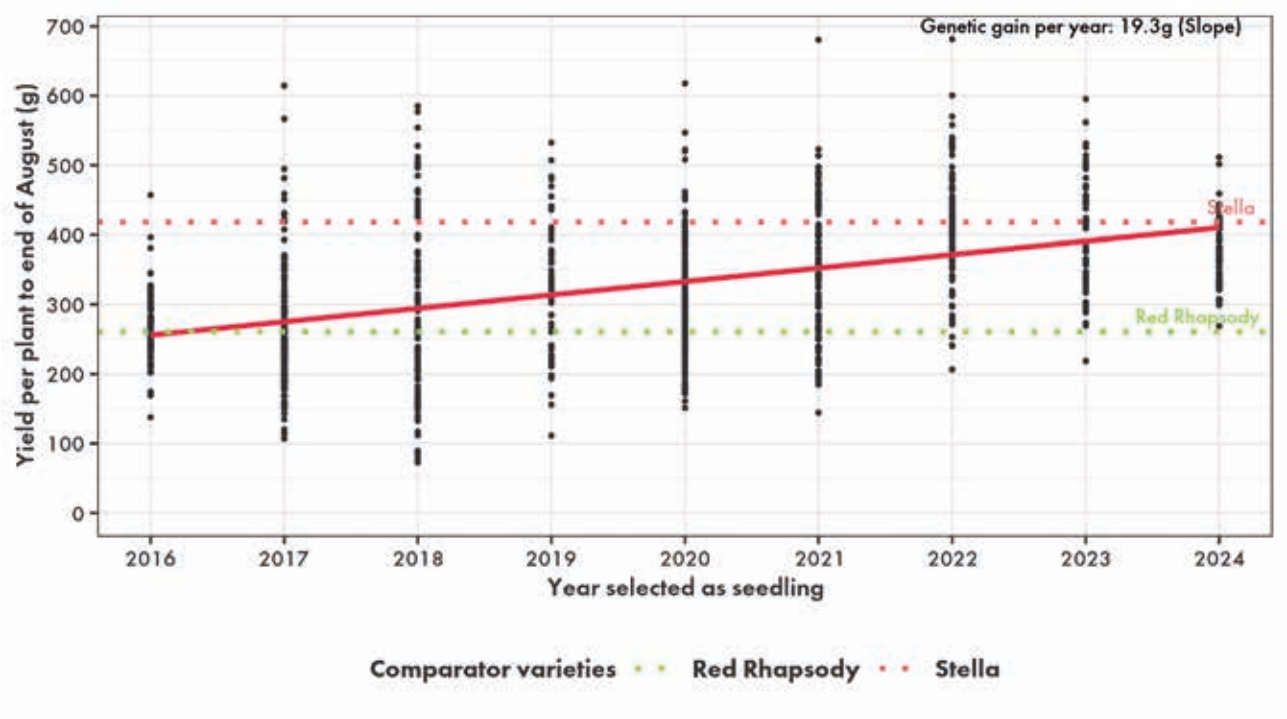

Figure 1. Genetic gain of total season yield per plant from 2016 to 2024 for the subtropical region

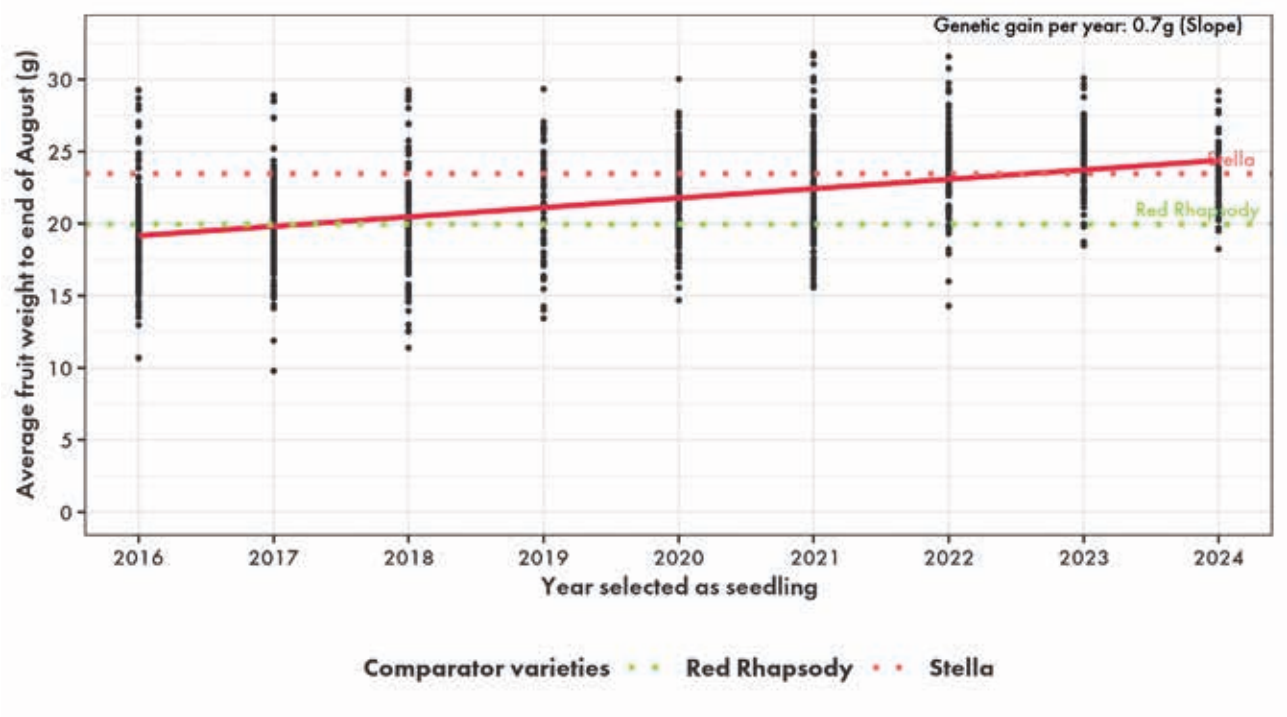

Figure 2. Genetic gain of average fruit size across the season from 2016 to 2024 for the subtropical region

Temperate Node: Steady Progress in Yield and Fruit Size

In the temperate breeding node, the ASBP continues to make steady genetic gains, particularly in fruit size. Since 2016, the program has achieved:

- **Total Yield:** A modest but valuable increase of 7 grams per plant per year, contributing to overall productivity (Figure 3)
- **Fruit Size:** A gain of 0.5 grams per fruit per year (Figure 4), with particularly strong improvements during the hot months of December and January

These gains are especially important for growers in temperate regions, where the typically smaller fruit sizes during peak summer months significantly increase the cost of production.

The temperate breeding population also outperforms popular varieties like *Albion* and *Cabrillo* in several key traits, including a higher brix-to-acid ratio (indicating better flavour), higher proportion of marketable fruit, higher levels of single-stemmed fruit compared to branched trusses, and a lower proportion of small fruit (less than 10 grams). Additionally, the population shows less truss branching, which results in more uniformly sized fruit, simplifies harvesting, and reduces labour costs.

In terms of economic gains within this node, our pre-commercial accession 2017-025-130 is outperforming *Cabrillo*. In December, 2017-025-130 has an average yield per plant of 45g more than *Cabrillo*, and an average fruit weight of 37.6g compared to *Cabrillo*'s 26.5g. This translates to an economic gain of $0.38 per plant[3]. Similar gains are observed for January (+94g yield per plant, +4.9g fruit, +$0.72 per plant[4]). 2017-025-130 (often abbreviated to "ASBP-130") is currently being grown in medium-scale trials (100-1000 plants) at 11 farms across four states. A commercialisation decision for it will be made at the conclusion of this season.

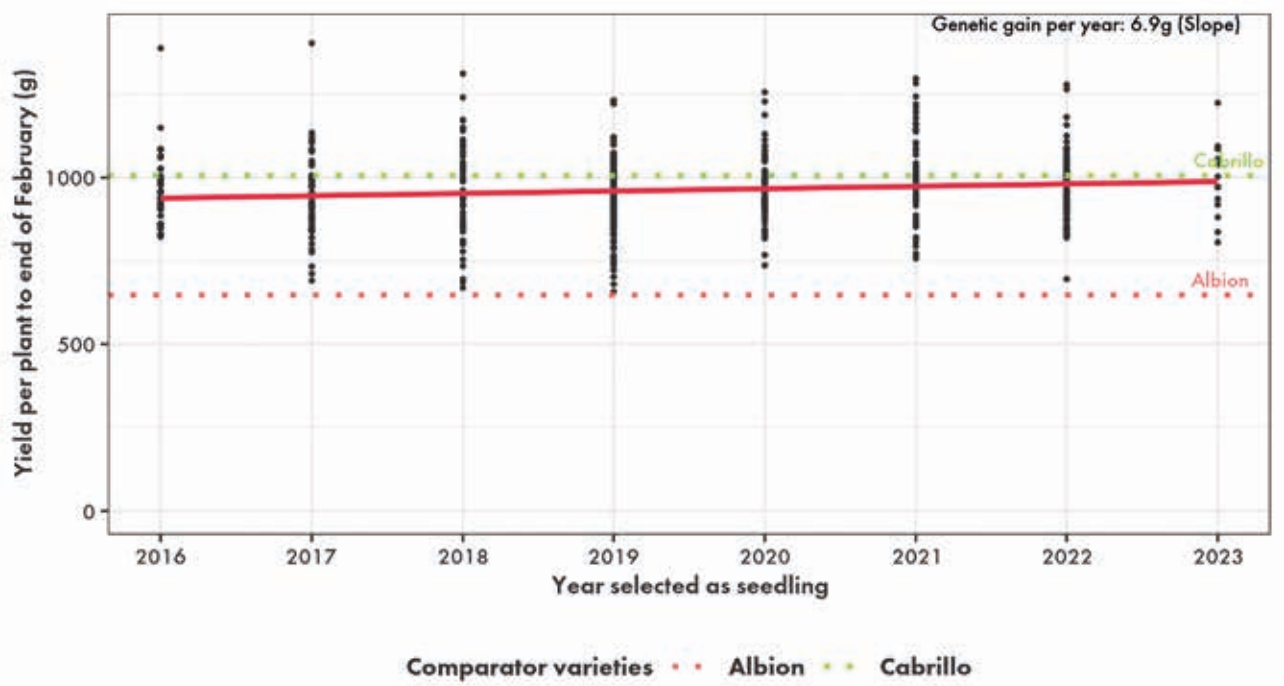

Figure 3. Genetic gain of total season yield per plant (until the end of February, as data was only collected until this point historically) from 2016 to 2023 for the temperate region

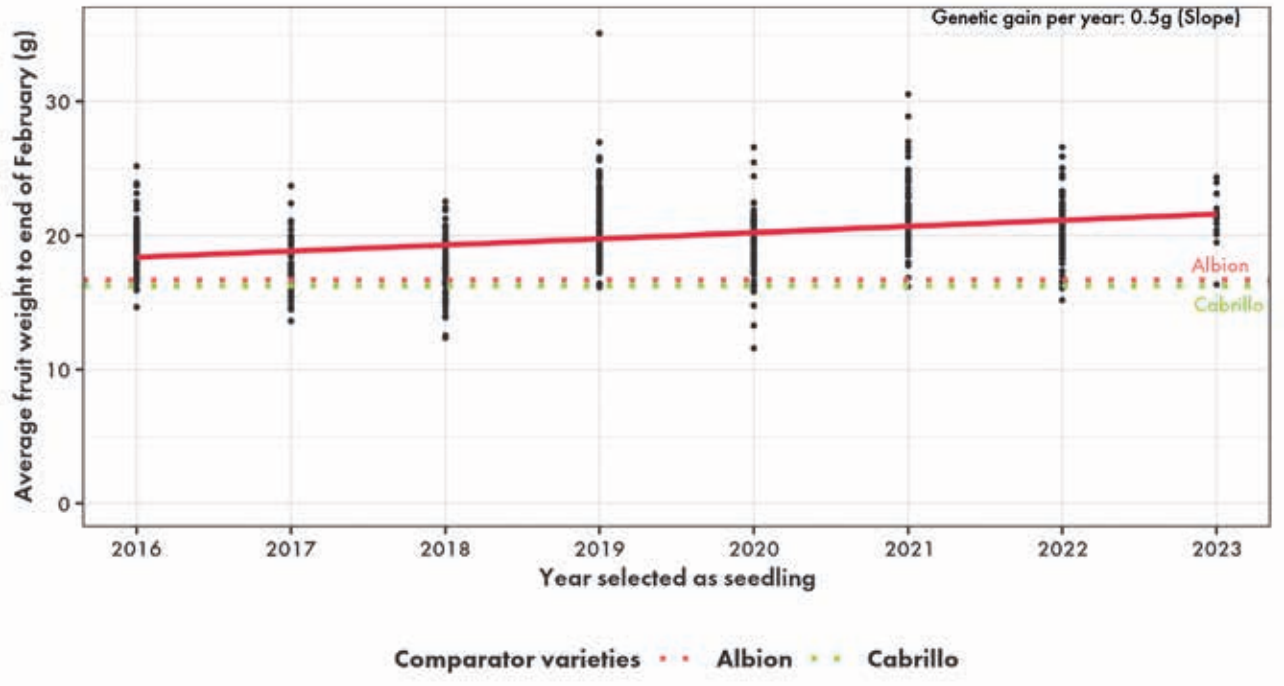

Figure 4. Genetic gain of average fruit size across the season from 2016 to 2023 for the temperate region

Continuous Improvement: A Commitment to Growers

While the ASBP is proud of the progress made to date, our team remains firmly focused on continuous improvement. By systematically assessing genetic gain at the end of each season, the team can measure the successful advances, as well as identify the areas where further improvements are needed.

The program's achievements to date, particularly in yield and fruit size, represent a significant step forward. Economic modelling has confirmed that these traits are critical drivers in increasing profitability through increased productivity (yield), as well as reduced cost of production from larger and more consistent fruit sizes. Larger fruit require fewer picks (and therefore less time in labour) to fill a punnet. These gains demonstrate the strength of the ASBP's breeding strategies and the program's ongoing commitment to delivering commercially significant outcomes for Australian strawberry growers.

For more information about the program or to share your thoughts, please contact Jodi Neal at **jodi.neal@dpi.qld.gov.au** or **07 5381 1352**.

Your feedback helps us ensure that the ASBP remains focused on delivering the best possible outcomes for growers and the industry as a whole.

By working together, we can continue to achieve genetic gains that benefit everyone, from growers in the field to consumers enjoying strawberries at home.

Notes

1 based on the average Brisbane market 250g punnet price of $3.56 in May 2025, obtained from Ausmarket Consultants

2 based on calculations of the number of fruit per plant, number of fruit per 250g punnet, number of punnets per plant, and August 2025 punnet price of $2.06

3 based on the average Melbourne market punnet price of $2.10 in December 2024

4 based on punnet price of $1.91

Acknowledgments

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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 accessions. This has helped us make more informed and better commercial judgments.

The Australian Strawberry Breeding Program team members include Jodi Neal (project lead), Michaela Antoine (Perth field assistant), Sarah Brindley (Wandin field assistant), Freya Brinkley (Nambour lab assistant), Joanna Gillespie (genetics and virus indexing), Dilmini Hettiarachchi (PhD student), Lilian Kass (Nambour field assistant), Dale McKenna (Nambour field technical officer and hydroponics), Alan Noon (Wandin field assistant), Katie O'Connor (breeding and genomics), Michelle Paynter (virus indexing, tissue culture, and pathology), Karen Spencer (Wandin operations manager), and Louella Woolcock (Nambour field and glasshouse operations manager).

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