

# VALUE AND IMPORTANCE OF THE GF PLUS™ ROYALTY

PUBLISHED APRIL 2019



**RPBC**<sup>®</sup>  
Radiata Pine Breeding Co Ltd





The Radiata Pine Breeding Company (RPBC) is a world leader in the production of genetically improved radiata pine (*Pinus radiata*) for commercial deployment. The RPBC is now capitalising on its strong foundations and unique genetic resources by embracing new breeding technologies and a more commercial approach to its operations.

RPBC continues to deliver genetic gains in key traits, investigate new breeding technologies and develop deployment decision tools. It aims to provide speedy market access to an ongoing supply of elite genetic materials, and enable all plantation owners, regardless of size, to increase their profitability.

The RPBC breeding population is now in its third and fourth cycles of selection. Significant improvements in growth rate, form, wood quality and resistance to *Dothistroma* needle blight have been achieved since radiata pine breeding began in the 1950s.

Superior genetic materials produced through RPBC's breeding programme are made available to seed orchards and clonal providers for propagation. These are then supplied to the market via commercial nurseries as seedlings or cuttings.

RPBC is funded principally by 15 shareholders, including Australasian forest owners and commercial producers of radiata pine seed and clones. From 2003 to 2018, the New Zealand Government was also a major contributor to RPBC research through funding partnerships. A Royalty paid 'at the nursery gate' on all radiata pine stock is another significant component of RPBC's funding.



## GENETIC QUALITY, OP AND CP STOCK

The growth and form of radiata pine trees reflects their genetic potential. Genetic information inherited from parent trees is the code for physical characteristics stored in the seed. Fortunately, many of the desirable characteristics (traits) required in the NZ market are moderately to highly heritable.

By the late 1960s, most radiata pine seed in the market came from open pollinated (OP) orchards and the genetic quality of trees in OP orchards has improved over time. By the late 1980s, radiata seedlots also became available from control pollinated (CP) orchards. The identity of both parent trees is known for all seed produced in CP orchards. Superior trees are selected from tree breeding trials designed to test the performance and quality of seedling off-spring.



Tree measurements are used to calculate breeding values for each trait. Breeding values are used to rate the genetic quality of all genetic material. Breeding and measurement is a continuous process and seed orchard managers replace seed orchard populations as new elite trees are identified to deliver ongoing gains in the genetic quality of radiata seed.

RPBC has shortened the radiata breeding cycle so the breeding population is being refreshed more quickly (faster turnover) and new selections are now available for seed orchards faster than in the past.



## GF AND GF PLUS™ RATINGS FOR GENETIC QUALITY

The GF system was introduced for OP seed in 1987 to provide a single numerical value to describe gains in growth (stem diameter) and form (straightness) in the ratio 2/3 growth to 1/3 form. Each radiata parent was assigned a GF rating and the weighted average GF value was calculated for each OP seedlot and seedlings produced. GF 19 was the last and most genetically improved OP seed rated using this system.

The GF Plus™ rating system replaced the GF scheme in 1998. GF Plus™ provides a rating for five specific traits:

- Stem diameter
- Wood density
- Stem straightness
- Branching habit (frequency of branch whorls)
- Resistance to *Dothistroma* needle blight.

GF Plus™ ratings are directly related to breeding values derived from breeding trials as shown in Fig 1.

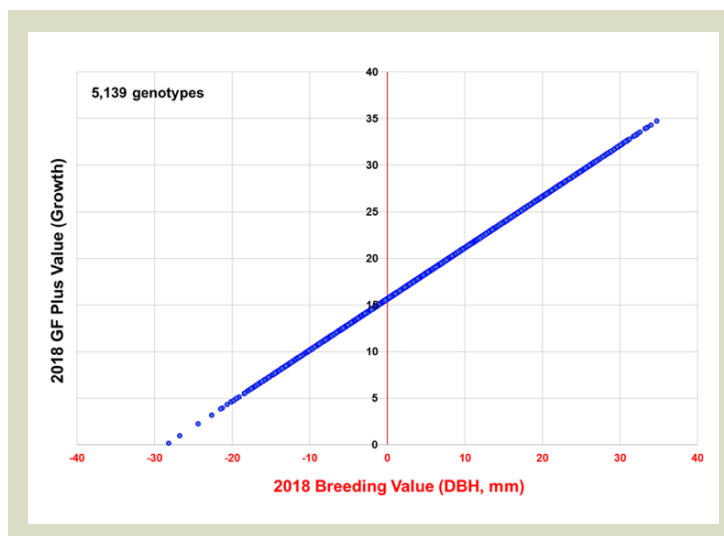


Fig 1: Relationship between 2018 GF Plus™ ratings for growth and 2018 breeding values for DBH. Source: Wei-Young Wang.



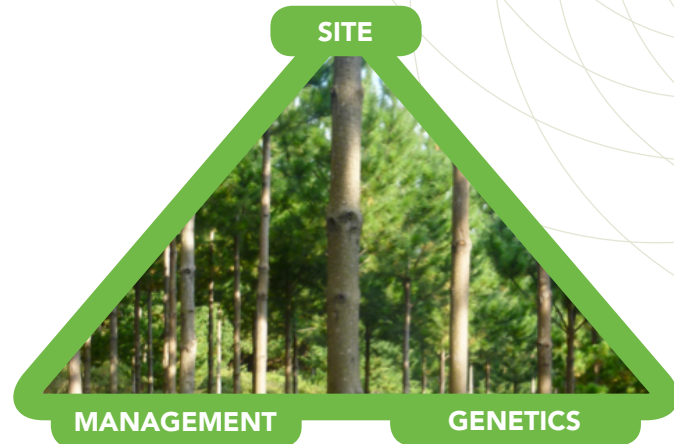
GF Plus™ values can be used to select seed, seedlings and cuttings with higher ratings for traits that favour their end-product objectives. Seed certificates showing the GF Plus™ values for each trait in each seedlot are available from seed orchard managers. Certificates are provided to seed orchard managers by the Seed Certification Service.

Breeding values and GF Plus™ values are derived from trials spread across NZ and eastern Australia. Testing occurs across a wide range of sites to validate performance. More measurement data become available each year and breeding values are recalculated: this can result in small changes in the genetic ratings of seed orchard parents and is a natural outcome of continuous testing. GF Plus™ ratings indicate genetic potential, not the actual performance of trees under any one site and silvicultural regime. Site and management have a significant impact on crop performance. RPBC recommends including at least six crosses in CP seed mixes to reduce the risk of performance instability with variations in site quality.

Traits	GF Plus™ values – 2018		
	Min	Median	Max
Growth (DBH)	0	18	35
Straightness	8	17	24
Branch habit	11	20	29
Wood density	-17	17	49
Corewood stiffness (PME)	9	15	23
<i>Dothistroma</i> resistance	-2	18	40

The GF Plus™ scale for each trait is unit-less and has no upper limit. The maximum values increase over time as more improved genetic selections are identified through the breeding trial programme. The table above shows GF Plus™ scales for the key traits as of 2018.





### THE GF PLUS™ ROYALTY

In 1998 RPBC introduced the GF Plus™ Royalty, also known as the 'RPBC Royalty', payable on all radiata stock including seedlings, cuttings and clones derived from its NZ breeding programme. The Royalty is an essential component of RPBC's funding and ensures that all growers of radiata pine can benefit from current and future genetic improvements.



RPBC owns the genetic make-up of all products from the breeding programme. The Royalty is payable on all radiata stock, including stock from both OP and CP seed, because all radiata planted today are genetically improved.

All OP and CP seed orchards are planted with elite trees selected using the GF Plus™ rating system. Today's OP seed is more genetically advanced than GF19. Buyers can request specific CP crosses and seedlots targeting genetic traits relevant to their desired end products based on GF Plus™ values. For example, CP seed can be produced to favour productivity, high wood density and *Dothistroma* resistance. OP seedlots reflect the genetic quality of each OP orchard with annual variations related to the volume of seed produced by each mother tree.

The GF Plus™ Royalty is reviewed annually and collected by licensed nursery growers 'at the nursery gate' on behalf of RPBC. At present the Royalty is paid by all purchasers of radiata pine planting stock who are not RPBC shareholders. Shareholders pay annual levies, and since 2014 have also contributed an additional \$500,000 per annum to the RPBC Genomics Selection research programme.





## CHANGES ARE HAPPENING IN 2019

From 2019 the RPBC GF Plus™ Royalty and shareholder levy contributions are being aligned and all purchasers of genetically improved radiata pine will be charged equitably.

In addition, anyone who buys radiata pine stock will have access to key genetic information from RPBC. The following changes and projects will be progressed in 2019:

- Breeding Values will be released to the wider market. Access will no longer be restricted to RPBC shareholders as has been the case to date.
- Sharing data and germplasm with core research partners in a more open and transparent manner.
- The GF Plus™ rating system for traits will be reviewed and may ultimately be replaced with a new system.
- A third staff member will be employed by RPBC. This person will focus on the market and those who deploy genetically improved radiata pine.
- A new website will improve RPBC's connectivity with all radiata pine growers – both shareholders and other forest owners.
- RPBC's breeding objective is being reviewed, and it is likely this process will see the first tweaking of RPBC's breeding objective in many years.
- RPBC's archiving methodology will be reviewed – not all germplasm currently carried by the company will remain in the breeding and conservation archive orchards.
- The quality and quantity of the field testing programme in NZ and Australia will be reviewed – not all trials will survive that review.
- Genomic selection will be used to check and confirm the accuracy of all pedigrees in the RPBC breeding programme – i.e. are the individuals comprising the breeding population actually what we think they are.
- Participating in more collaborative research with Forest Growers Research in order to leverage a broader range of outcomes into RPBC's breeding programme.
- RPBC will develop a relationship with the only other large radiata pine breeder in Australia – the Southern Tree Breeding Association.

As RPBC moves forward with more rapid breeding and faster delivery of genetic improvement, we are enthusiastic about the opportunity for all radiata pine growers to capture the benefits of genetic gain delivered through ongoing RPBC investment and free access to breeding information.

**CONTACT US:** [www.rpbc.co.nz](http://www.rpbc.co.nz) : [info@rpbc.co.nz](mailto:info@rpbc.co.nz)

