Supplementary Materials S1: Method of deriving clonal values for trait of tree height

The published scores for these clones were converted to Clonal values using a BLUP-derived equation (linear model) based on the relationship between the published scores of the other 44 G1 clones and their Clonal values (Figure A1). This conversion method was adopted because the published scores of the other G1 clones correlated significantly with the corresponding Clonal values determined by BLUP ($r=0.62$, $p<0.001$).

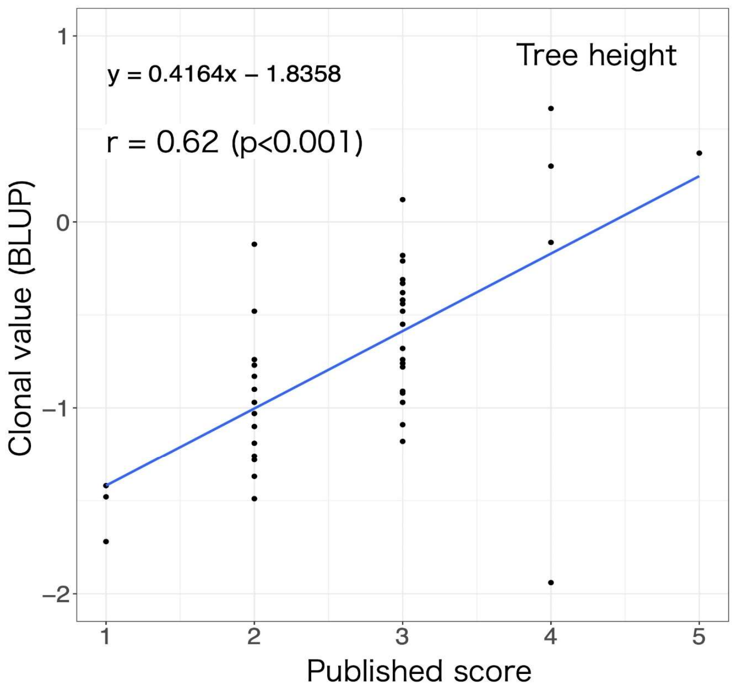
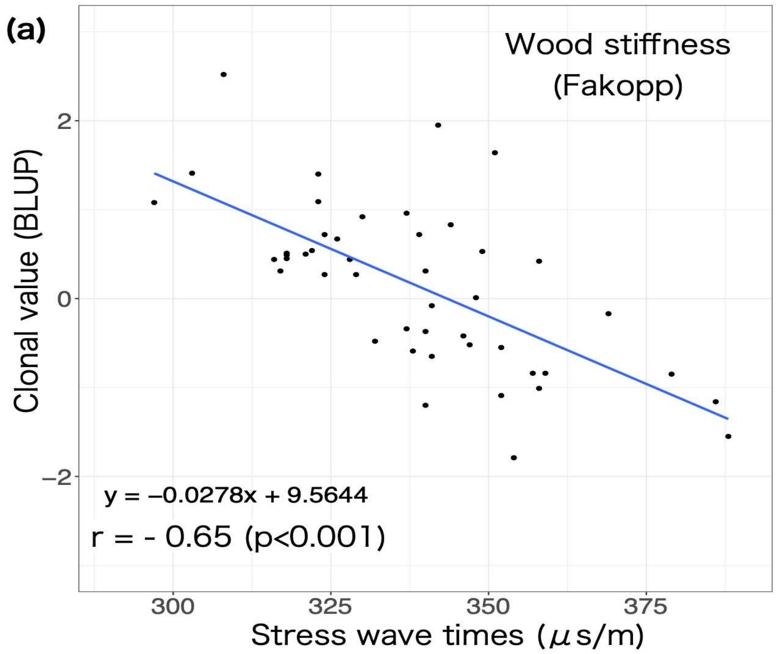


Figure A1.
Relationship between published scores (Kyushu Forestry Research Association 1998) and Clonal values calculated using BLUP for tree height at age 10 years.
Pearson's correlation coefficient = 0.62 ($p<0.001$).
The blue line shows the linear model of the relationship between the two variables ($y = 0.4164x - 1.8358$).

Supplementary Materials S2: Method of deriving clonal values for trait of wood stiffness

The wood stiffness of the 72 clones not included in the lumber survey was determined in standing tree surveys. Fifty-three of these clones were surveyed for wood stiffness using a Fakopp instrument in around 2010, when the trees were 22-29 years old. The remaining 19 clones lacking previous stiffness survey data were surveyed in 2021 with the TreeSonic timer, when the trees were 30-39 years old. Average stress wave times were obtained for each clone in both cases. A linear model was formulated to relate the average stress wave times measured in standing trees before felling using the TreeSonic timer and Fakopp instruments to the Clonal values determined from the dynamic Young's modulus measurements acquired during lumber surveys (Figure A2). These variables were expected to be related because of a previously reported correlation between stress wave velocity and the dynamic Young's modulus [28], and because the stress wave times measured with the Fakopp and Treesonic instruments correlated significantly with the Clonal values determined by BLUP in the lumber survey (Fakopp; $r=-0.65$, $p<0.001$, Treesonic; $r=-0.69$, $p<0.001$) (Figure A2).



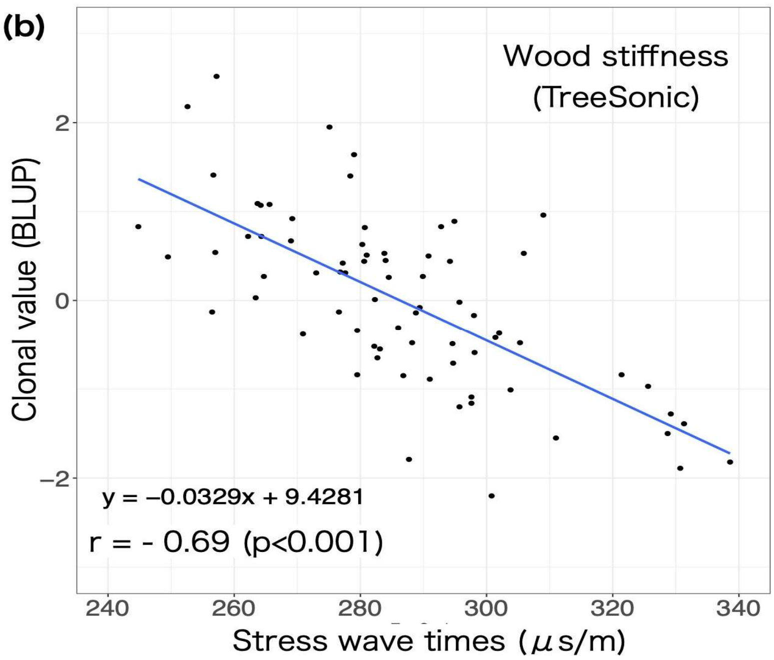


Figure A2.

(a) Relationship between Stress wave times determined using a Fakopp instrument in standing trees and BLUP Clonal values calculated from lumber survey data.

Pearson's correlation coefficient = - 0.65 ($p<0.001$).

The linear model equation ($y = -0.0278x + 9.5644$) is plotted in blue.

(b) Relationship between Stress wave times determined using a TreeSonic instrument in standing trees and BLUP Clonal values calculated from lumber survey data.

Pearson's correlation coefficient = - 0.69 ($p<0.001$).

The linear model ($y = -0.0329x + 9.4281$) is plotted in blue.

Supplementary Materials S3: Method of deriving clonal values for trait of male flower quantity

The published scores for each clone were classified using a five-point scale based on standardization values calculated from the annual mean and standard deviation for all clones used raw observed data. On this scale, a score of 1 indicates no male flowers and higher scores indicate progressively greater numbers of male flowers [39]. In addition to assessments using BLUP-derived Clonal values, the results for the G2 clones in the test sites were evaluated based on standardization values similar to those applied to the published scores for G1. To this end, linear models were generated to relate the 5-level scores calculated from the standardization values to BLUP Clonal values (Figure A3). The linear models were then used to convert the published scores for G1 (47 clones) into Clonal values. This conversion was justified by the finding that the scores calculated using standardization values [39] for G2 correlated significantly with the corresponding BLUP Clonal values ($r=0.94$, $p<0.001$) (Figure A3).

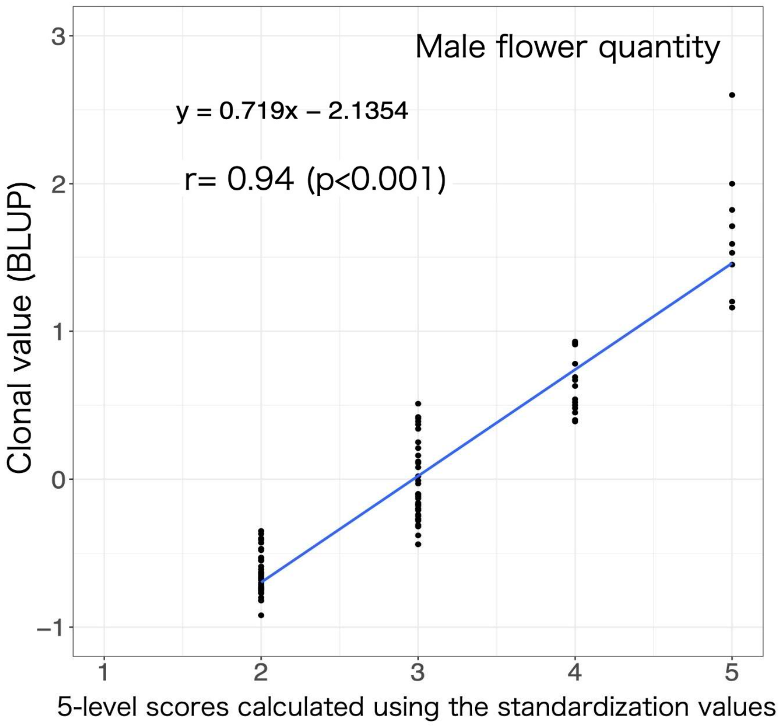


Figure A3.
Relationship between 5-level scores for male flower quantity calculated using standardization values and the corresponding Clonal values calculated using BLUP.
Pearson’s correlation coefficient = 0.94 ($p<0.001$).
The linear model ($y = 0.719x - 2.1354$) is plotted in blue.