**Sup. Table 4. Estimated variance components1 (line 1) and their standard errors (line 2) for rust resistance.**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Scenario2 | $$\overbar{G^{\*}}$$ | $$σ\_{g}^{2}$$ | $$\overbar{G^{\*}}σ\_{g}^{2}$$ | $$σ\_{a}^{2}$$ | $$σ\_{p}^{2}$$ | $$σ\_{i\_{1}}^{2}$$ | $$σ\_{i\_{2}}^{2}$$ | $$σ\_{e}^{2}$$ | $$σ\_{P\_{f}}^{2}$$ | $$σ\_{P\_{p}}^{2}$$ | $$h\_{f}^{2}$$ |
| FILTLOW1 | 2.35 | 3.29E-013.59E-02 | 7.74E-018.45E-02 | 8.87E-086.98E-02 | 2.21E-011.25E-02 | 2.42E-012.88E-02 | 2.35E-011.26E-02 | 5.01E-011.09E-02 | 1.06E+004.96E-02 | 1.97E+004.90E-02 | 7.28E-016.49E-02 |
| FILTLOW2 | 2.40 | 3.22E-013.54E-02 | 7.73E-018.50E-02 | 1.19E-077.05E-02 | 2.21E-011.25E-02 | 2.42E-012.89E-02 | 2.35E-011.26E-02 | 5.01E-011.09E-02 | 1.06E+004.96E-02 | 1.97E+004.90E-02 | 7.27E-016.55E-02 |
| FILTLOW3 | 2.59 | 2.95E-013.26E-02 | 7.65E-018.46E-02 | 2.25E-077.08E-02 | 2.20E-011.25E-02 | 2.45E-012.90E-02 | 2.35E-011.26E-02 | 5.01E-011.09E-02 | 1.06E+004.91E-02 | 1.97E+004.85E-02 | 7.24E-016.61E-02 |
| FILTLOW4 | 2.71 | 2.73E-012.98E-02 | 7.39E-018.07E-02 | 2.89E-026.49E-02 | 2.20E-011.25E-02 | 2.54E-012.95E-02 | 2.34E-011.26E-02 | 5.01E-011.09E-02 | 1.06E+004.99E-02 | 1.98E+004.94E-02 | 6.95E-016.07E-02 |
| FILTLOW5 | 2.60 | 2.34E-012.72E-02 | 6.10E-017.08E-02 | 1.60E-015.94E-02 | 2.20E-011.25E-02 | 2.58E-012.98E-02 | 2.34E-011.26E-02 | 5.01E-011.09E-02 | 1.07E+005.00E-02 | 1.98E+004.94E-02 | 5.71E-015.43E-02 |
| FILTLOW6 | 2.42 | 1.94E-012.58E-02 | 4.71E-016.27E-02 | 3.17E-015.67E-02 | 2.20E-011.25E-02 | 2.59E-012.98E-02 | 2.34E-011.26E-02 | 5.00E-011.09E-02 | 1.09E+005.05E-02 | 2.00E+004.99E-02 | 4.34E-014.90E-02 |
| FILTLOW7 | 2.25 | 1.60E-012.47E-02 | 3.60E-015.54E-02 | 4.30E-015.54E-02 | 2.20E-011.25E-02 | 2.64E-013.01E-02 | 2.34E-011.26E-02 | 5.00E-011.09E-02 | 1.09E+005.05E-02 | 2.01E+004.99E-02 | 3.30E-014.48E-02 |
| FILTLOW8 | 1.97 | 8.68E-022.19E-02 | 1.71E-014.32E-02 | 6.17E-015.72E-02 | 2.20E-011.25E-02 | 2.66E-013.02E-02 | 2.34E-011.26E-02 | 5.00E-011.09E-02 | 1.09E+004.90E-02 | 2.01E+004.83E-02 | 1.57E-013.79E-02 |
| FILTLOW9 | 1.69 | 4.86E-022.04E-02 | 8.23E-023.45E-02 | 7.06E-015.77E-02 | 2.20E-011.25E-02 | 2.67E-013.03E-02 | 2.34E-011.26E-02 | 5.00E-011.09E-02 | 1.09E+004.84E-02 | 2.01E+004.78E-02 | 7.55E-023.12E-02 |
| FILTLOW10 | 1.55 | 5.29E-022.13E-02 | 8.19E-023.30E-02 | 7.06E-015.66E-02 | 2.20E-011.25E-02 | 2.68E-013.03E-02 | 2.34E-011.26E-02 | 5.00E-011.09E-02 | 1.09E+004.85E-02 | 2.01E+004.78E-02 | 7.51E-022.97E-02 |
| FILTLOW11 | 1.44 | 7.16E-022.43E-02 | 1.03E-013.50E-02 | 6.86E-015.59E-02 | 2.20E-011.25E-02 | 2.67E-013.03E-02 | 2.34E-011.26E-02 | 5.00E-011.09E-02 | 1.09E+004.87E-02 | 2.01E+004.81E-02 | 9.46E-023.12E-02 |
| FILTHIGH1 | 2.36 | 3.29E-013.58E-02 | 7.74E-018.44E-02 | 3.15E-086.96E-02 | 2.21E-011.25E-02 | 2.42E-012.88E-02 | 2.35E-011.26E-02 | 5.01E-011.09E-02 | 1.06E+004.96E-02 | 1.97E+004.91E-02 | 7.28E-016.47E-02 |
| FILTHIGH2 | 2.36 | 3.28E-013.58E-02 | 7.74E-018.44E-02 | 2.67E-076.95E-02 | 2.21E-011.25E-02 | 2.42E-012.88E-02 | 2.35E-011.26E-02 | 5.01E-011.09E-02 | 1.06E+004.97E-02 | 1.97E+004.91E-02 | 7.28E-016.46E-02 |
| FILTHIGH3 | 2.36 | 3.28E-013.58E-02 | 7.74E-018.43E-02 | 3.67E-076.95E-02 | 2.21E-011.25E-02 | 2.42E-012.88E-02 | 2.35E-011.26E-02 | 5.01E-011.09E-02 | 1.06E+004.97E-02 | 1.97E+004.91E-02 | 7.28E-016.46E-02 |
| FILTHIGH4 | 2.36 | 3.28E-013.57E-02 | 7.73E-018.42E-02 | 1.43E-076.93E-02 | 2.21E-011.25E-02 | 2.42E-012.88E-02 | 2.35E-011.26E-02 | 5.01E-011.09E-02 | 1.06E+004.97E-02 | 1.97E+004.91E-02 | 7.28E-016.44E-02 |
| FILTHIGH5 | 2.36 | 3.28E-013.57E-02 | 7.73E-018.41E-02 | 3.78E-086.91E-02 | 2.21E-011.25E-02 | 2.42E-012.89E-02 | 2.35E-011.26E-02 | 5.01E-011.09E-02 | 1.06E+004.97E-02 | 1.97E+004.91E-02 | 7.27E-016.42E-02 |
| FILTHIGH6 | 2.35 | 3.29E-013.56E-02 | 7.74E-018.37E-02 | 1.97E-076.86E-02 | 2.21E-011.25E-02 | 2.43E-012.89E-02 | 2.35E-011.26E-02 | 5.01E-011.09E-02 | 1.06E+004.98E-02 | 1.97E+004.92E-02 | 7.27E-016.37E-02 |
| FILTHIGH7 | 2.35 | 3.29E-013.53E-02 | 7.72E-018.28E-02 | 2.57E-086.73E-02 | 2.20E-011.25E-02 | 2.45E-012.90E-02 | 2.35E-011.26E-02 | 5.01E-011.09E-02 | 1.06E+004.99E-02 | 1.97E+004.93E-02 | 7.26E-016.25E-02 |
| FILTHIGH8 | 2.32 | 3.32E-013.49E-02 | 7.70E-018.08E-02 | 2.21E-036.44E-02 | 2.20E-011.25E-02 | 2.51E-012.93E-02 | 2.35E-011.26E-02 | 5.01E-011.09E-02 | 1.07E+005.03E-02 | 1.98E+004.97E-02 | 7.22E-015.97E-02 |
| FILTHIGH9 | 2.21 | 3.09E-013.25E-02 | 6.83E-017.19E-02 | 8.52E-025.85E-02 | 2.20E-011.25E-02 | 2.55E-012.96E-02 | 2.34E-011.26E-02 | 5.01E-011.09E-02 | 1.06E+005.00E-02 | 1.98E+004.94E-02 | 6.42E-015.35E-02 |
| FILTHIGH10 | 1.87 | 2.25E-012.91E-02 | 4.22E-015.46E-02 | 3.53E-015.31E-02 | 2.20E-011.25E-02 | 2.55E-012.96E-02 | 2.34E-011.26E-02 | 5.01E-011.09E-02 | 1.07E+004.91E-02 | 1.98E+004.85E-02 | 3.94E-014.39E-02 |
| FILTHIGH11 | 1.49 | 6.57E-021.49E-02 | 9.79E-022.21E-02 | 6.19E-015.40E-02 | 2.20E-011.25E-02 | 2.65E-013.02E-02 | 2.34E-011.26E-02 | 5.00E-011.09E-02 | 1.02E+004.58E-02 | 1.94E+004.53E-02 | 9.62E-022.21E-02 |
| FILTBOTH1 | 1.49 | 6.56E-021.49E-02 | 9.75E-022.21E-02 | 6.19E-015.40E-02 | 2.20E-011.25E-02 | 2.65E-013.02E-02 | 2.34E-011.26E-02 | 5.00E-011.09E-02 | 1.02E+004.58E-02 | 1.94E+004.53E-02 | 9.58E-022.20E-02 |
| FILTBOTH2 | 1.95 | 2.06E-012.77E-02 | 4.01E-015.41E-02 | 3.72E-015.40E-02 | 2.20E-011.25E-02 | 2.57E-012.97E-02 | 2.34E-011.26E-02 | 5.00E-011.09E-02 | 1.07E+004.90E-02 | 1.99E+004.84E-02 | 3.75E-014.41E-02 |
| FILTBOTH3 | 2.51 | 2.55E-012.79E-02 | 6.39E-017.01E-02 | 1.24E-015.89E-02 | 2.20E-011.25E-02 | 2.58E-012.98E-02 | 2.34E-011.26E-02 | 5.01E-011.09E-02 | 1.06E+004.96E-02 | 1.98E+004.90E-02 | 6.03E-015.36E-02 |
| FILTBOTH4 | 2.78 | 2.05E-012.43E-02 | 5.69E-016.75E-02 | 2.08E-015.81E-02 | 2.20E-011.25E-02 | 2.56E-012.96E-02 | 2.34E-011.26E-02 | 5.01E-011.09E-02 | 1.07E+004.99E-02 | 1.99E+004.93E-02 | 5.30E-015.21E-02 |
| FILTBOTH5 | 2.74 | 1.75E-012.16E-02 | 4.82E-015.93E-02 | 2.94E-015.35E-02 | 2.20E-011.25E-02 | 2.60E-012.98E-02 | 2.34E-011.26E-02 | 5.00E-011.09E-02 | 1.07E+005.01E-02 | 1.99E+004.95E-02 | 4.48E-014.60E-02 |
| FILTBOTH6 | 2.59 | 1.15E-011.89E-02 | 3.00E-014.91E-02 | 4.89E-015.40E-02 | 2.20E-011.25E-02 | 2.59E-012.98E-02 | 2.34E-011.26E-02 | 5.00E-011.09E-02 | 1.09E+004.95E-02 | 2.00E+004.89E-02 | 2.76E-014.08E-02 |
| FILTBOTH7 | 2.50 | 1.06E-011.79E-02 | 2.65E-014.49E-02 | 5.15E-015.24E-02 | 2.20E-011.25E-02 | 2.65E-013.02E-02 | 2.34E-011.26E-02 | 5.00E-011.09E-02 | 1.08E+004.96E-02 | 2.00E+004.90E-02 | 2.45E-013.75E-02 |
| FILTBOTH8 | 2.38 | 4.21E-021.26E-02 | 1.00E-013.00E-02 | 6.78E-015.41E-02 | 2.20E-011.25E-02 | 2.68E-013.04E-02 | 2.34E-011.26E-02 | 5.00E-011.09E-02 | 1.08E+004.82E-02 | 2.00E+004.75E-02 | 9.26E-022.70E-02 |
| FILTBOTH9 | 2.08 | 2.96E-036.68E-03 | 6.14E-031.39E-02 | 7.79E-015.45E-02 | 2.20E-011.25E-02 | 2.70E-013.05E-02 | 2.34E-011.26E-02 | 5.00E-011.09E-02 | 1.09E+004.82E-02 | 2.01E+004.76E-02 | 5.64E-031.28E-02 |
| FILTBOTH10 | 1.87 | 2.05E-036.33E-03 | 3.84E-031.18E-02 | 7.82E-015.39E-02 | 2.20E-011.25E-02 | 2.70E-013.05E-02 | 2.34E-011.26E-02 | 5.00E-011.09E-02 | 1.09E+004.82E-02 | 2.01E+004.75E-02 | 3.52E-031.09E-02 |
| FILTBOTH11 | 1.68 | 9.69E-038.30E-03 | 1.63E-021.39E-02 | 7.69E-015.34E-02 | 2.20E-011.25E-02 | 2.69E-013.04E-02 | 2.34E-011.26E-02 | 5.00E-011.09E-02 | 1.09E+004.81E-02 | 2.01E+004.75E-02 | 1.50E-021.28E-02 |
| FILTBOTH12 | 1.37 | 6.49E-022.35E-02 | 8.90E-023.22E-02 | 6.98E-015.53E-02 | 2.20E-011.25E-02 | 2.68E-013.04E-02 | 2.34E-011.26E-02 | 5.00E-011.09E-02 | 1.09E+004.86E-02 | 2.01E+004.80E-02 | 8.17E-022.89E-02 |
| RAN5 | 2.36 | 7.58E-021.50E-02 | 1.79E-013.55E-02 | 5.73E-015.43E-02 | 2.20E-011.25E-02 | 2.64E-013.01E-02 | 2.34E-011.26E-02 | 5.00E-011.09E-02 | 1.05E+004.68E-02 | 1.97E+004.62E-02 | 1.70E-013.25E-02 |
| RAN10 | 2.35 | 1.25E-011.93E-02 | 2.94E-014.53E-02 | 4.64E-015.34E-02 | 2.20E-011.25E-02 | 2.62E-013.00E-02 | 2.34E-011.26E-02 | 5.00E-011.09E-02 | 1.06E+004.78E-02 | 1.98E+004.72E-02 | 2.78E-013.91E-02 |
| RAN20 | 2.35 | 1.66E-012.25E-02 | 3.91E-015.30E-02 | 3.77E-015.39E-02 | 2.20E-011.25E-02 | 2.59E-012.98E-02 | 2.34E-011.26E-02 | 5.00E-011.09E-02 | 1.07E+004.88E-02 | 1.98E+004.82E-02 | 3.67E-014.36E-02 |
| RAN40 | 2.35 | 2.24E-012.63E-02 | 5.27E-016.17E-02 | 2.45E-015.49E-02 | 2.20E-011.25E-02 | 2.57E-012.97E-02 | 2.34E-011.26E-02 | 5.01E-011.09E-02 | 1.07E+004.96E-02 | 1.98E+004.91E-02 | 4.93E-014.79E-02 |
| RAN60 | 2.35 | 2.52E-012.83E-02 | 5.93E-016.67E-02 | 1.77E-015.69E-02 | 2.20E-011.25E-02 | 2.56E-012.96E-02 | 2.34E-011.26E-02 | 5.01E-011.09E-02 | 1.07E+004.97E-02 | 1.98E+004.91E-02 | 5.56E-015.11E-02 |
| RAN80 | 2.35 | 2.77E-013.06E-02 | 6.51E-017.20E-02 | 1.18E-015.98E-02 | 2.20E-011.25E-02 | 2.56E-012.96E-02 | 2.34E-011.26E-02 | 5.01E-011.09E-02 | 1.07E+004.99E-02 | 1.98E+004.93E-02 | 6.11E-015.46E-02 |
| RAN100 | 2.35 | 3.00E-013.18E-02 | 7.05E-017.49E-02 | 5.86E-026.08E-02 | 2.20E-011.25E-02 | 2.56E-012.96E-02 | 2.34E-011.26E-02 | 5.01E-011.09E-02 | 1.06E+004.98E-02 | 1.97E+004.92E-02 | 6.65E-015.62E-02 |
| RAN120 | 2.35 | 3.19E-013.32E-02 | 7.51E-017.81E-02 | 1.33E-026.24E-02 | 2.20E-011.25E-02 | 2.54E-012.95E-02 | 2.34E-011.26E-02 | 5.01E-011.09E-02 | 1.06E+004.99E-02 | 1.97E+004.94E-02 | 7.09E-015.80E-02 |
| RAN140 | 2.35 | 3.25E-013.41E-02 | 7.64E-018.03E-02 | 2.26E-036.45E-02 | 2.20E-011.25E-02 | 2.51E-012.94E-02 | 2.34E-011.26E-02 | 5.01E-011.09E-02 | 1.06E+004.99E-02 | 1.97E+004.93E-02 | 7.20E-015.99E-02 |
| RAN160 | 2.35 | 3.27E-013.50E-02 | 7.69E-018.24E-02 | 1.14E-076.70E-02 | 2.20E-011.25E-02 | 2.47E-012.91E-02 | 2.35E-011.26E-02 | 5.01E-011.09E-02 | 1.06E+004.98E-02 | 1.97E+004.92E-02 | 7.25E-016.24E-02 |
| RAN180 | 2.35 | 3.29E-013.57E-02 | 7.73E-018.40E-02 | 1.08E-076.91E-02 | 2.21E-011.25E-02 | 2.43E-012.89E-02 | 2.35E-011.26E-02 | 5.01E-011.09E-02 | 1.06E+004.97E-02 | 1.97E+004.91E-02 | 7.27E-016.42E-02 |

1$\overbar{G^{\*}}$ = mean diagonal of **G\*** matrix; $σ\_{g}^{2}$ = additive genomic variance; $σ\_{a}^{2}$ = residual genetic variance; $σ\_{p}^{2}$ = random plot variance; $σ\_{i\_{1}}^{2}$ = family × sowing year × location × management variance; $σ\_{i\_{2}}^{2}$ = family × sowing year × location × management × farming year variance; $σ\_{e}^{2}$ = residual environment variance; $σ\_{P\_{f}}^{2}$ = phenotypic variance on individual family level; $σ\_{P\_{p}}^{2}$ = phenotypic variance on plot level; $h\_{f}^{2}$ = family heritability based on multiple plots.

2 FILTLOW = strategy filtering out SNPs having low average depth; FILTHIGH = strategy filtering out SNPs having high average depth; FILTBOTH = strategy filtering out SNPs having both low average and high average depth; RAN = strategy keeping SNPs randomly with different data size.