**Sup. Table 3. Estimated variance components1 (line 1) and their standard errors (line 2) for heading date.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Scenario2 | $$\overbar{G^{\*}}$$ | $$σ\_{g}^{2}$$ | $$\overbar{G^{\*}}σ\_{g}^{2}$$ | $$σ\_{a}^{2}$$ | $$σ\_{i\_{1}}^{2}$$ | $$σ\_{e}^{2}$$ | $$σ\_{P\_{f}}^{2}$$ | $$σ\_{P\_{p}}^{2}$$ | $$h\_{f}^{2}$$ |
| FILTLOW1 | 2.60 | 4.02E+004.35E-01 | 1.05E+011.13E+00 | 2.35E-061.16E+00 | 1.81E+004.93E-01 | 3.88E+002.08E-01 | 1.41E+017.27E-01 | 1.61E+017.27E-01 | 7.40E-017.31E-02 |
| FILTLOW2 | 2.67 | 3.93E+004.30E-01 | 1.05E+011.14E+00 | 9.51E-071.17E+00 | 1.81E+004.93E-01 | 3.88E+002.08E-01 | 1.42E+017.29E-01 | 1.62E+017.28E-01 | 7.40E-017.41E-02 |
| FILTLOW3 | 2.89 | 3.66E+004.06E-01 | 1.06E+011.17E+00 | 3.74E-071.21E+00 | 1.83E+004.97E-01 | 3.87E+002.08E-01 | 1.43E+017.34E-01 | 1.63E+017.33E-01 | 7.41E-017.59E-02 |
| FILTLOW4 | 3.03 | 3.50E+003.78E-01 | 1.06E+011.14E+00 | 9.08E-071.13E+00 | 1.98E+005.23E-01 | 3.87E+002.08E-01 | 1.44E+017.38E-01 | 1.65E+017.37E-01 | 7.34E-016.98E-02 |
| FILTLOW5 | 2.91 | 3.67E+003.76E-01 | 1.07E+011.09E+00 | 1.02E-071.02E+00 | 2.27E+005.78E-01 | 3.89E+002.10E-01 | 1.48E+017.61E-01 | 1.68E+017.60E-01 | 7.22E-015.90E-02 |
| FILTLOW6 | 2.71 | 3.99E+004.07E-01 | 1.08E+011.10E+00 | 1.45E-071.02E+00 | 3.13E+007.47E-01 | 3.93E+002.12E-01 | 1.57E+018.35E-01 | 1.79E+018.33E-01 | 6.89E-014.99E-02 |
| FILTLOW7 | 2.50 | 4.08E+004.36E-01 | 1.02E+011.09E+00 | 9.49E-081.17E+00 | 4.59E+001.03E+00 | 3.94E+002.13E-01 | 1.64E+018.98E-01 | 1.88E+018.97E-01 | 6.24E-014.53E-02 |
| FILTLOW8 | 2.19 | 4.03E+005.37E-01 | 8.85E+001.18E+00 | 3.01E+001.32E+00 | 4.90E+001.12E+00 | 3.96E+002.15E-01 | 1.83E+011.01E+00 | 2.07E+011.01E+00 | 4.84E-014.84E-02 |
| FILTLOW9 | 1.88 | 3.64E+005.81E-01 | 6.83E+001.09E+00 | 4.85E+001.44E+00 | 5.36E+001.21E+00 | 3.97E+002.16E-01 | 1.85E+011.01E+00 | 2.10E+011.00E+00 | 3.69E-014.82E-02 |
| FILTLOW10 | 1.72 | 3.04E+006.11E-01 | 5.21E+001.05E+00 | 6.59E+001.53E+00 | 5.53E+001.25E+00 | 3.98E+002.17E-01 | 1.88E+011.01E+00 | 2.13E+019.99E-01 | 2.77E-014.90E-02 |
| FILTLOW11 | 1.58 | 3.20E+006.60E-01 | 5.07E+001.05E+00 | 6.70E+001.55E+00 | 5.63E+001.28E+00 | 3.98E+002.17E-01 | 1.89E+011.02E+00 | 2.14E+011.01E+00 | 2.69E-014.88E-02 |
| FILTHIGH1 | 2.61 | 4.01E+004.34E-01 | 1.05E+011.13E+00 | 3.63E-071.15E+00 | 1.80E+004.93E-01 | 3.88E+002.08E-01 | 1.41E+017.27E-01 | 1.61E+017.26E-01 | 7.40E-017.28E-02 |
| FILTHIGH2 | 2.61 | 4.01E+004.33E-01 | 1.04E+011.13E+00 | 2.21E-071.15E+00 | 1.80E+004.93E-01 | 3.88E+002.08E-01 | 1.41E+017.27E-01 | 1.61E+017.26E-01 | 7.39E-017.27E-02 |
| FILTHIGH3 | 2.61 | 4.00E+004.33E-01 | 1.04E+011.13E+00 | 3.41E-071.15E+00 | 1.80E+004.93E-01 | 3.88E+002.08E-01 | 1.41E+017.27E-01 | 1.61E+017.26E-01 | 7.39E-017.26E-02 |
| FILTHIGH4 | 2.61 | 4.00E+004.32E-01 | 1.04E+011.13E+00 | 5.41E-071.15E+00 | 1.81E+004.94E-01 | 3.88E+002.08E-01 | 1.41E+017.27E-01 | 1.61E+017.26E-01 | 7.39E-017.25E-02 |
| FILTHIGH5 | 2.61 | 4.00E+004.32E-01 | 1.04E+011.13E+00 | 3.29E-071.14E+00 | 1.80E+004.93E-01 | 3.88E+002.08E-01 | 1.41E+017.26E-01 | 1.61E+017.26E-01 | 7.39E-017.24E-02 |
| FILTHIGH6 | 2.60 | 4.01E+004.32E-01 | 1.05E+011.13E+00 | 2.13E-061.14E+00 | 1.81E+004.95E-01 | 3.88E+002.08E-01 | 1.41E+017.27E-01 | 1.61E+017.27E-01 | 7.39E-017.19E-02 |
| FILTHIGH7 | 2.59 | 4.03E+004.31E-01 | 1.05E+011.12E+00 | 1.23E-061.13E+00 | 1.84E+004.99E-01 | 3.88E+002.08E-01 | 1.42E+017.28E-01 | 1.62E+017.27E-01 | 7.38E-017.07E-02 |
| FILTHIGH8 | 2.56 | 4.11E+004.34E-01 | 1.05E+011.11E+00 | 9.84E-071.10E+00 | 1.88E+005.08E-01 | 3.88E+002.09E-01 | 1.43E+017.32E-01 | 1.63E+017.31E-01 | 7.37E-016.84E-02 |
| FILTHIGH9 | 2.43 | 4.33E+004.35E-01 | 1.05E+011.06E+00 | 1.06E-061.01E+00 | 2.01E+005.32E-01 | 3.90E+002.10E-01 | 1.44E+017.41E-01 | 1.64E+017.40E-01 | 7.31E-016.08E-02 |
| FILTHIGH10 | 2.02 | 4.76E+004.52E-01 | 9.64E+009.16E-01 | 2.06E-079.50E-01 | 3.27E+007.72E-01 | 3.94E+002.13E-01 | 1.46E+017.72E-01 | 1.68E+017.71E-01 | 6.59E-014.38E-02 |
| FILTHIGH11 | 1.56 | 2.94E+003.77E-01 | 4.58E+005.88E-01 | 3.95E+001.23E+00 | 4.62E+001.06E+00 | 3.95E+002.14E-01 | 1.47E+017.37E-01 | 1.71E+017.36E-01 | 3.12E-013.69E-02 |
| FILTBOTH1 | 1.56 | 2.94E+003.77E-01 | 4.58E+005.87E-01 | 3.93E+001.23E+00 | 4.63E+001.06E+00 | 3.95E+002.14E-01 | 1.47E+017.37E-01 | 1.71E+017.36E-01 | 3.12E-013.69E-02 |
| FILTBOTH2 | 2.12 | 4.60E+004.40E-01 | 9.75E+009.33E-01 | 2.24E-079.59E-01 | 3.27E+007.73E-01 | 3.94E+002.13E-01 | 1.48E+017.80E-01 | 1.70E+017.79E-01 | 6.61E-014.43E-02 |
| FILTBOTH3 | 2.78 | 3.87E+003.92E-01 | 1.08E+011.09E+00 | 4.07E-071.03E+00 | 2.12E+005.53E-01 | 3.90E+002.10E-01 | 1.47E+017.56E-01 | 1.68E+017.55E-01 | 7.30E-016.07E-02 |
| FILTBOTH4 | 3.11 | 3.43E+003.49E-01 | 1.07E+011.08E+00 | 7.64E-091.01E+00 | 2.57E+006.32E-01 | 3.90E+002.10E-01 | 1.50E+017.75E-01 | 1.71E+017.75E-01 | 7.10E-015.60E-02 |
| FILTBOTH5 | 3.07 | 3.29E+003.29E-01 | 1.01E+011.01E+00 | 3.41E-071.00E+00 | 3.40E+007.97E-01 | 3.91E+002.11E-01 | 1.52E+018.06E-01 | 1.74E+018.05E-01 | 6.64E-014.68E-02 |
| FILTBOTH6 | 2.90 | 3.46E+003.64E-01 | 1.00E+011.05E+00 | 2.62E-011.10E+00 | 4.37E+009.94E-01 | 3.95E+002.14E-01 | 1.62E+018.95E-01 | 1.86E+018.94E-01 | 6.17E-014.31E-02 |
| FILTBOTH7 | 2.80 | 3.07E+003.49E-01 | 8.60E+009.78E-01 | 1.18E+001.18E+00 | 4.89E+001.09E+00 | 3.94E+002.14E-01 | 1.62E+019.01E-01 | 1.86E+018.99E-01 | 5.31E-014.17E-02 |
| FILTBOTH8 | 2.65 | 2.29E+003.72E-01 | 6.06E+009.87E-01 | 5.63E+001.37E+00 | 5.09E+001.17E+00 | 3.96E+002.15E-01 | 1.83E+011.00E+00 | 2.07E+019.97E-01 | 3.31E-014.42E-02 |
| FILTBOTH9 | 2.31 | 1.66E+003.48E-01 | 3.84E+008.03E-01 | 7.41E+001.48E+00 | 5.62E+001.27E+00 | 3.97E+002.16E-01 | 1.83E+019.85E-01 | 2.08E+019.78E-01 | 2.09E-013.87E-02 |
| FILTBOTH10 | 2.12 | 5.56E-012.27E-01 | 1.18E+004.81E-01 | 9.94E+001.60E+00 | 5.92E+001.34E+00 | 3.98E+002.17E-01 | 1.85E+019.39E-01 | 2.10E+019.29E-01 | 6.38E-022.55E-02 |
| FILTBOTH11 | 1.89 | 4.60E-012.57E-01 | 8.68E-014.85E-01 | 1.03E+011.65E+00 | 5.99E+001.36E+00 | 3.98E+002.17E-01 | 1.86E+019.43E-01 | 2.11E+019.33E-01 | 4.68E-022.58E-02 |
| FILTBOTH12 | 1.50 | 2.98E+006.46E-01 | 4.46E+009.66E-01 | 7.30E+001.53E+00 | 5.56E+001.26E+00 | 3.97E+002.16E-01 | 1.88E+011.00E+00 | 2.13E+019.96E-01 | 2.37E-014.59E-02 |
| RAN5 | 2.61 | 2.61E+003.14E-01 | 6.81E+008.19E-01 | 2.49E+001.26E+00 | 4.93E+001.12E+00 | 3.95E+002.14E-01 | 1.58E+018.19E-01 | 1.82E+018.16E-01 | 4.32E-014.17E-02 |
| RAN10 | 2.60 | 3.26E+003.42E-01 | 8.50E+008.91E-01 | 5.51E-011.16E+00 | 4.62E+001.05E+00 | 3.95E+002.14E-01 | 1.52E+018.05E-01 | 1.76E+018.04E-01 | 5.58E-014.25E-02 |
| RAN20 | 2.60 | 3.76E+003.68E-01 | 9.78E+009.59E-01 | 1.65E-021.02E+00 | 3.65E+008.48E-01 | 3.93E+002.13E-01 | 1.51E+018.00E-01 | 1.74E+017.99E-01 | 6.47E-014.44E-02 |
| RAN40 | 2.60 | 3.99E+003.85E-01 | 1.04E+011.00E+00 | 5.26E-089.45E-01 | 2.60E+006.42E-01 | 3.91E+002.11E-01 | 1.48E+017.70E-01 | 1.69E+017.69E-01 | 7.03E-015.03E-02 |
| RAN60 | 2.60 | 4.04E+004.00E-01 | 1.05E+011.04E+00 | 1.90E-079.80E-01 | 2.24E+005.73E-01 | 3.90E+002.10E-01 | 1.46E+017.52E-01 | 1.66E+017.52E-01 | 7.21E-015.64E-02 |
| RAN80 | 2.60 | 4.04E+004.11E-01 | 1.05E+011.07E+00 | 5.27E-071.03E+00 | 2.05E+005.39E-01 | 3.89E+002.09E-01 | 1.44E+017.41E-01 | 1.65E+017.41E-01 | 7.29E-016.15E-02 |
| RAN100 | 2.60 | 4.03E+004.18E-01 | 1.05E+011.09E+00 | 6.43E-071.06E+00 | 1.94E+005.18E-01 | 3.89E+002.09E-01 | 1.43E+017.34E-01 | 1.63E+017.34E-01 | 7.34E-016.51E-02 |
| RAN120 | 2.60 | 4.03E+004.24E-01 | 1.05E+011.10E+00 | 5.32E-071.09E+00 | 1.91E+005.12E-01 | 3.88E+002.09E-01 | 1.43E+017.33E-01 | 1.63E+017.32E-01 | 7.36E-016.75E-02 |
| RAN140 | 2.60 | 4.03E+004.28E-01 | 1.05E+011.11E+00 | 7.45E-071.11E+00 | 1.87E+005.05E-01 | 3.88E+002.09E-01 | 1.42E+017.30E-01 | 1.62E+017.29E-01 | 7.37E-016.95E-02 |
| RAN160 | 2.60 | 4.02E+004.32E-01 | 1.05E+011.12E+00 | 1.10E-061.13E+00 | 1.84E+004.99E-01 | 3.88E+002.09E-01 | 1.42E+017.29E-01 | 1.62E+017.28E-01 | 7.38E-017.12E-02 |
| RAN180 | 2.60 | 4.02E+004.35E-01 | 1.05E+011.13E+00 | 8.91E-071.15E+00 | 1.83E+004.97E-01 | 3.88E+002.08E-01 | 1.42E+017.28E-01 | 1.62E+017.27E-01 | 7.39E-017.25E-02 |

1$\overbar{G^{\*}}$ = mean diagonal of **G**\* matrix; $σ\_{g}^{2}$ = additive genomic variance; $σ\_{a}^{2}$ = residual genetic variance; $σ\_{i\_{1}}^{2}$ = family × sowing year × location × management variance; $σ\_{i\_{2}}^{2}$ = family × sowing year × location × management × farming year variance; $σ\_{P\_{p}}^{2}$ = 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.