**Supplementary Table 1.** Median AUC values of all the 32 simulation settings

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Species** | **Setting** | **Sample Size** | **MAF** | **Heritability** | **Effect Size** | **SNP Codename** | **BFT** | **DGLM** | **MLM** |
| Arabidopsis | vQTN | 500 | 0.1 | 0.33 | 0.1 | NA | 52.57297 | 52.08513 | 52.29831 |
| Arabidopsis | vQTN | FULL | 0.1 | 0.33 | 0.1 | NA | 52.30901 | 50.4743 | 52.13734 |
| Arabidopsis | vQTN | 500 | 0.1 | 0.33 | 0.5 | NA | 51.31866 | 53.40312 | 52.81646 |
| Arabidopsis | vQTN | FULL | 0.1 | 0.33 | 0.5 | NA | 52.25515 | 53.35654 | 52.04732 |
| Arabidopsis | vQTN | 500 | 0.1 | 0.33 | 0.9 | NA | 52.51251 | 53.89955 | 53.20752 |
| Arabidopsis | vQTN | FULL | 0.1 | 0.33 | 0.9 | NA | 52.7063 | 51.95754 | 51.86568 |
| Arabidopsis | vQTN | 500 | 0.1 | 0.63 | 0.1 | NA | 51.86509 | 52.31931 | 51.27516 |
| Arabidopsis | vQTN | FULL | 0.1 | 0.63 | 0.1 | NA | 52.12818 | 52.48105 | 52.12531 |
| Arabidopsis | vQTN | 500 | 0.1 | 0.63 | 0.5 | NA | 49.99569 | 53.76465 | 51.08654 |
| Arabidopsis | vQTN | FULL | 0.1 | 0.63 | 0.5 | NA | 52.20029 | 51.6923 | 51.82426 |
| Arabidopsis | VQTN | 500 | 0.1 | 0.63 | 0.9 | NA | 53.21822 | 53.43396 | 52.01721 |
| Arabidopsis | VQTN | FULL | 0.1 | 0.63 | 0.9 | NA | 52.63831 | 53.44069 | 51.50445 |
| Arabidopsis | VQTN | 500 | 0.4 | 0.33 | 0.1 | NA | 52.14024 | 52.34366 | 53.80448 |
| Arabidopsis | VQTN | FULL | 0.4 | 0.33 | 0.1 | NA | 52.18126 | 52.5446 | 52.27187 |
| Arabidopsis | VQTN | 500 | 0.4 | 0.33 | 0.5 | NA | 52.85383 | 52.72398 | 50.73699 |
| Arabidopsis | VQTN | FULL | 0.4 | 0.33 | 0.5 | NA | 53.68162 | 56.09933 | 52.21413 |
| Arabidopsis | VQTN | 500 | 0.4 | 0.33 | 0.9 | NA | 52.53524 | 53.24144 | 51.94996 |
| Arabidopsis | VQTN | FULL | 0.4 | 0.33 | 0.9 | NA | 53.90186 | 57.81029 | 50.09359 |
| Arabidopsis | VQTN | 500 | 0.4 | 0.63 | 0.1 | NA | 52.56871 | 51.52208 | 51.99103 |
| Arabidopsis | VQTN | FULL | 0.4 | 0.63 | 0.1 | NA | 52.15106 | 52.94764 | 52.21669 |
| Arabidopsis | VQTN | 500 | 0.4 | 0.63 | 0.5 | NA | 53.36255 | 55.17999 | 53.46859 |
| Arabidopsis | VQTN | FULL | 0.4 | 0.63 | 0.5 | NA | 52.85554 | 54.28068 | 51.78579 |
| Arabidopsis | VQTN | 500 | 0.4 | 0.63 | 0.9 | NA | 51.80207 | 55.11323 | 54.00815 |
| Arabidopsis | VQTN | FULL | 0.4 | 0.63 | 0.9 | NA | 51.83172 | 57.73794 | 53.0169 |
| Maize | VQTN | 500 | 0.1 | 0.33 | 0.1 | NA | 59.73439 | 60.74553 | 56.60283 |
| Maize | VQTN | FULL | 0.1 | 0.33 | 0.1 | NA | 55.58641 | 58.10417 | 55.20203 |
| Maize | VQTN | 500 | 0.1 | 0.33 | 0.5 | NA | 52.87468 | 50.14665 | 58.99188 |
| Maize | VQTN | FULL | 0.1 | 0.33 | 0.5 | NA | 57.36674 | 58.13135 | 52.31872 |
| Maize | VQTN | 500 | 0.1 | 0.33 | 0.9 | NA | 54.82983 | 56.12777 | 57.72731 |
| Maize | VQTN | FULL | 0.1 | 0.33 | 0.9 | NA | 56.4764 | 59.4778 | 58.01369 |
| Maize | VQTN | 500 | 0.1 | 0.63 | 0.1 | NA | 59.41097 | 53.78255 | 63.22778 |
| Maize | VQTN | 500 | 0.1 | 0.63 | 0.5 | NA | 53.14765 | 57.44081 | 58.23357 |
| Maize | VQTN | FULL | 0.1 | 0.63 | 0.5 | NA | 61.19516 | 54.58347 | 54.93808 |
| Maize | VQTN | 500 | 0.1 | 0.63 | 0.9 | NA | 57.86849 | 53.73408 | 59.62115 |
| Maize | VQTN | FULL | 0.1 | 0.63 | 0.9 | NA | 58.19977 | 60.23577 | 55.08327 |
| Maize | VQTN | 500 | 0.4 | 0.33 | 0.1 | NA | 51.83962 | 53.05837 | 52.16444 |
| Maize | VQTN | FULL | 0.4 | 0.33 | 0.1 | NA | 52.58255 | 59.40607 | 53.10769 |
| Maize | VQTN | 500 | 0.4 | 0.33 | 0.5 | NA | 53.80868 | 53.0206 | 51.36311 |
| Maize | VQTN | FULL | 0.4 | 0.33 | 0.5 | NA | 72.29017 | 68.92994 | 54.30279 |
| Maize | VQTN | 500 | 0.4 | 0.33 | 0.9 | NA | 52.50509 | 57.68923 | 52.09022 |
| Maize | VQTN | FULL | 0.4 | 0.33 | 0.9 | NA | 77.05214 | 67.68449 | 51.97274 |
| Maize | VQTN | 500 | 0.4 | 0.63 | 0.1 | NA | 52.36527 | 50.73433 | 52.57057 |
| Maize | VQTN | 500 | 0.4 | 0.63 | 0.5 | NA | 51.03006 | 54.57586 | 52.57745 |
| Maize | VQTN | FULL | 0.4 | 0.63 | 0.5 | NA | 58.83756 | 68.79571 | 52.67703 |
| Maize | VQTN | 500 | 0.4 | 0.63 | 0.9 | NA | 52.69184 | 56.04058 | 53.09614 |
| Maize | VQTN | FULL | 0.4 | 0.63 | 0.9 | NA | 70.89146 | 71.534 | 53.4196 |
| Maize | VQTN | FULL | 0.1 | 0.63 | 0.1 | NA | 58.3733 | 56.31001 | 54.94959 |
| Maize | VQTN | FULL | 0.4 | 0.63 | 0.1 | NA | 53.40596 | 55.4274 | 55.10461 |
| Arabidopsis | Epistasis | 500 | 0.1 | 0.3 | 0.75 | 1a | 50.1331 | 50.45479 | 50.21667 |
| Arabidopsis | Epistasis | 500 | 0.1 | 0.3 | 0.75 | 1b | 50.72499 | 50.4195 | 50.22026 |
| Arabidopsis | Epistasis | 500 | 0.1 | 0.3 | 0.75 | 2a | 50.33601 | 50.56981 | 50.44165 |
| Arabidopsis | Epistasis | 500 | 0.1 | 0.3 | 0.75 | 2b | 50.36014 | 50.31238 | 50.18411 |
| Arabidopsis | Epistasis | 500 | 0.1 | 0.3 | 0.75 | 3a | 50.88781 | 50.37521 | 50.18854 |
| Arabidopsis | Epistasis | 500 | 0.1 | 0.3 | 0.75 | 3b | 50.36022 | 50.70047 | 50.20294 |
| Arabidopsis | Epistasis | FULL | 0.1 | 0.3 | 0.75 | 1a | 50.14821 | 50.44895 | 50.39826 |
| Arabidopsis | Epistasis | FULL | 0.1 | 0.3 | 0.75 | 1b | 50.59707 | 50.56744 | 50.67394 |
| Arabidopsis | Epistasis | FULL | 0.1 | 0.3 | 0.75 | 2a | 50.52063 | 50.7176 | 50.80671 |
| Arabidopsis | Epistasis | FULL | 0.1 | 0.3 | 0.75 | 2b | 50.40066 | 50.26271 | 50.73977 |
| Arabidopsis | Epistasis | FULL | 0.1 | 0.3 | 0.75 | 3a | 50.19144 | 50.67595 | 50.36948 |
| Arabidopsis | Epistasis | FULL | 0.1 | 0.3 | 0.75 | 3b | 50.08748 | 50.50466 | 50.80671 |
| Arabidopsis | Epistasis | 500 | 0.1 | 0.8 | 0.75 | 1a | 50.54266 | 50.54514 | 50.17167 |
| Arabidopsis | Epistasis | 500 | 0.1 | 0.8 | 0.75 | 1b | 50.40582 | 50.43273 | 50.45957 |
| Arabidopsis | Epistasis | 500 | 0.1 | 0.8 | 0.75 | 2a | 50.3749 | 50.2822 | 50.57618 |
| Arabidopsis | Epistasis | 500 | 0.1 | 0.8 | 0.75 | 2b | 50.29373 | 50.53696 | 50.1615 |
| Arabidopsis | Epistasis | 500 | 0.1 | 0.8 | 0.75 | 3a | 50.67487 | 50.40837 | 50.21739 |
| Arabidopsis | Epistasis | 500 | 0.1 | 0.8 | 0.75 | 3b | 50.29226 | 50.30035 | 50.24398 |
| Arabidopsis | Epistasis | FULL | 0.1 | 0.8 | 0.75 | 1a | 50.52361 | 50.17984 | 50.47854 |
| Arabidopsis | Epistasis | FULL | 0.1 | 0.8 | 0.75 | 1b | 50.40726 | 50.22014 | 50.47854 |
| Arabidopsis | Epistasis | FULL | 0.1 | 0.8 | 0.75 | 2a | 50.11095 | 50.91324 | 50.28623 |
| Arabidopsis | Epistasis | FULL | 0.1 | 0.8 | 0.75 | 2b | 50.41943 | 50.55049 | 50.28623 |
| Arabidopsis | Epistasis | FULL | 0.1 | 0.8 | 0.75 | 3a | 50.39265 | 50.75887 | 50.28623 |
| Arabidopsis | Epistasis | FULL | 0.1 | 0.8 | 0.75 | 3b | 50.52202 | 50.51846 | 50.4247 |
| Arabidopsis | GxE | 500 | 0.3 | 0.7 | NA | Both Environments | 50.09205 | 50.3165 | 50.35181 |
| Arabidopsis | GxE | 500 | 0.3 | 0.7 | NA | Environment Specific A | 50.18458 | 50.36237 | 50.26638 |
| Arabidopsis | GxE | 500 | 0.3 | 0.7 | NA | Environment Specific B | 50.20492 | 50.39801 | 50.26673 |
| Arabidopsis | GxE | FULL | 0.3 | 0.7 | NA | Both Environments | 50.4035 | 50.61249 | 50.99902 |
| Arabidopsis | GxE | FULL | 0.3 | 0.7 | NA | Environment Specific A | 50.62795 | 50.45034 | 50.82828 |
| Arabidopsis | GxE | FULL | 0.3 | 0.7 | NA | Environment Specific B | 50.81268 | 50.43116 | 51.30795 |
| Maize | Epistasis | FULL | 0.1 | 0.3 | 0.75 | 1a | 52.32864 | 50.25778 | 50.65048 |
| Maize | Epistasis | FULL | 0.1 | 0.3 | 0.75 | 1b | 52.2307 | 50.57947 | 50.84308 |
| Maize | Epistasis | FULL | 0.1 | 0.3 | 0.75 | 2a | 52.57656 | 50.74501 | 50.52855 |
| Maize | Epistasis | FULL | 0.1 | 0.3 | 0.75 | 2b | 52.2667 | 50.53097 | 50.65048 |
| Maize | Epistasis | FULL | 0.1 | 0.3 | 0.75 | 3a | 52.49987 | 50.46516 | 50.86274 |
| Maize | Epistasis | FULL | 0.1 | 0.3 | 0.75 | 3b | 52.06507 | 50.65302 | 50.84308 |
| Maize | Epistasis | FULL | 0.1 | 0.8 | 0.75 | 1a | 54.30695 | 51.62179 | 51.10159 |
| Maize | Epistasis | FULL | 0.1 | 0.8 | 0.75 | 1b | 53.84306 | 52.023 | 51.40015 |
| Maize | Epistasis | FULL | 0.1 | 0.8 | 0.75 | 2a | 53.71757 | 51.59016 | 51.40015 |
| Maize | Epistasis | FULL | 0.1 | 0.8 | 0.75 | 2b | 53.78033 | 52.00053 | 51.10159 |
| Maize | Epistasis | FULL | 0.1 | 0.8 | 0.75 | 3a | 53.732 | 51.97243 | 51.32507 |
| Maize | Epistasis | FULL | 0.1 | 0.8 | 0.75 | 3b | 53.72608 | 51.70764 | 51.40015 |
| Maize | GxE | FULL | 0.3 | 0.7 | NA | Both Environments | 56.459 | 50.35084 | 53.08873 |
| Maize | GxE | FULL | 0.3 | 0.7 | NA | Environment Specific A | 55.98505 | 50.66707 | 52.9836 |
| Maize | GxE | FULL | 0.3 | 0.7 | NA | Environment Specific B | 56.90893 | 50.36751 | 53.04125 |
| Maize | GxE | 500 | 0.3 | 0.7 | NA | Both Environments | 50.29954 | 51.15671 | 51.5471 |
| Maize | GxE | 500 | 0.3 | 0.7 | NA | Environment Specific A | 50.63374 | 50.97805 | 52.24543 |
| Maize | GxE | 500 | 0.3 | 0.7 | NA | Environment Specific B | 50.63556 | 50.91966 | 51.67165 |
| Maize | Epistasis | 500 | 0.1 | 0.3 | 0.75 | 1a | 50.58567 | 50.43186 | 50.37853 |
| Maize | Epistasis | 500 | 0.1 | 0.3 | 0.75 | 1b | 50.85551 | 50.05869 | 50.81581 |
| Maize | Epistasis | 500 | 0.1 | 0.3 | 0.75 | 2a | 50.42984 | 50.31396 | 51.00688 |
| Maize | Epistasis | 500 | 0.1 | 0.3 | 0.75 | 2b | 50.66408 | 50.69367 | 50.31918 |
| Maize | Epistasis | 500 | 0.1 | 0.3 | 0.75 | 3a | 50.48336 | 50.21711 | 50.47427 |
| Maize | Epistasis | 500 | 0.1 | 0.3 | 0.75 | 3b | 50.38972 | 50.63208 | 50.48528 |
| Maize | Epistasis | 500 | 0.1 | 0.8 | 0.75 | 1a | 51.22772 | 50.8902 | 50.70673 |
| Maize | Epistasis | 500 | 0.1 | 0.8 | 0.75 | 1b | 50.98016 | 50.56267 | 50.67238 |
| Maize | Epistasis | 500 | 0.1 | 0.8 | 0.75 | 2a | 50.75863 | 50.69719 | 50.67238 |
| Maize | Epistasis | 500 | 0.1 | 0.8 | 0.75 | 2b | 50.65302 | 50.35186 | 50.70673 |
| Maize | Epistasis | 500 | 0.1 | 0.8 | 0.75 | 3a | 51.35779 | 50.95579 | 50.95794 |
| Maize | Epistasis | 500 | 0.1 | 0.8 | 0.75 | 3b | 52.54604 | 50.61178 | 51.15892 |

MAF – minor allele frequency; SNP codename – details describing which environment(s) (for the GxE setting) or epistatic QTN a given SNP is contributing to (for the Epistasis setting); BFT – median area under the receiver operating curve (AUC) value for the Brown-Forsythe test across ten randomly selected replicate traits; DGLM – median AUC value for the double generalized linear model across ten randomly selected replicate traits; MLM- median AUC value for the unified mixed linear mode across ten randomly selected replicate traits