**Supplementary material**

**Supplementary Table S1:** Mean and variance components for GLS disease severity in each location for IMAS AM panel and five biparental populations

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| IMAS AM panel | Mean | σ2G | σ2e | h2 | LSD | CV |
| Kitale2013 | 3.05 | 0.15\* | 0.16 | 0.66 | 0.47 | 26.95 |
| Kitale2014 | 3.80 | 0.14\* | 0.17 | 0.61 | 0.46 | 24.03 |
| Kakamega2014 | 3.80 | 0.02\* | 0.04 | 0.41 | 0.19 | 9.60 |
| CZL0618 x LaPostaSeqC7-F71-1-2-1-1B - Pop1 | | | | | | |
| Kakamega2011 | 4.21 | 0.04\* | 0.14 | 0.35 | 0.31 | 14.41 |
| Embu 2011 | 2.70 | 0.02\* | 0.05 | 0.50 | 0.11 | 21.45 |
| CZL074xLaPostaSeqC7-F103-1-2-1-1B F3pop2 | | | | | | |
| Kakamega2011 | 3.70 | 0.04\* | 0.19 | 0.29 | 0.33 | 19.04 |
| Kitale2011 | 2.50 | 0.02 | 0.11 | 0.27 | 0.16 | 27.01 |
| Embu 2011 | 4.12 | 0.07\* | 0.15 | 0.49 | 0.38 | 15.48 |
| CZL00009 x CZL99017 – Pop3 | | | | | | |
| Kakamega2011 | 4.30 | 0.03\* | 0.19 | 0.25 | 0.31 | 20.90 |
| Embu 2011 | 2.47 | 0.04\* | 0.17 | 0.35 | 0.11 | 12.96 |
| CML505 x CZL99017 – Pop4 | | | | | | |
| Kakamega2011 | 3.12 | 0.02\* | 0.11 | 0.27 | 0.09 | 21.66 |
| Embu 2011 | 2.47 | 0.11\* | 0.25 | 0.46 | 0.48 | 17.21 |
| CZL0723 x CZL0724 – Pop5 | | | | | | |
| Kakamega2011 | 4.27 | 0.05\* | 0.19 | 0.35 | 0.36 | 17.64 |
| Embu 2011 | 3.22 | 0.03\* | 0.16 | 0.27 | 0.19 | 29.16 |

\* P = 0.05

**Supplementary Table S2:** Phenotypiccorrelations among locations for common rust resistance in IMAS AM panel and five F3 populations

|  |  |  |
| --- | --- | --- |
| IMAS AM panel | Kitale2013 | Kitale2014 |
| Kitale2013 | 0.90\* |  |
| Kakamega2014 | 0.60\* | 0.71\* |
| CZL074xLaPostaSeqC7-F103-1-2-1-1B F3pop2 | Kitale2011 | Embu2011 |
| Kakamega2011 | 0.56\* | 0.51\* |
| Embu2011 | 0.63\* | NA |
| CZL0618 x LaPostaSeqC7-F71-1-2-1-1B - Pop1 | Embu2011 |  |
| Kakamega2011 | 0.59\* |  |
| CZL00009 x CZL99017 – Pop3 | Embu2011 |  |
| Kakamega2011 | 0.68\* |  |
| CML505 x CZL99017 – Pop4 | Embu2011 |  |
| Kakamega2011 | 0.52\* |  |
| CZL0723 x CZL0724 – Pop5 | Embu2011 |  |
| Kakamega2011 | 0.46\* |  |

\* P = 0.05

**Supplementary Table S3**. Summary of the linkage groups constructed based on data from five F3 populations.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Population** | **No. of progenies** | **No. of SNPs** | **Map length** | **Avg distance (cM)** |
| CZL0618 x LaPostaSeqC7-F71-1-2-1-1B - Pop1 | 183 | 1130 | 4605.2 | 4.07 |
| CZL074 x LaPostaSeqC7-F103-1-2-1-1B – Pop2 | 174 | 1047 | 4390.8 | 4.19 |
| CZL00009 x CZL99017 – Pop3 | 187 | 1099 | 5049.7 | 4.59 |
| CML505 x CZL99017 – Pop4 | 189 | 1122 | 5632.3 | 5.02 |
| CZL0723 x CZL0724 – Pop5 | 188 | 1081 | 4698.8 | 4.35 |