**Table S3:**

**Epistatic-effect QTLs for seed vigor traits detected in wheat IL-1 population.**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Trait | Aging time | QTL1 | Marker Name 1 | QTL2 | Marker Name 2 | LOD | PVE(%) | AA |
| GP | 36 h | *qGP-36h-1A* | *Xgwm497* | *qGP-36h-7A-1* | *Xgwm276* | 5.15 | 3.23 | -1.34 |
|  | 36 h | *qGP-36h-6A* | *Xwmc145* | *qGP-36h-7A-2* | *Xgwm282* | 5.19 | 1.5 | 1.37 |
|  | 36 h | *qGP-36h-6A* | *Xwmc145* | *qGP-36h-7A-3* | *Xgwm63* | 5.23 | 1.79 | 1.47 |
|  | 48 h | *qGP-48h-5A* | *Xbarc165* | *qGP-48h-7A* | *Xcfa2019* | 5.53 | 7.13 | -1.28 |
| SL | 0 h | *qSL-0h-2D* | *Xwmc41* | *qSL-0h-4D-2* | *Xwmc331* | 6.46 | 3.22 | -1.01 |
|  | 0 h | *qSL-0h-4D-1* | *Xwmc720* | *qSL-0h-5A* | *Xwmc752* | 6.07 | 2.1 | -1.16 |
|  | 0 h | *qSL-0h-4D-1* | *Xwmc720* | *qSL-0h-5D* | *Xgwm583* | 6.11 | 1.13 | -0.78 |
|  | 0 h | *qSL-0h-4D-1* | *Xwmc720* | *qSL-0h-7A* | *Xgwm63* | 6.33 | 3.56 | 0.96 |
|  | 0 h | *qSL-0h-4D-1* | *Xwmc720* | *qSL-0h-7B* | *Xwmc758* | 6.28 | 2.12 | -1.19 |
|  | 0 h | *qSL-0h-4D-2* | *Xwmc331* | *qSL-0h-7A* | *Xgwm63* | 7.29 | 4.3 | 1.08 |
|  | 24 h | *qSL-24h-4D* | *Xwmc331* | *qSL-24h-7A* | *Xgwm63* | 6.67 | 15.92 | 1.03 |
|  | 36 h | *qSL-36h-4D-1* | *Xwmc720* | *qSL-36h-7B* | *Xwmc696* | 6.16 | 3.24 | -0.8 |
|  | 36 h | *qSL-36h-4D-2* | *Xwmc331* | *qSL-36h-7A* | *Xgwm63* | 6.54 | 9.63 | 1.02 |
| SFW | 0 h | *qSFW-0h-5A-1* | *Xwmc752* | *qSFW-0h-6A* | *Xwmc201* | 7.33 | 6.63 | 6.5 |
|  | 0 h | *qSFW-0h-5A-2* | *Xbarc186* | *qSFW-0h-6A* | *Xwmc201* | 6.05 | 5.51 | 5.81 |
|  | 0 h | *qSFW-0h-5A-3* | *Xbarc56* | *qSFW-0h-6A* | *Xwmc201* | 6.1 | 5.24 | 6.3 |
| VI | 0 h | *qVI-0h-1B* | *Xwmc766* | *qVI-0h-4D-1* | *Xwmc720* | 5 | 0.29 | -14.36 |
|  | 0 h | *qVI-0h-2A* | *Xwmc819* | *qVI-0h-4D-1* | *Xwmc720* | 5.3 | 0.26 | -13.39 |
|  | 0 h | *qVI-0h-2B* | *Xgwm148* | *qVI-0h-4D-1* | *Xwmc720* | 5.03 | 0.74 | 12.7 |
|  | 0 h | *qVI-0h-2B* | *Xgwm148* | *qVI-0h-4D-2* | *Xwmc331* | 5.7 | 0.8 | 14.73 |
|  | 0 h | *qVI-0h-2D* | *Xwmc41* | *qVI-0h-4D-1* | *Xwmc720* | 4.9 | 0.41 | -15.44 |
|  | 0 h | *qVI-0h-2D* | *Xwmc41* | *qVI-0h-4D-2* | *Xwmc331* | 4.97 | 0.53 | -14.04 |
|  | 0 h | *qVI-0h-4D-1* | *Xwmc720* | *qVI-0h-5A-1* | *Xwmc752* | 5.03 | 0.33 | -15.39 |
|  | 0 h | *qVI-0h-4D-1* | *Xwmc720* | *qVI-0h-5A-2* | *Xwmc705* | 4.97 | 0.35 | -15.44 |
|  | 0 h | *qVI-0h-4D-1* | *Xwmc720* | *qVI-0h-5A-3* | *Xbarc56* | 5.28 | 0.31 | -14.48 |
|  | 0 h | *qVI-0h-4D-1* | *Xwmc720* | *qVI-0h-5D* | *Xgwm583* | 5.35 | 0.2 | -11.2 |
|  | 0 h | *qVI-0h-4D-1* | *Xwmc720* | *qVI-0h-7A* | *Xgwm63* | 5.19 | 0.77 | 14.52 |
|  | 0 h | *qVI-0h-4D-1* | *Xwmc720* | *qVI-0h-7B-1* | *Xgwm400* | 4.98 | 0.34 | -15.29 |
|  | 0 h | *qVI-0h-4D-1* | *Xwmc720* | *qVI-0h-7B-2* | *Xgwm46* | 5.09 | 0.33 | -15.14 |
|  | 0 h | *qVI-0h-4D-1* | *Xwmc720* | *qVI-0h-7B-3* | *Xwmc758* | 5.14 | 0.34 | -15.88 |
|  | 0 h | *qVI-0h-4D-1* | *Xwmc720* | *qVI-0h-7B-4* | *Xwmc696* | 5.1 | 0.34 | -15.2 |
|  | 0 h | *qVI-0h-4D-1* | *Xwmc720* | *qVI-0h-7B-5* | *Xwmc662* | 5.01 | 0.35 | -16.42 |
|  | 0 h | *qVI-0h-4D-1* | *Xwmc720* | *qVI-0h-7B-6* | *Xwmc76* | 5 | 0.34 | -15.5 |
|  | 0 h | *qVI-0h-4D-2* | *Xwmc331* | *qVI-0h-7A* | *Xgwm63* | 6 | 0.89 | 16.57 |
|  | 60 h | *qVI-60h-3D* | *Xgwm314* | *qVI-60h-7A* | *Xgwm276* | 4.89 | 11.35 | 15.66 |
| SVI | 0 h | *qSVI-0h-1B* | *Xwmc766* | *qSVI-0h-4D-1* | *Xwmc720* | 6.69 | 0.65 | -1.12 |
|  | 0 h | *qSVI-0h-2A* | *Xwmc819* | *qSVI-0h-4D-1* | *Xwmc720* | 6.95 | 0.57 | -1 |
|  | 0 h | *qSVI-0h-2B* | *Xgwm148* | *qSVI-0h-4D-1* | *Xwmc720* | 5.79 | 1.21 | 0.82 |
|  | 0 h | *qSVI-0h-2B* | *Xgwm148* | *qSVI-0h-4D-2* | *Xwmc331* | 6.6 | 1.31 | 0.95 |
|  | 0 h | *qSVI-0h-2D* | *Xwmc41* | *qSVI-0h-4D-1* | *Xwmc720* | 6.59 | 0.86 | -1.11 |
|  | 0 h | *qSVI-0h-2D* | *Xwmc41* | *qSVI-0h-4D-2* | *Xwmc331* | 6.23 | 0.93 | -0.93 |
|  | 0 h | *qSVI-0h-4D-1* | *Xwmc720* | *qSVI-0h-5A-1* | *Xwmc752* | 6.9 | 0.72 | -1.15 |
|  | 0h | *qSVI-0h-4D-1* | *Xwmc720* | *qSVI-0h-5A-2* | *Xwmc705* | 6.86 | 0.75 | -1.15 |
|  | 0 h | *qSVI-0h-4D-1* | *Xwmc720* | *qSVI-0h-5A-3* | *Xbarc56* | 6.86 | 0.67 | -1.09 |
|  | 0 h | *qSVI-0h-4D-1* | *Xwmc720* | *qSVI-0h-5D* | *Xgwm583* | 7.11 | 0.44 | -0.85 |
|  | 0 h | *qSVI-0h-4D-1* | *Xwmc720* | *qSVI-0h-7A* | *Xgwm63* | 6.74 | 1.28 | 0.95 |
|  | 0 h | *qSVI-0h-4D-1* | *Xwmc720* | *qSVI-0h-7B-1* | *Xgwm400* | 6.71 | 0.72 | -1.14 |
|  | 0 h | *qSVI-0h-4D-1* | *Xwmc720* | *qSVI-0h-7B-2* | *Xgwm46* | 6.79 | 0.68 | -1.11 |
|  | 0 h | *qSVI-0h-4D-1* | *Xwmc720* | *qSVI-0h-7B-3* | *Xwmc758* | 7.22 | 0.74 | -1.21 |
|  | 0 h | *qSVI-0h-4D-1* | *Xwmc720* | *qSVI-0h-7B-4* | *Xwmc696* | 6.79 | 0.7 | -1.11 |
|  | 0 h | *qSVI-0h-4D-1* | *Xwmc720* | *qSVI-0h-7B-5* | *Xwmc662* | 6.84 | 0.68 | -1.15 |
|  | 0 h | *qSVI-0h-4D-1* | *Xwmc720* | *qSVI-0h-7B-6* | *Xwmc76* | 6.79 | 0.71 | -1.13 |
|  | 0 h | *qSVI-0h-4D-2* | *Xwmc331* | *qSVI-0h-7A* | *Xgwm63* | 7.74 | 1.52 | 1.08 |
|  | 24 h | *qSVI-24h-4D* | *Xwmc720* | *qSVI-24h-7B-1* | *Xgwm400* | 5.28 | 1.8 | -0.78 |
|  | 24 h | *qSVI-24h-4D* | *Xwmc720* | *qSVI-24h-7B-2* | *Xwmc76* | 5.3 | 1.84 | -0.79 |

**Note:** Positive value means parent type effect ＞ recombinant type effect while negative value means recombinant type effect ＞ parent type effect.