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| Table S1 Statistics of sequencing data of three F2 populations. |  |
| Population | Total Reads | Total Bases | Q30 Percentage (%) | GC Percentage (%) |
| Y32 | 162880924 | 32543922562 | 84.65 | 41.71 |
| Y133 | 148125690 | 29606583860 | 90.15 | 42.39 |
| Y159 | 167249759 | 33425150914 | 84.65 | 41.58 |

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| Table S2 Number of SLAF marker in three F2 populations. |  |
| Population | Total SLAF | Polymorphic SLAF | Percentage | SLAF Number |
| Y32 | 160979 | 27430 | 17.04% | 6872 |
| Y133 | 141341 | 17915 | 12.68% | 7136 |
| Y159 | 156180 | 2178 | 13.95% | 7924 |

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| Table S3 Identification of additional QTL by removing the effect of *E1* gene in Y32 population. |  |  |  |  |  |  |
| Population | QTL | Chr | LeftMarker | Physical position (bp) | RightMarker | Physical position (bp) | LOD | PVE(%) | Add | Dom | Distance to known QTL or gene (kb) | QTL in SoyBase or known gene |
| **Y32-*E1*** | *qFT10\_2* | 10 | Marker776629 | 45046804 | Marker863420 | 45440450 | 3.09  | 43.92  | 1.96  | -9.65  | Included | *E2* (Watanabe et al., 2011) |
|  | *qFT20\_2* | 20 | Marker1228966 | 1956141 | Marker1135381 | 1795026 | 3.05  | 44.62  | 1.08  | 7.42  |  |  |
|  | *qPH9\_1* | 9 | Marker669769 | 5584243 | Marker623942 | 6496253 | 6.18  | 67.61  | -6.32  | -72.55  | 55.48kb | Plant height 17-4 (Yao et al., 2015A) |
|  | *qBR10\_1* | 10 | Marker811909 | 43784166 | Marker748599 | 44987192 | 6.97  | 49.74  | -0.08  | -4.05  | 273.27kb | Branching 2-1 (Li et al., 2008) |
|  | *qBR15\_1* | 15 | Marker2274799 | 50732054 | Marker2310522 | 1742838 | 5.59  | 33.30  | -1.16  | -0.09  | Included | Branching 1-5 (Chen et al., 2007) |
|  | *qBR20\_1* | 20 | Marker1139561 | 38365623 | Marker1161006 | 37006103 | 3.93  | 19.98  | -0.91  | 0.05  |  |  |
|  | *qNode15\_1* | 15 | Marker2229610 | 11939150 | Marker2254444 | 12382773 | 19.40  | 98.17  | 77.59  | -76.71  |  |  |
|  | *qPod1\_2* | 1 | Marker2898538 | 4648217 | Marker2846473 | 4782894 | 5.68  | 50.33  | 65.58  | 10.24  |  |  |
|  | *qPod12\_1* | 12 | Marker1358768 | 5868300 | Marker1454425 | 4981513 | 2.97  | 19.74  | 5.83  | 68.58  |  |  |
| 　 | *qPod19\_1* | 19 | Marker2376336 | 38154884 | Marker2480383 | 37869958 | 3.33  | 13.09  | 11.37  | 43.08  | 　 | 　 |
| **Y32-*e1*** | *qFT4\_1* | 4 | Marker3295408 | 4553895 | Marker3288456 | 3168820 | 3.84  | 66.10  | -7.19  | 6.15  |  |  |
|  | *qFT5\_1* | 5 | Marker1493500 | 39601969 | Marker1488945 | 41318423 | 3.33  | 55.25  | -0.40  | -9.34  |  |  |
|  | *qFT8\_1* | 8 | Marker444770 | 46542606 | Marker403828 | 45027949 | 2.66  | 67.92  | -6.32  | 8.15  |  |  |
|  | *qPH2\_1* | 2 | Marker1983460 | 12924730 | Marker1830524 | 9900064 | 4.43  | 31.03  | 13.11  | -25.74  | 417.73kb | Plant height 23-1 (Reinprecht et al., 2006) |
|  | *qPH2\_2* | 2 | Marker1874132 | 39089204 | Marker1930951 | 39464576 | 2.95  | 23.15  | 11.85  | -17.18  | 868.18kb | Plant height 33-3 (Kim et al., 2012) |
|  | *qPH4\_1* | 4 | Marker3295408 | 4553895 | Marker3288456 | 3168820 | 3.05  | 27.30  | -6.88  | 26.19  | 132kb | Plant height 33-4 (Kim et al., 2012) |
|  | *qPH8\_1* | 8 | Marker503095 | 44453489 | Marker468911 | 44291501 | 2.89  | 23.62  | -10.77  | 19.26  |  |  |
|  | *qPH13\_1* | 13 | Marker969634 | 23067750 | Marker1072088 | 21754282 | 4.29  | 33.91  | 13.94  | -25.73  | Inside | Plant height 37-8 (Yao et al., 2015) |
|  | *qPH14\_1* | 14 | Marker1762040 | 7057513 | Marker1709446 | 4700609 | 2.86  | 29.48  | 14.83  | -26.94  | 2595.82kb | Plant height 34-6 (Kim et al., 2012) |
|  | *qPH15\_3* | 15 | Marker2188521 | 51667997 | Marker2193874 | 50669471 | 3.77  | 27.57  | 12.16  | -21.59  | 352.24kb | Plant height 13-3 (Specht et al., 2001) |
|  | *qPH15\_4* | 15 | Marker2256742 | 10683143 | Marker2248389 | 6350450 | 3.44  | 45.87  | -3.98  | -60.26  |  |  |
|  | *qBR10\_2* | 10 | Marker753141 | 2569603 | Marker871220 | 2811723 | 2.82  | 13.57  | 1.02  | -0.50  |  |  |
|  | *qBR10\_3* | 10 | Marker856739 | 2496414 | Marker881068 | 1530799 | 2.95  | 14.14  | 1.08  | -0.38  |  |  |
|  | *qBR11\_1* | 11 | Marker2102110 | 5764052 | Marker2056824 | 4504984 | 2.65  | 12.81  | 0.91  | -1.07  | Inside | Branching 1-1 (Chen et al., 2007) |
|  | *qBR13\_1* | 13 | Marker1045635 | 33388825 | Marker1094632 | 32571480 | 2.95  | 23.45  | 0.13  | -2.67  |  |  |
|  | *qBR14\_1* | 14 | Marker1792639 | 38716712 | Marker1643198 | 44087851 | 4.68  | 35.73  | 1.71  | -1.38  |  |  |
|  | *qNode3\_1* | 3 | Marker51677 | 34432502 | Marker85007 | 35368824 | 11.44  | 26.12  | 0.13  | -4.46  |  |  |
|  | *qNode3\_2* | 3 | Marker34365 | 41212483 | Marker37993 | 44054643 | 8.82  | 14.82  | -0.17  | 2.97  |  |  |
|  | *qNode9\_1* | 9 | Marker725322 | 1573416 | Marker656516 | 789646 | 4.28  | 4.67  | 0.02  | 2.94  |  |  |
|  | *qNode15\_2* | 15 | Marker2256742 | 10683143 | Marker2248389 | 6350450 | 17.39  | 83.82  | 0.04  | -12.54  |  |  |
|  | *qNode20\_1* | 20 | Marker1112314 | 2032772 | Marker1291840 | 23479729 | 7.42  | 11.07  | -1.53  | 0.04  |  |  |
| 　 | *qPod2\_1* | 2 | Marker1894321 | 42679545 | Marker1907855 | 43898375 | 3.49  | 49.30  | 68.55  | -42.72  | 　 | 　 |

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| Table S4 Identification of additional QTL by removing the effect of *E1* gene in Y133 population. |  |  |  |  |  |  |
| Population | QTL | Chr | LeftMarker | Physical position (bp) | RightMarker | Physical position (bp) | LOD | PVE(%) | Add | Dom | Distance to known QTL or gene (kb) | QTL in SoyBase or known gene |
| Y133-*E1* | *qFT1\_1*  | 1 | Marker860296 | 49059102 | Marker889667 | 48966442 | 4.92  | 14.37  | -2.53  | -0.56  |  |  |
|  | *qFT6\_2* | 6 | Marker1449694 | 46856851 | Marker1596115 | 45088674 | 7.36  | 29.52  | -4.08  | 0.58  | 762.59kb | First flower 1-2 (Keim et al., 1990) |
|  | *qFT7\_2* | 7 | Marker1838814 | 42480669 | Marker1823729 | 43139642 | 3.70  | 4.88  | 1.76  | 1.38  |  |  |
|  | *qFT18\_2* | 18 | Marker2566070 | 2491200 | Marker2566544 | 2374218 | 3.30  | 8.84  | 0.12  | 3.11  | 624.28kb | First flower 21-4 (Reinprecht et al., 2006) |
|  | *qFT20\_2* | 20 | Marker1380631 | 43548635 | Marker1408825 | 47015159 | 10.50  | 58.84  | -0.17  | -9.06  |  |  |
|  | *qPH19\_2* | 19 | Marker1629638 | 44862177 | Marker1666593 | 45184768 | 3.20  | 41.35  | 5.45  | 29.49  | 0.23kb | Plant height 10-4 (Orf et al., 1999) |
|  | *qPH19\_3* | 19 | Marker1620683 | 40760282 | Marker1769282 | 40958504 | 2.98  | 42.27  | 14.61  | 1.26  | 578.02kb | Plant height 8-3 (Orf et al., 1999) |
|  | *qBR2\_1* | 2 | Marker949955 | 11687058 | Marker1059871 | 11367075 | 3.06  | 14.01  | 0.61  | 2.11  |  |  |
|  | *qBR5\_1* | 5 | Marker3267895 | 34369728 | Marker3340114 | 31545456 | 3.04  | 19.06  | -0.83  | -2.34  | Inside | Branching 4-1 (Yao et al., 2015) |
|  | *qBR6\_1* | 6 | Marker1570324 | 17656443 | Marker1578129 | 16421211 | 4.72  | 45.32  | -2.29  | 1.18  | 1899.28kb | Branching 3-1 (Sayama et al., 2010) |
|  | *qBR7\_1* | 7 | Marker1835020 | 37550684 | Marker1860076 | 3572434 | 3.26  | 27.27  | -1.80  | 0.30  |  |  |
|  | *qBR8\_1* | 8 | Marker2713366 | 40908851 | Marker2800357 | 38375557 | 2.61  | 12.51  | -0.97  | 0.38  |  |  |
|  | *qNode6\_2* | 6 | Marker1490011 | 9213156 | Marker1524454 | 8060722 | 2.85  | 25.30  | 0.53  | -3.05  |  |  |
|  | *qNode6\_3* | 6 | Marker1523371 | 5747476 | Marker1535031 | 3027287 | 3.08  | 31.93  | 0.20  | -3.25  |  |  |
|  | *qNode8\_1* | 8 | Marker2713366 | 40908851 | Marker2800357 | 38375557 | 2.90  | 41.84  | -1.81  | 1.21  |  |  |
|  | *qNode9\_1* | 9 | Marker3118242 | 2275187 | Marker3120808 | 1116389 | 2.51  | 22.93  | -1.32  | 1.08  |  |  |
|  | *qNode20\_1* | 20 | Marker1258177 | 37795328 | Marker1320117 | 40695692 | 2.67  | 24.37  | 0.34  | -2.71  |  |  |
|  | *qPod11\_2* | 11 | Marker1183720 | 6021949 | Marker1210060 | 4627307 | 2.76  | 23.99  | 7.07  | 64.82  | 340kb | Pod number 3-1 (Sun et al., 2006) |
|  | *qPod15\_2* | 15 | Marker476641 | 5187960 | Marker330620 | 4141915 | 2.56  | 22.82  | 22.47  | -45.67  |  |  |
| 　 | *qPod19\_2* | 19 | Marker1635921 | 41294702 | Marker1620683 | 40760479 | 3.04  | 43.48  | 43.31  | -24.94  | 321.49kb | Pod number 9-3 (Kuroda et al., 2013) |
| Y133-*e1* | *qFT6\_3* | 6 | Marker1550448 | 43529248 | Marker1596115 | 45088674 | 7.62  | 32.58  | -2.49  | -11.72  | 461.41kb | First flower 12-1 (Zhang et al., 2004) |
|  | *qFT6\_4* | 6 | Marker1547068 | 11086775 | Marker1452469 | 10820805 | 3.08  | 4.52  | -2.30  | -3.35  |  |  |
|  | *qFT6\_5* | 6 | Marker1523034 | 5949576 | Marker1536475 | 3149103 | 3.86  | 11.93  | 3.57  | -0.66  |  |  |
|  | *qFT16\_1* | 16 | Marker2199160 | 175187 | Marker2153289 | 119447 | 7.36  | 34.73  | -0.60  | 12.36  |  |  |
|  | *qPH6\_1* | 6 | Marker1434937 | 15504018 | Marker1558850 | 13723869 | 2.94  | 47.72  | -20.36  | -24.52  |  |  |
|  | *qPH8\_1* | 8 | Marker2711396 | 17240120 | Marker2770106 | 15919776 | 2.55  | 52.93  | -1.06  | 45.74  |  |  |
|  | *qPH15\_1* | 15 | Marker394633 | 14911800 | Marker480088 | 17330244 | 3.40  | 56.64  | 11.74  | -36.26  | 1257.82kb | Plant height 29-4 (Liu et al., 2011) |
|  | *qBR14\_1* | 14 | Marker2886171 | 345481 | Marker2833216 | 452968 | 2.57  | 43.23  | -1.73  | -0.53  |  |  |
|  | *qBR15\_1* | 15 | Marker481532 | 1825138 | Marker437611 | 1984973 | 2.84  | 46.43  | 0.65  | 2.66  |  |  |
|  | *qBR17\_1* | 17 | Marker52634 | 11719926 | Marker98971 | 12110861 | 3.56  | 54.16  | -1.35  | -1.50  | Inside | Branching 3-4 (Sayama et al., 2010) |
|  | *qBR17\_2* | 17 | Marker134981 | 37768211 | Marker100052 | 38188111 | 3.18  | 50.60  | -1.37  | -2.53  |  |  |
|  | *qNode4\_1* | 4 | Marker649171 | 5294909 | Marker673149 | 1650768 | 3.04  | 7.65  | -1.26  | -1.69  |  |  |
|  | *qNode6\_4* | 6 | Marker1587916 | 34230280 | Marker1561476 | 44179958 | 5.37  | 30.58  | 0.34  | -5.33  | 189.3kb | Node number 1-4 (Gai et al., 2007) |
|  | *qNode9\_2* | 9 | Marker3125692 | 8507082 | Marker3083552 | 8701969 | 2.55  | 5.88  | -0.41  | 1.73  |  |  |
|  | *qNode10\_1* | 10 | Marker2050793 | 51561569 | Marker2002012 | 49350327 | 2.69  | 6.12  | 0.36  | 2.45  |  |  |
|  | *qNode15\_1* | 15 | Marker318422 | 9999755 | Marker394993 | 14823774 | 5.35  | 31.79  | 0.04  | -5.55  |  |  |
|  | *qNode16\_2* | 16 | Marker2199160 | 175187 | Marker2153289 | 119447 | 3.40  | 8.34  | -1.28  | 0.00  |  |  |
|  | *qNode17\_1* | 17 | Marker130433 | 7779356 | Marker135800 | 5852893 | 4.23  | 8.89  | -0.15  | 2.29  | Inside | Node number 7-1 (Li et al., 2009) |
|  | *qNode19\_2* | 19 | Marker1695229 | 42565531 | Marker1722002 | 44921078 | 3.25  | 14.37  | 0.22  | 2.74  |  |  |
|  | *qPod11\_2* | 11 | Marker1191778 | 4626607 | Marker1158449 | 4567661 | 2.82  | 52.77  | 20.64  | 56.72  |  |  |
| 　 | *qPod17\_1* | 17 | Marker71932 | 4835831 | Marker57299 | 3850128 | 2.54  | 42.84  | -26.06  | -6.53  | 　 | 　 |

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| Table S5 Identification of additional QTL by removing the effect of *E2* gene in Y159 population. |  |  |  |  |  |  |
| Population | QTL | Chr | LeftMarker | Physical position (bp) | RightMarker | Physical position (bp) | LOD | PVE(%) | Add | Dom | Distance to known QTL or gene (kb) | QTL in SoyBase or known gene |
| Y159-*E2* | *qFT16\_1*  | 16 | Marker133751 | 1744685 | Marker4884 | 1469283 | 2.55  | 19.34  | 0.85  | 5.78  |  |  |
|  | *qFT18\_1*  | 18 | Marker2873468 | 8587965 | Marker2951053 | 7774568 | 4.00  | 60.20  | 4.25  | -1.77  | 742.96kb | First flower 9-2 (Reinprecht et al., 2006) |
|  | *qPH2\_1* | 2 | Marker2073773 | 43210350 | Marker1997222 | 41732879 | 3.09  | 74.12  | 6.56  | 13.54  | 700.31kb | Plant height 26-9 (Sun et al., 2006) |
|  | *qPH4\_1* | 4 | Marker2251035 | 41180835 | Marker2328095 | 13336223 | 2.62  | 45.61  | 10.64  | 16.83  |  |  |
|  | *qBR2\_1* | 2 | Marker2084568 | 285567 | Marker2046426 | 1200000 | 3.85  | 58.91  | -2.34  | -3.49  |  |  |
|  | *qBR4\_1* | 4 | Marker2211959 | 14076044 | Marker2180729 | 12902708 | 3.60  | 57.78  | -1.88  | -4.37  |  |  |
|  | *qBR10\_1* | 10 | Marker2491207 | 46582574 | Marker2562044 | 48212365 | 3.73  | 64.74  | 0.46  | 4.42  |  |  |
|  | *qBR12\_1* | 12 | Marker259797 | 39092894 | Marker190876 | 2635815 | 2.63  | 58.77  | -0.53  | 4.81  | Included | Branching 5-3 (Shim et al., 2018) |
|  | *qNode2\_1* | 2 | Marker2004129 | 38592420 | Marker2057410 | 38154226 | 4.29  | 2.12  | -0.54  | -0.06  | 66.8kb | Node number 4-1 (Liu et al., 2011) |
|  | *qNode4\_1* | 4 | Marker2263186 | 3853836 | Marker2194298 | 3567846 | 9.25  | 9.34  | 0.02  | -2.46  |  |  |
|  | *qNode9\_1* | 9 | Marker1445830 | 49555447 | Marker1384932 | 48059714 | 8.28  | 7.48  | 0.01  | 1.93  |  |  |
|  | *qNode10\_1* | 10 | Marker2581131 | 45301061 | Marker2607150 | 46746333 | 15.76  | 43.82  | 4.91  | -4.43  |  |  |
| 　 | *qPod12\_1* | 12 | Marker160225 | 34446165 | Marker277796 | 37051858 | 2.74  | 55.29  | ##### | 78.28  | 　 | 　 |