

Quantitative trait locus mapping for drought tolerance in soybean recombinant inbred line population

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Supplementary Table S1. Marker distribution and length of linkage maps of 20 chromosomes

| Name of chromosome | Number of markers | Linkage map length (cM) | Average distance between adjacent markers (cM) |
|--------------------|-------------------|-------------------------|--|
| Chromosome1 | 158 | 170.8 | 1.08 |
| Chromosome2 | 153 | 213.18 | 1.39 |
| Chromosome3 | 177 | 213.65 | 1.21 |
| Chromosome4 | 97 | 170.24 | 1.76 |
| Chromosome5 | 87 | 153.82 | 1.77 |
| Chromosome6 | 122 | 199.05 | 1.63 |
| Chromosome7 | 122 | 187.31 | 1.54 |
| Chromosome8 | 113 | 211.63 | 1.87 |
| Chromosome9 | 184 | 192.17 | 1.04 |
| Chromosome10 | 110 | 151.08 | 1.37 |
| Chromosome11 | 87 | 146.01 | 1.68 |
| Chromosome12 | 89 | 157.56 | 1.77 |
| Chromosome13 | 209 | 262.44 | 1.26 |
| Chromosome14 | 108 | 147.19 | 1.36 |
| Chromosome15 | 64 | 145.71 | 2.28 |
| Chromosome16 | 214 | 190.82 | 0.89 |
| Chromosome17 | 85 | 145.84 | 1.72 |
| Chromosome18 | 196 | 188.72 | 0.96 |
| Chromosome19 | 123 | 160.61 | 1.31 |
| Chromosome20 | 150 | 200.57 | 1.34 |
| Whole Genome | 2648 | 3608.4 | 1.36 |

Supplementary Table S2. Correlation between different traits under control and drought conditions

| Trait | Treatment | Plant height | Node number | Branch number | Pod number | Biomass | Leaf area |
|---------------|-----------|---------------------|----------------------|----------------------|---------------------|-----------|-----------|
| Plant height | Control | 1 | | | | | |
| | Drought | 1 | | | | | |
| Node number | Control | 0.595**** | 1 | | | | |
| | Drought | 0.744**** | 1 | | | | |
| Branch number | Control | 0.174* | 0.155 ^{ns} | 1 | | | |
| | Drought | 0.337**** | 0.294*** | 1 | | | |
| Pod number | Control | 0.192* | 0.445**** | 0.361**** | 1 | | |
| | Drought | 0.287** | 0.281*** | 0.386**** | 1 | | |
| Biomass | Control | 0.221** | 0.452**** | 0.209* | 0.851**** | 1 | |
| | Drought | 0.389**** | 0.379**** | 0.209* | 0.811**** | 1 | |
| Leaf area | Control | 0.100 ^{ns} | 0.022 ^{ns} | -0.135 ^{ns} | 0.186* | 0.360**** | 1 |
| | Drought | 0.107 ^{ns} | -0.027 ^{ns} | 0.106 ^{ns} | 0.105 ^{ns} | 0.281*** | 1 |

^{ns}, *, **, and **** denote non-significant and significant difference at <.05, <.01, <.001, and <.0001, respectively.

Supplementary Table S3. Plant height (PH), number of nodes on main stem (NN), number of branches on main stem (BN), number of pods (PN), biomass (BM), and leaf area (LA) under the control (C) and drought (D) in three years

| Trait | Year | Parents | | | | RILs | | | | H^2 | |
|-------|-------------------|-----------------|--------|-----------|-------|-------|--------|--------------|--------------|-------|-----------------|
| | | PI416937 | | Cheonsang | | Mean | | Range | | | |
| | | C | D | C | D | C | D | C | D | C | D |
| PH | 2017 | 82.80 | 83.00 | 81.45 | 81.00 | 94.31 | 85.85 | 40.20–144.50 | 50.00–147.5 | 0.58 | na |
| | 2018 | 37.00 | 35.67 | 43.00 | 35.67 | 37.44 | 28.59 | 25.00–51.33 | 17.00–41.67 | 0.89 | 0.85 |
| | 2019 | 48.67 | 37.00 | 65.00 | 42.00 | 60.02 | 45.87 | 35.33–99.67 | 18.00–80.33 | 0.89 | 0.86 |
| | Mean ¹ | 56.16 | 51.89 | 63.15 | 52.89 | 64.12 | 53.06 | 25.00–144.50 | 17.00–147.50 | 0.33 | 0.40 |
| NN | 2017 | 15.00 | 16.00 | 14.00 | 15.00 | 14.72 | 15.11 | 8.00–20.00 | 9.00–19.00 | 0.66 | na ^b |
| | 2018 | 9.67 | 10.00 | 11.00 | 10.00 | 10.38 | 9.27 | 8.00–12.67 | 7.00–12.00 | 0.64 | 0.64 |
| | 2019 | 13.00 | 11.00 | 13.00 | 11.50 | 12.88 | 12.52 | 9.00–16.33 | 6.00–18.00 | 0.75 | 0.79 |
| | Mean | 12.56 | 12.33 | 12.67 | 12.17 | 12.68 | 12.27 | 8.00–20.00 | 6.00–19.00 | 0.42 | 0.20 |
| BN | 2017 | na ³ | na | na | na | na | na | na | na | na | na |
| | 2018 | 3.67 | 1.67 | 3.33 | 1.33 | 2.71 | 1.17 | 0.67–5.00 | 0.00–3.67 | 0.71 | 0.77 |
| | 2019 | 3.67 | 2.67 | 2.00 | 1.00 | 3.75 | 2.76 | 0.00–6.67 | 0.00–6.50 | 0.59 | 0.68 |
| | Mean | 3.67 | 2.17 | 2.67 | 1.17 | 3.23 | 1.97 | 0.00–6.67 | 0.00–6.50 | 0.36 | 0.30 |
| PN | 2017 | 161.5 | 118.00 | 81.5 | 36.00 | 67.79 | 49.17 | 0.00–206.00 | 2.00–168.00 | 0.53 | na |
| | 2018 | 17.67 | 19.67 | 27.00 | 19.00 | 24.22 | 12.04 | 9.33–51.33 | 2.00–31.33 | 0.83 | 0.79 |
| | 2019 | 52.33 | 42.33 | 60.00 | 48.50 | 53.90 | 33.57 | 7.00–140.67 | 1.33–120.00 | 0.74 | 0.73 |
| | Mean | 77.17 | 60.00 | 56.17 | 34.50 | 48.81 | 31.44 | 0.00–206.00 | 1.33–168.00 | 0.27 | 0.01 |
| LA | 2017 | 119.63 | 105.00 | 121.76 | 36.47 | 96.53 | 58.05 | 19.11–165.97 | 11.81–132.2 | 0.53 | 0.34 |
| | 2018 | 62.72 | 39.43 | 59.11 | 28.57 | 53.86 | 27.92 | 28.40–83.38 | 8.53–72.10 | 0.82 | 0.84 |
| | 2019 | 37.68 | 34.79 | 72.26 | 28.81 | 51.61 | 25.75 | 14.87–134.74 | 7.91–80.69 | 0.89 | 0.90 |
| | Mean | 73.34 | 60.07 | 84.38 | 31.28 | 67.43 | 37.14 | 14.87–165.97 | 7.91–106.10 | 0.36 | 0.16 |
| BM | 2017 | 480.50 | 303.00 | 247.50 | 68.00 | 189.2 | 127.11 | 18.00–542.00 | 12.00–498.00 | 0.49 | 0.41 |
| | 2018 | 33.33 | 20.17 | 37.43 | 19.83 | 31.87 | 14.17 | 12.40–65.10 | 2.70–36.77 | 0.78 | 0.83 |
| | 2019 | 21.05 | 48.83 | 21.64 | 50.50 | 80.61 | 43.24 | 13.67–237.83 | 8.50–50.50 | 0.77 | 0.77 |
| | Mean | 189.73 | 124.00 | 128.09 | 46.11 | 58.65 | 34.37 | 6.00–237.83 | 2.70–150.50 | 0.26 | 0.17 |

¹ Average value of three years. ² Broad-sense heritability. ³ Not available.

Supplementary Table S4. Analysis of variance for plant height, number of nodes and branched in main stem, number of pods, biomass, and leaf area of the recombinant inbred line (RIL) population derived from a drought-tolerant 'PI416937' and susceptible 'Cheonsang' parents

| Source of Variation | Plant height | | Node number | | Branch number | | Pod number | | Biomass | | Leaf area | |
|---------------------|--------------|---------|-------------|---------|---------------|---------|------------|---------|---------|---------|-----------|---------|
| | F value | P value | F value | P value | F value | P value | F value | P value | F value | P value | F value | P value |
| RIL (G) | 14.87 | <.0001 | 9.41 | <.0001 | 5.87 | <.0001 | 7.66 | <.0001 | 6.52 | <.0001 | 10.21 | <.0001 |
| Year (Y) | 7428.04 | <.0001 | 2968.5 | <.0001 | 203.16 | <.0001 | 609.91 | <.0001 | 445.64 | <.0001 | 1515.81 | <.0001 |
| Treatment (T) | 869.32 | <.0001 | 29.76 | <.0001 | 403.22 | <.0001 | 414.86 | <.0001 | 465.21 | <.0001 | 3050.27 | <.0001 |
| G*Y | 8.69 | <.0001 | 5.66 | <.0001 | 3.22 | <.0001 | 5.77 | <.0001 | 4.85 | <.0001 | 6.38 | <.0001 |
| G*T | 3.11 | <.0001 | 2.83 | <.0001 | 1.2 | 0.0634 | 2.33 | <.0001 | 1.46 | 0.0007 | 3.04 | <.0001 |
| G*Y*T | 3.54 | <.0001 | 2.96 | <.0001 | 1.61 | <.0001 | 2.37 | <.0001 | 1.62 | <.0001 | 3.45 | <.0001 |