

Supplementary Information

Seed protein content and its relationships with agronomic traits in pigeonpea is controlled by both main and epistatic effects QTLs

Jimmy Obala^{1,2}, Rachit K. Saxena¹, Vikas K. Singh¹, Sandip M. Kale¹, Vanika Garg¹, C. V. Sameer Kumar³, K. B. Saxena⁴, Pangirayi Tongoona², Julia Sibiya², Rajeev K. Varshney^{1,*}

¹International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Hyderabad, 502324, India

²University of KwaZulu-Natal, African Center for Crop Improvement, Scottsville, 3209 Pietermaritzburg, South Africa

³Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad-500030, Telangana, India

⁴Former Principal Scientist, ICRISAT, Present address: 17, NMC Housing, Al Ain, Abu Dhabi

*Email address for correspondence: r.k.varshney@cgiar.org

Supplementary Table S1. Sequence data generated using genotyping-by-sequencing of parental lines and F₂ individuals of five pigeonpea mapping population

| Pop1 (ICP 11605 × ICP 14209) | | | | | |
|------------------------------|---------------------|-----------|-----------|---------------------|-----------|
| Sample ID | No. reads (Million) | Data (Gb) | Sample ID | No. reads (Million) | Data (Gb) |
| Parents | | | 18 | 5.17 | 0.52 |
| ICP 11605 (P ₁) | 1.13 | 0.11 | 19 | 2.95 | 0.30 |
| ICP 14209 (P ₂) | 2.60 | 0.26 | 20 | 3.95 | 0.40 |
| F ₂ | | | 21 | 2.22 | 0.22 |
| 1 | 3.57 | 0.36 | 22 | 2.30 | 0.23 |
| 2 | 3.36 | 0.34 | 23 | 3.10 | 0.31 |
| 3 | 5.82 | 0.59 | 24 | 2.91 | 0.29 |
| 4 | 4.03 | 0.41 | 25 | 3.30 | 0.33 |
| 5 | 2.57 | 0.26 | 26 | 1.82 | 0.18 |
| 6 | 2.98 | 0.30 | 27 | 1.93 | 0.19 |
| 7 | 3.76 | 0.38 | 28 | 3.01 | 0.30 |
| 8 | 3.42 | 0.35 | 29 | 1.94 | 0.20 |
| 9 | 1.99 | 0.20 | 30 | 3.67 | 0.37 |
| 10 | 2.28 | 0.23 | 31 | 2.16 | 0.22 |
| 11 | 3.74 | 0.38 | 33 | 2.93 | 0.30 |
| 12 | 2.26 | 0.23 | 34 | 2.28 | 0.23 |
| 13 | 2.96 | 0.30 | 35 | 1.53 | 0.15 |
| 14 | 2.34 | 0.24 | 36 | 1.76 | 0.18 |
| 15 | 1.92 | 0.19 | 37 | 3.03 | 0.31 |
| 16 | 3.04 | 0.31 | 38 | 1.73 | 0.17 |
| 17 | 2.30 | 0.23 | 39 | 3.00 | 0.30 |

Supplementary Table S1 (continued)

| Pop1 (ICP 11605 × ICP 14209) | | | | | |
|------------------------------|---------------------|-----------|-----------|---------------------|-----------|
| Sample ID | No. reads (Million) | Data (Gb) | Sample ID | No. reads (Million) | Data (Gb) |
| 40 | 2.14 | 0.22 | 78 | 1.54 | 0.16 |
| 41 | 2.53 | 0.26 | 79 | 1.68 | 0.17 |
| 42 | 1.80 | 0.18 | 80 | 1.62 | 0.16 |
| 43 | 2.74 | 0.28 | 81 | 3.00 | 0.30 |
| 44 | 1.69 | 0.17 | 82 | 3.31 | 0.33 |
| 45 | 2.76 | 0.28 | 83 | 2.44 | 0.25 |
| 46 | 2.96 | 0.30 | 84 | 2.29 | 0.23 |
| 47 | 2.49 | 0.25 | 85 | 0.79 | 0.08 |
| 48 | 2.78 | 0.28 | 86 | 1.21 | 0.12 |
| 49 | 2.22 | 0.22 | 87 | 1.01 | 0.10 |
| 50 | 4.17 | 0.42 | 88 | 1.52 | 0.15 |
| 51 | 2.31 | 0.23 | 89 | 1.11 | 0.11 |
| 52 | 2.69 | 0.27 | 95 | 2.32 | 0.23 |
| 53 | 3.28 | 0.33 | 96 | 1.68 | 0.17 |
| 54 | 2.50 | 0.25 | 97 | 3.13 | 0.32 |
| 55 | 2.43 | 0.25 | 98 | 2.90 | 0.29 |
| 56 | 1.97 | 0.20 | 99 | 1.90 | 0.19 |
| 57 | 2.40 | 0.24 | 100 | 2.55 | 0.26 |
| 58 | 1.64 | 0.17 | 101 | 2.38 | 0.24 |
| 59 | 1.45 | 0.15 | 102 | 3.18 | 0.32 |
| 60 | 2.27 | 0.23 | 103 | 1.51 | 0.15 |
| 61 | 4.74 | 0.48 | 104 | 2.34 | 0.24 |
| 62 | 1.82 | 0.18 | 105 | 1.59 | 0.16 |
| 63 | 2.39 | 0.24 | 106 | 1.43 | 0.14 |
| 64 | 2.11 | 0.21 | 107 | 1.92 | 0.19 |
| 65 | 2.12 | 0.21 | 108 | 1.74 | 0.18 |
| 66 | 2.14 | 0.22 | 109 | 1.15 | 0.12 |
| 67 | 1.89 | 0.19 | 110 | 2.24 | 0.23 |
| 68 | 2.47 | 0.25 | 111 | 2.53 | 0.26 |
| 69 | 3.17 | 0.32 | 112 | 2.01 | 0.20 |
| 70 | 1.92 | 0.19 | 113 | 1.77 | 0.18 |
| 71 | 2.45 | 0.25 | 114 | 2.85 | 0.29 |
| 72 | 2.28 | 0.23 | 115 | 2.41 | 0.24 |
| 73 | 2.13 | 0.22 | 116 | 1.90 | 0.19 |
| 74 | 1.20 | 0.12 | 117 | 2.46 | 0.25 |
| 75 | 1.57 | 0.16 | 118 | 1.76 | 0.18 |
| 76 | 2.11 | 0.21 | 119 | 2.02 | 0.20 |
| 77 | 1.94 | 0.20 | 120 | 1.27 | 0.13 |

Supplementary Table S1 (continued)

| Pop1 (ICP 11605 × ICP 14209) | | | | | |
|------------------------------|---------------------|-----------|------------------------|---------------------|-----------|
| Sample ID | No. reads (Million) | Data (Gb) | Sample ID | No. reads (Million) | Data (Gb) |
| 121 | 1.30 | 0.13 | 159 | 1.90 | 0.19 |
| 122 | 1.65 | 0.17 | 160 | 1.13 | 0.11 |
| 123 | 1.11 | 0.11 | 161 | 1.68 | 0.17 |
| 124 | 2.28 | 0.23 | 162 | 1.72 | 0.17 |
| 125 | 1.06 | 0.11 | 163 | 2.52 | 0.25 |
| 126 | 1.03 | 0.10 | 164 | 1.14 | 0.11 |
| 127 | 1.82 | 0.18 | 165 | 2.17 | 0.22 |
| 128 | 1.82 | 0.18 | 166 | 2.29 | 0.23 |
| 129 | 1.11 | 0.11 | 167 | 1.27 | 0.13 |
| 130 | 1.26 | 0.13 | 168 | 1.11 | 0.11 |
| 131 | 2.25 | 0.23 | 169 | 1.48 | 0.15 |
| 132 | 1.89 | 0.19 | 170 | 2.88 | 0.29 |
| 133 | 2.32 | 0.23 | 172 | 1.40 | 0.14 |
| 134 | 2.54 | 0.26 | 175 | 1.46 | 0.15 |
| 135 | 3.58 | 0.36 | 176 | 1.70 | 0.17 |
| 136 | 2.13 | 0.21 | 177 | 1.35 | 0.14 |
| 137 | 2.59 | 0.26 | 178 | 1.57 | 0.16 |
| 138 | 3.29 | 0.33 | 180 | 1.23 | 0.12 |
| 139 | 2.96 | 0.30 | 181 | 1.48 | 0.15 |
| 140 | 3.09 | 0.31 | 182 | 2.82 | 0.29 |
| 141 | 1.66 | 0.17 | 183 | 1.33 | 0.13 |
| 142 | 2.89 | 0.29 | 184 | 0.83 | 0.08 |
| 143 | 1.66 | 0.17 | 185 | 1.41 | 0.14 |
| 144 | 3.28 | 0.33 | 186 | 2.18 | 0.22 |
| 145 | 2.18 | 0.22 | 187 | 0.92 | 0.09 |
| 146 | 4.01 | 0.40 | 188 | 1.58 | 0.16 |
| 147 | 2.93 | 0.30 | F ₂ total | 399.93 | 40.40 |
| 148 | 2.10 | 0.21 | F ₂ average | 2.25 | 0.23 |
| 149 | 2.41 | 0.24 | | | |
| 150 | 2.17 | 0.22 | | | |
| 151 | 1.64 | 0.17 | | | |
| 152 | 1.19 | 0.12 | | | |
| 153 | 1.10 | 0.11 | | | |
| 154 | 2.19 | 0.22 | | | |
| 155 | 1.78 | 0.18 | | | |
| 156 | 1.57 | 0.16 | | | |
| 157 | 2.39 | 0.24 | | | |
| 158 | 3.96 | 0.40 | | | |

Supplementary Table S1 (continued)

| Pop2 (ICP 8863 × ICP 11605) | | | | | |
|-----------------------------|---------------------|-----------|-----------|---------------------|-----------|
| Sample ID | No. reads (Million) | Data (Gb) | Sample ID | No. reads (Million) | Data (Gb) |
| Parents | | | 36 | 1.82 | 0.18 |
| ICP 8863 (P ₁) | 3.00 | 0.30 | 37 | 2.32 | 0.23 |
| ICP 11605 (P ₂) | 7.59 | 0.77 | 39 | 0.69 | 0.07 |
| F ₂ | | | 40 | 1.33 | 0.13 |
| 1 | 3.68 | 0.37 | 42 | 0.98 | 0.10 |
| 2 | 1.53 | 0.15 | 44 | 1.24 | 0.13 |
| 3 | 3.75 | 0.38 | 45 | 0.79 | 0.08 |
| 4 | 3.33 | 0.34 | 46 | 0.81 | 0.08 |
| 5 | 1.80 | 0.18 | 47 | 0.74 | 0.07 |
| 6 | 3.12 | 0.31 | 49 | 0.76 | 0.08 |
| 7 | 3.57 | 0.36 | 52 | 0.80 | 0.08 |
| 8 | 5.44 | 0.55 | 53 | 1.40 | 0.14 |
| 9 | 1.44 | 0.15 | 54 | 1.50 | 0.15 |
| 10 | 1.36 | 0.14 | 55 | 1.48 | 0.15 |
| 11 | 3.66 | 0.37 | 56 | 1.62 | 0.16 |
| 12 | 1.74 | 0.18 | 57 | 2.76 | 0.28 |
| 13 | 6.71 | 0.68 | 58 | 1.52 | 0.15 |
| 14 | 5.22 | 0.53 | 59 | 1.14 | 0.11 |
| 15 | 0.65 | 0.07 | 60 | 1.62 | 0.16 |
| 16 | 1.84 | 0.19 | 61 | 2.47 | 0.25 |
| 17 | 2.54 | 0.26 | 62 | 1.69 | 0.17 |
| 18 | 3.44 | 0.35 | 63 | 1.29 | 0.13 |
| 19 | 2.04 | 0.21 | 64 | 0.75 | 0.08 |
| 20 | 9.52 | 0.96 | 65 | 1.95 | 0.20 |
| 21 | 1.25 | 0.13 | 66 | 2.24 | 0.23 |
| 22 | 2.41 | 0.24 | 67 | 1.91 | 0.19 |
| 23 | 2.17 | 0.22 | 68 | 0.90 | 0.09 |
| 24 | 1.98 | 0.20 | 69 | 2.47 | 0.25 |
| 25 | 1.43 | 0.14 | 70 | 4.31 | 0.43 |
| 26 | 1.40 | 0.14 | 71 | 1.44 | 0.14 |
| 27 | 2.38 | 0.24 | 72 | 1.74 | 0.18 |
| 28 | 3.04 | 0.31 | 73 | 0.86 | 0.09 |
| 29 | 0.96 | 0.10 | 74 | 4.69 | 0.47 |
| 30 | 1.34 | 0.14 | 75 | 0.78 | 0.08 |
| 31 | 1.09 | 0.11 | 76 | 3.37 | 0.34 |
| 33 | 1.95 | 0.20 | 77 | 1.58 | 0.16 |
| 34 | 2.13 | 0.21 | 78 | 2.97 | 0.30 |
| 35 | 1.85 | 0.19 | 79 | 0.86 | 0.09 |

Supplementary Table S1 (continued)

| Pop2 (ICP 8863 × ICP 11605) | | | | | |
|-----------------------------|---------------------|-----------|-----------|---------------------|-----------|
| Sample ID | No. reads (Million) | Data (Gb) | Sample ID | No. reads (Million) | Data (Gb) |
| 80 | 1.15 | 0.12 | 119 | 3.80 | 0.38 |
| 81 | 4.03 | 0.41 | 121 | 1.53 | 0.15 |
| 82 | 2.58 | 0.26 | 122 | 3.23 | 0.33 |
| 83 | 1.04 | 0.11 | 123 | 1.98 | 0.20 |
| 84 | 0.70 | 0.07 | 124 | 2.98 | 0.30 |
| 85 | 0.56 | 0.06 | 125 | 2.74 | 0.28 |
| 86 | 0.76 | 0.08 | 126 | 2.19 | 0.22 |
| 87 | 0.68 | 0.07 | 127 | 3.94 | 0.40 |
| 88 | 1.57 | 0.16 | 128 | 3.99 | 0.40 |
| 89 | 0.86 | 0.09 | 129 | 3.93 | 0.40 |
| 90 | 0.63 | 0.06 | 130 | 3.93 | 0.40 |
| 91 | 1.44 | 0.15 | 131 | 4.75 | 0.48 |
| 92 | 1.21 | 0.12 | 132 | 3.65 | 0.37 |
| 93 | 0.79 | 0.08 | 133 | 1.63 | 0.16 |
| 94 | 1.22 | 0.12 | 135 | 1.97 | 0.20 |
| 95 | 2.38 | 0.24 | 136 | 2.52 | 0.25 |
| 96 | 2.21 | 0.22 | 137 | 1.94 | 0.20 |
| 97 | 3.77 | 0.38 | 138 | 2.14 | 0.22 |
| 98 | 3.42 | 0.34 | 139 | 1.37 | 0.14 |
| 99 | 0.95 | 0.10 | 140 | 2.30 | 0.23 |
| 100 | 3.19 | 0.32 | 141 | 1.89 | 0.19 |
| 101 | 1.74 | 0.18 | 142 | 1.39 | 0.14 |
| 102 | 4.22 | 0.43 | 143 | 1.55 | 0.16 |
| 103 | 2.28 | 0.23 | 144 | 1.62 | 0.16 |
| 104 | 1.46 | 0.15 | 145 | 0.94 | 0.09 |
| 105 | 2.90 | 0.29 | 146 | 0.85 | 0.09 |
| 106 | 1.13 | 0.11 | 147 | 2.03 | 0.20 |
| 107 | 1.77 | 0.18 | 148 | 1.26 | 0.13 |
| 108 | 1.48 | 0.15 | 149 | 0.92 | 0.09 |
| 109 | 1.13 | 0.11 | 150 | 0.87 | 0.09 |
| 110 | 0.75 | 0.08 | 152 | 0.83 | 0.08 |
| 111 | 1.37 | 0.14 | 154 | 1.14 | 0.12 |
| 112 | 1.36 | 0.14 | 155 | 0.90 | 0.09 |
| 113 | 1.01 | 0.10 | 156 | 2.23 | 0.22 |
| 114 | 1.09 | 0.11 | 157 | 0.74 | 0.07 |
| 115 | 1.41 | 0.14 | 159 | 1.04 | 0.11 |
| 117 | 6.78 | 0.68 | 160 | 1.34 | 0.14 |
| 118 | 0.72 | 0.07 | 161 | 1.90 | 0.19 |

Supplementary Table S1 (continued)

| Pop2 (ICP 8863 × ICP 11605) | | |
|-----------------------------|---------------------|-----------|
| Sample ID | No. reads (Million) | Data (Gb) |
| 162 | 1.03 | 0.10 |
| 163 | 1.48 | 0.15 |
| 164 | 1.25 | 0.13 |
| 165 | 2.12 | 0.21 |
| 166 | 2.25 | 0.23 |
| 167 | 1.28 | 0.13 |
| 168 | 0.94 | 0.09 |
| 169 | 1.26 | 0.13 |
| 170 | 1.68 | 0.17 |
| 171 | 0.73 | 0.07 |
| 172 | 0.94 | 0.09 |
| 173 | 0.92 | 0.09 |
| 174 | 1.09 | 0.11 |
| 175 | 1.89 | 0.19 |
| 176 | 1.16 | 0.12 |
| 177 | 0.68 | 0.07 |
| 178 | 1.43 | 0.14 |
| 179 | 0.58 | 0.06 |
| 180 | 0.63 | 0.06 |
| 181 | 0.61 | 0.06 |
| 182 | 0.63 | 0.06 |
| 183 | 0.87 | 0.09 |
| 184 | 0.49 | 0.05 |
| 185 | 0.98 | 0.10 |
| 186 | 1.09 | 0.11 |
| 187 | 0.83 | 0.08 |
| 188 | 0.78 | 0.08 |
| F ₂ total | 332.68 | 34.67 |
| F ₂ average | 1.90 | 0.20 |

Supplementary Table S1 (continued)

| Pop3 (HPL 24 × ICP 11605) | | | | | |
|---------------------------|---------------------|-----------|-----------|---------------------|-----------|
| Sample ID | No. reads (Million) | Data (Gb) | Sample ID | No. reads (Million) | Data (Gb) |
| Parents | | | 54 | 1.32 | 0.13 |
| HPL 24 | 2.96 | 0.30 | 55 | 2.62 | 0.26 |
| ICP 11605 | 3.31 | 0.33 | 56 | 1.20 | 0.12 |
| F ₂ | | | 57 | 4.88 | 0.49 |
| 2 | 1.04 | 0.10 | 58 | 1.00 | 0.10 |
| 3 | 1.29 | 0.13 | 59 | 2.01 | 0.20 |
| 7 | 4.36 | 0.44 | 60 | 1.64 | 0.17 |
| 8 | 0.85 | 0.09 | 61 | 1.92 | 0.19 |
| 9 | 1.96 | 0.20 | 62 | 1.10 | 0.11 |
| 11 | 1.90 | 0.19 | 63 | 0.80 | 0.08 |
| 13 | 0.89 | 0.09 | 64 | 0.92 | 0.09 |
| 16 | 3.65 | 0.37 | 65 | 0.92 | 0.09 |
| 17 | 1.08 | 0.11 | 66 | 2.66 | 0.27 |
| 18 | 2.97 | 0.30 | 67 | 1.65 | 0.17 |
| 20 | 1.08 | 0.11 | 69 | 1.16 | 0.12 |
| 21 | 1.80 | 0.18 | 71 | 1.45 | 0.15 |
| 22 | 0.79 | 0.08 | 73 | 2.80 | 0.28 |
| 23 | 2.29 | 0.23 | 74 | 3.03 | 0.31 |
| 24 | 0.86 | 0.09 | 75 | 2.57 | 0.26 |
| 25 | 4.75 | 0.48 | 76 | 1.27 | 0.13 |
| 26 | 0.81 | 0.08 | 77 | 1.31 | 0.13 |
| 27 | 1.95 | 0.20 | 78 | 0.97 | 0.10 |
| 31 | 1.24 | 0.12 | 79 | 3.45 | 0.35 |
| 32 | 1.03 | 0.10 | 80 | 1.02 | 0.10 |
| 33 | 3.82 | 0.39 | 83 | 1.13 | 0.11 |
| 34 | 2.28 | 0.23 | 84 | 1.02 | 0.10 |
| 35 | 2.07 | 0.21 | 85 | 2.53 | 0.26 |
| 37 | 0.87 | 0.09 | 86 | 4.84 | 0.49 |
| 39 | 5.04 | 0.51 | 87 | 2.20 | 0.22 |
| 40 | 6.84 | 0.69 | 88 | 1.37 | 0.14 |
| 42 | 1.53 | 0.15 | 89 | 2.58 | 0.26 |
| 43 | 1.15 | 0.12 | 90 | 3.73 | 0.38 |
| 45 | 1.10 | 0.11 | 91 | 1.28 | 0.13 |
| 47 | 3.08 | 0.31 | 92 | 2.57 | 0.26 |
| 49 | 1.96 | 0.20 | 93 | 3.12 | 0.32 |
| 51 | 1.36 | 0.14 | 94 | 3.75 | 0.38 |
| 52 | 1.84 | 0.19 | 95 | 3.45 | 0.35 |
| 53 | 1.44 | 0.15 | 96 | 2.95 | 0.30 |

Supplementary Table S1 (continued)

| Pop3 (HPL 24 × ICP 11605) | | | | | |
|---------------------------|---------------------|-----------|-----------|---------------------|-----------|
| Sample ID | No. reads (Million) | Data (Gb) | Sample ID | No. reads (Million) | Data (Gb) |
| 97 | 4.42 | 0.45 | 140 | 1.52 | 0.15 |
| 98 | 4.99 | 0.50 | 141 | 0.80 | 0.08 |
| 99 | 1.13 | 0.11 | 142 | 1.54 | 0.16 |
| 100 | 1.80 | 0.18 | 144 | 3.40 | 0.34 |
| 101 | 2.75 | 0.28 | 145 | 1.73 | 0.18 |
| 102 | 2.62 | 0.26 | 146 | 1.74 | 0.18 |
| 103 | 2.42 | 0.24 | 147 | 1.17 | 0.12 |
| 104 | 2.61 | 0.26 | 148 | 1.23 | 0.12 |
| 105 | 3.13 | 0.32 | 149 | 3.12 | 0.32 |
| 106 | 1.79 | 0.18 | 150 | 2.04 | 0.21 |
| 107 | 3.14 | 0.32 | 151 | 1.80 | 0.18 |
| 108 | 1.79 | 0.18 | 152 | 1.64 | 0.17 |
| 109 | 1.26 | 0.13 | 153 | 2.17 | 0.22 |
| 110 | 2.40 | 0.24 | 154 | 2.52 | 0.25 |
| 111 | 3.17 | 0.32 | 155 | 2.47 | 0.25 |
| 112 | 3.18 | 0.32 | 156 | 3.05 | 0.31 |
| 113 | 1.33 | 0.13 | 157 | 2.47 | 0.25 |
| 114 | 1.87 | 0.19 | 158 | 1.80 | 0.18 |
| 115 | 1.26 | 0.13 | 159 | 2.64 | 0.27 |
| 117 | 1.44 | 0.15 | 160 | 1.86 | 0.19 |
| 119 | 1.83 | 0.18 | 161 | 2.01 | 0.20 |
| 122 | 2.25 | 0.23 | 162 | 3.07 | 0.31 |
| 124 | 1.85 | 0.19 | 163 | 3.07 | 0.31 |
| 125 | 0.89 | 0.09 | 164 | 2.34 | 0.24 |
| 126 | 1.64 | 0.17 | 165 | 2.79 | 0.28 |
| 127 | 2.02 | 0.20 | 166 | 2.56 | 0.26 |
| 128 | 2.21 | 0.22 | 167 | 4.54 | 0.46 |
| 129 | 1.08 | 0.11 | 168 | 2.01 | 0.20 |
| 130 | 1.33 | 0.13 | 169 | 2.65 | 0.27 |
| 131 | 1.26 | 0.13 | 170 | 2.63 | 0.27 |
| 132 | 2.06 | 0.21 | 171 | 1.91 | 0.19 |
| 133 | 1.42 | 0.14 | 172 | 1.96 | 0.20 |
| 134 | 2.72 | 0.27 | 173 | 2.52 | 0.25 |
| 135 | 1.80 | 0.18 | 174 | 3.71 | 0.37 |
| 136 | 2.19 | 0.22 | 175 | 2.68 | 0.27 |
| 137 | 1.63 | 0.16 | 176 | 3.38 | 0.34 |
| 138 | 2.54 | 0.26 | 177 | 2.20 | 0.22 |
| 139 | 1.75 | 0.18 | 178 | 2.45 | 0.25 |

Supplementary Table S1 (continued)

| Pop3 (HPL 24 × ICP 11605) | | |
|---------------------------|---------------------|-----------|
| Sample ID | No. reads (Million) | Data (Gb) |
| 179 | 1.01 | 0.10 |
| 180 | 1.35 | 0.14 |
| 181 | 2.49 | 0.25 |
| 182 | 1.70 | 0.17 |
| 183 | 1.33 | 0.13 |
| 185 | 0.96 | 0.10 |
| 186 | 1.29 | 0.13 |
| 187 | 0.97 | 0.10 |
| 188 | 3.10 | 0.31 |
| F ₂ total | 335.52 | 33.89 |
| F ₂ average | 2.14 | 0.22 |

| Pop4 (ICP 8863 × ICPL 87119) | | | | | |
|--|---------------------|-----------|-----------|---------------------|-----------|
| Sample ID | No. reads (Million) | Data (Gb) | Sample ID | No. reads (Million) | Data (Gb) |
| Parents | | | 26 | 2.21 | 0.22 |
| ICP 8863 | 2.56 | 0.26 | 27 | 1.13 | 0.11 |
| ICPL 87119 (Reference genome sequence) | | | 28 | 1.34 | 0.14 |
| F ₂ | | | 29 | 0.84 | 0.08 |
| 1 | 6.45 | 0.65 | 30 | 1.08 | 0.11 |
| 3 | 2.71 | 0.27 | 31 | 0.84 | 0.08 |
| 4 | 6.48 | 0.65 | 32 | 1.58 | 0.16 |
| 7 | 1.17 | 0.12 | 33 | 1.14 | 0.11 |
| 8 | 1.66 | 0.17 | 35 | 1.83 | 0.18 |
| 9 | 1.75 | 0.18 | 36 | 1.40 | 0.14 |
| 11 | 1.07 | 0.11 | 37 | 1.14 | 0.12 |
| 12 | 1.31 | 0.13 | 38 | 1.47 | 0.15 |
| 13 | 3.33 | 0.34 | 41 | 2.20 | 0.22 |
| 14 | 1.10 | 0.11 | 45 | 0.94 | 0.10 |
| 15 | 0.89 | 0.09 | 47 | 1.69 | 0.17 |
| 16 | 1.20 | 0.12 | 53 | 1.67 | 0.17 |
| 18 | 1.00 | 0.10 | 54 | 1.02 | 0.10 |
| 19 | 1.73 | 0.18 | 55 | 1.01 | 0.10 |
| 20 | 1.94 | 0.20 | 56 | 2.10 | 0.21 |
| 22 | 1.52 | 0.15 | 57 | 1.50 | 0.15 |
| 24 | 1.76 | 0.18 | 58 | 2.14 | 0.22 |
| 25 | 1.38 | 0.14 | 60 | 0.97 | 0.10 |

Supplementary Table S1 (continued)

| Pop4 (ICP 8863 × ICPL 87119) | | | | | |
|------------------------------|---------------------|-----------|-----------|---------------------|-----------|
| Sample ID | No. reads (Million) | Data (Gb) | Sample ID | No. reads (Million) | Data (Gb) |
| 61 | 1.03 | 0.10 | 120 | 1.58 | 0.16 |
| 62 | 2.04 | 0.21 | 122 | 1.35 | 0.14 |
| 63 | 1.19 | 0.12 | 123 | 6.32 | 0.64 |
| 64 | 3.29 | 0.33 | 124 | 1.35 | 0.14 |
| 65 | 1.14 | 0.12 | 125 | 7.65 | 0.77 |
| 66 | 1.23 | 0.12 | 126 | 1.53 | 0.15 |
| 68 | 1.01 | 0.10 | 127 | 0.85 | 0.09 |
| 69 | 1.42 | 0.14 | 128 | 1.27 | 0.13 |
| 70 | 0.97 | 0.10 | 130 | 1.35 | 0.14 |
| 71 | 1.59 | 0.16 | 131 | 1.64 | 0.17 |
| 72 | 4.24 | 0.43 | 132 | 1.68 | 0.17 |
| 73 | 2.51 | 0.25 | 136 | 1.04 | 0.11 |
| 74 | 0.97 | 0.10 | 137 | 1.03 | 0.10 |
| 75 | 1.31 | 0.13 | 141 | 1.16 | 0.12 |
| 76 | 1.06 | 0.11 | 142 | 0.89 | 0.09 |
| 77 | 1.10 | 0.11 | 145 | 0.91 | 0.09 |
| 78 | 1.54 | 0.16 | 146 | 0.98 | 0.10 |
| 80 | 1.80 | 0.18 | 147 | 1.22 | 0.12 |
| 81 | 0.88 | 0.09 | 148 | 1.21 | 0.12 |
| 82 | 1.10 | 0.11 | 149 | 2.36 | 0.24 |
| 83 | 0.93 | 0.09 | 150 | 1.71 | 0.17 |
| 84 | 0.91 | 0.09 | 151 | 1.07 | 0.11 |
| 87 | 1.73 | 0.17 | 152 | 5.88 | 0.59 |
| 88 | 2.19 | 0.22 | 153 | 1.33 | 0.13 |
| 92 | 1.07 | 0.11 | 154 | 4.05 | 0.41 |
| 93 | 2.36 | 0.24 | 155 | 2.09 | 0.21 |
| 94 | 1.20 | 0.12 | 157 | 2.74 | 0.28 |
| 101 | 1.21 | 0.12 | 158 | 2.06 | 0.21 |
| 102 | 2.58 | 0.26 | 159 | 7.21 | 0.73 |
| 103 | 2.18 | 0.22 | 162 | 2.14 | 0.22 |
| 105 | 1.12 | 0.11 | 163 | 0.94 | 0.10 |
| 106 | 2.60 | 0.26 | 165 | 1.34 | 0.14 |
| 108 | 1.75 | 0.18 | 166 | 0.92 | 0.09 |
| 109 | 1.46 | 0.15 | 167 | 1.86 | 0.19 |
| 110 | 1.66 | 0.17 | 168 | 0.87 | 0.09 |
| 112 | 0.88 | 0.09 | 171 | 1.59 | 0.16 |
| 117 | 2.41 | 0.24 | 172 | 1.46 | 0.15 |
| 118 | 1.57 | 0.16 | 173 | 1.25 | 0.13 |

Supplementary Table S1 (continued)

| Pop4 (ICP 8863 × ICPL 87119) | | |
|------------------------------|---------------------|-----------|
| Sample ID | No. reads (Million) | Data (Gb) |
| 174 | 5.19 | 0.52 |
| 175 | 6.33 | 0.64 |
| 177 | 3.70 | 0.37 |
| 178 | 1.33 | 0.13 |
| 179 | 3.85 | 0.39 |
| 181 | 3.23 | 0.33 |
| 182 | 0.96 | 0.10 |
| 184 | 0.88 | 0.09 |
| 187 | 1.03 | 0.10 |
| 218 | 3.19 | 0.32 |
| 220 | 8.19 | 0.83 |
| 221 | 1.59 | 0.16 |
| 222 | 5.33 | 0.54 |
| 223 | 2.62 | 0.26 |
| 224 | 4.22 | 0.43 |
| 225 | 3.42 | 0.35 |
| 226 | 2.11 | 0.21 |
| 227 | 3.82 | 0.39 |
| 229 | 5.47 | 0.55 |
| 231 | 2.81 | 0.28 |
| 232 | 4.18 | 0.42 |
| F ₂ total | 284.77 | 28.76 |
| F ₂ average | 2.06 | 0.21 |

Supplementary Table S1 (continued)

| Pop5 (ICP 5529 × ICP 11605) | | | | | |
|-----------------------------|---------------------|-----------|-----------|---------------------|-----------|
| Sample ID | No. reads (Million) | Data (Gb) | Sample ID | No. reads (Million) | Data (Gb) |
| Parents | | | 37 | 1.29 | 0.13 |
| ICP 5529 | 5.37 | 0.54 | 38 | 0.64 | 0.06 |
| ICP 11605 | 1.61 | 0.16 | 39 | 1.09 | 0.11 |
| F ₂ | | | 40 | 1.28 | 0.13 |
| 2 | 2.25 | 0.23 | 41 | 2.43 | 0.25 |
| 3 | 0.97 | 0.10 | 42 | 0.89 | 0.09 |
| 4 | 1.82 | 0.18 | 43 | 2.19 | 0.22 |
| 6 | 3.40 | 0.34 | 44 | 0.91 | 0.09 |
| 7 | 1.91 | 0.19 | 45 | 0.86 | 0.09 |
| 8 | 5.26 | 0.53 | 46 | 0.96 | 0.10 |
| 9 | 2.57 | 0.26 | 48 | 2.22 | 0.22 |
| 10 | 1.00 | 0.10 | 49 | 2.66 | 0.27 |
| 12 | 1.43 | 0.14 | 50 | 2.02 | 0.20 |
| 13 | 1.14 | 0.12 | 52 | 0.71 | 0.07 |
| 14 | 1.97 | 0.20 | 53 | 0.96 | 0.10 |
| 15 | 0.62 | 0.06 | 54 | 0.64 | 0.06 |
| 16 | 1.00 | 0.10 | 55 | 0.80 | 0.08 |
| 17 | 1.33 | 0.13 | 56 | 0.99 | 0.10 |
| 18 | 0.77 | 0.08 | 57 | 3.05 | 0.31 |
| 19 | 2.59 | 0.26 | 58 | 1.30 | 0.13 |
| 20 | 0.87 | 0.09 | 59 | 2.02 | 0.20 |
| 21 | 0.68 | 0.07 | 60 | 2.04 | 0.21 |
| 22 | 1.02 | 0.10 | 61 | 1.92 | 0.19 |
| 23 | 4.11 | 0.41 | 62 | 1.73 | 0.17 |
| 24 | 1.82 | 0.18 | 63 | 1.05 | 0.11 |
| 25 | 1.98 | 0.20 | 64 | 1.26 | 0.13 |
| 26 | 1.22 | 0.12 | 65 | 3.57 | 0.36 |
| 27 | 0.96 | 0.10 | 66 | 2.52 | 0.25 |
| 28 | 2.82 | 0.28 | 67 | 4.01 | 0.41 |
| 29 | 0.67 | 0.07 | 68 | 1.46 | 0.15 |
| 30 | 1.15 | 0.12 | 69 | 2.18 | 0.22 |
| 31 | 1.26 | 0.13 | 70 | 2.20 | 0.22 |
| 32 | 0.72 | 0.07 | 71 | 1.19 | 0.12 |
| 33 | 0.89 | 0.09 | 72 | 1.83 | 0.18 |
| 35 | 1.94 | 0.20 | 73 | 2.04 | 0.21 |
| 36 | 1.58 | 0.16 | 74 | 2.26 | 0.23 |

Supplementary Table S1 (continued)

| Pop5 (ICP 5529 × ICP 11605) | | | | | |
|-----------------------------|---------------------|-----------|-----------|---------------------|-----------|
| Sample ID | No. reads (Million) | Data (Gb) | Sample ID | No. reads (Million) | Data (Gb) |
| 75 | 2.70 | 0.27 | 114 | 2.52 | 0.25 |
| 76 | 1.91 | 0.19 | 115 | 1.17 | 0.12 |
| 77 | 3.47 | 0.35 | 116 | 0.64 | 0.07 |
| 78 | 1.89 | 0.19 | 117 | 1.68 | 0.17 |
| 79 | 2.06 | 0.21 | 118 | 0.51 | 0.05 |
| 80 | 2.14 | 0.22 | 119 | 0.91 | 0.09 |
| 81 | 4.08 | 0.41 | 120 | 1.13 | 0.11 |
| 82 | 1.43 | 0.14 | 121 | 1.56 | 0.16 |
| 83 | 2.48 | 0.25 | 122 | 1.62 | 0.16 |
| 84 | 3.11 | 0.31 | 123 | 1.21 | 0.12 |
| 85 | 0.92 | 0.09 | 124 | 1.91 | 0.19 |
| 86 | 1.64 | 0.17 | 125 | 0.96 | 0.10 |
| 87 | 1.89 | 0.19 | 126 | 0.52 | 0.05 |
| 89 | 1.24 | 0.12 | 127 | 2.93 | 0.30 |
| 90 | 1.22 | 0.12 | 128 | 1.06 | 0.11 |
| 91 | 1.37 | 0.14 | 129 | 0.91 | 0.09 |
| 92 | 1.18 | 0.12 | 130 | 2.32 | 0.23 |
| 93 | 2.90 | 0.29 | 131 | 1.33 | 0.13 |
| 94 | 1.92 | 0.19 | 132 | 1.32 | 0.13 |
| 95 | 1.31 | 0.13 | 133 | 1.00 | 0.10 |
| 96 | 1.23 | 0.12 | 134 | 0.59 | 0.06 |
| 97 | 1.91 | 0.19 | 135 | 1.16 | 0.12 |
| 98 | 1.39 | 0.14 | 136 | 1.43 | 0.14 |
| 99 | 0.64 | 0.06 | 137 | 2.05 | 0.21 |
| 100 | 1.06 | 0.11 | 138 | 2.05 | 0.21 |
| 101 | 0.58 | 0.06 | 139 | 1.53 | 0.15 |
| 102 | 0.76 | 0.08 | 140 | 1.23 | 0.12 |
| 103 | 0.74 | 0.07 | 142 | 0.66 | 0.07 |
| 104 | 0.70 | 0.07 | 143 | 1.29 | 0.13 |
| 105 | 1.89 | 0.19 | 144 | 0.89 | 0.09 |
| 106 | 1.04 | 0.11 | 145 | 0.80 | 0.08 |
| 107 | 0.79 | 0.08 | 146 | 1.65 | 0.17 |
| 108 | 0.47 | 0.05 | 147 | 1.26 | 0.13 |
| 109 | 0.41 | 0.04 | 148 | 1.12 | 0.11 |
| 111 | 0.83 | 0.08 | 149 | 0.74 | 0.07 |
| 112 | 1.44 | 0.15 | 150 | 1.70 | 0.17 |
| 113 | 1.61 | 0.16 | 151 | 1.99 | 0.20 |

Supplementary Table S1 (continued)

| Pop5 (ICP 5529 × ICP 11605) | | |
|-----------------------------|---------------------|-----------|
| Sample ID | No. reads (Million) | Data (Gb) |
| 152 | 1.56 | 0.16 |
| 153 | 1.87 | 0.19 |
| 154 | 2.18 | 0.22 |
| 155 | 2.81 | 0.28 |
| 156 | 1.90 | 0.19 |
| 157 | 2.28 | 0.23 |
| 158 | 2.73 | 0.28 |
| 159 | 1.27 | 0.13 |
| 160 | 2.25 | 0.23 |
| 161 | 2.04 | 0.21 |
| 162 | 1.38 | 0.14 |
| 163 | 3.36 | 0.34 |
| 164 | 1.86 | 0.19 |
| 165 | 3.77 | 0.38 |
| 166 | 2.36 | 0.24 |
| 167 | 3.08 | 0.31 |
| 168 | 2.32 | 0.23 |
| 169 | 1.55 | 0.16 |
| 170 | 1.98 | 0.20 |
| 171 | 1.83 | 0.19 |
| 172 | 2.36 | 0.24 |
| 173 | 2.96 | 0.30 |
| 174 | 1.53 | 0.15 |
| 175 | 3.02 | 0.31 |
| 176 | 1.95 | 0.20 |
| 177 | 1.63 | 0.16 |
| 178 | 2.35 | 0.24 |
| 179 | 2.11 | 0.21 |
| 180 | 2.65 | 0.27 |
| 181 | 2.13 | 0.22 |
| 182 | 0.69 | 0.07 |
| 183 | 2.16 | 0.22 |
| 184 | 0.62 | 0.06 |
| 185 | 0.92 | 0.09 |
| 186 | 0.61 | 0.06 |
| 187 | 1.96 | 0.20 |
| 188 | 1.94 | 0.20 |
| F ₂ total | 298.56 | 30.15 |
| F ₂ average | 1.67 | 0.17 |

Supplementary Table S2. Main effect QTLs for seed protein content and agronomic traits identified using composite interval mapping (CIM) and inclusive composite interval mapping (ICIM) in five pigeonpea F₂ mapping populations

| QTL name | Position | Flanking markers | QTL interval | LOD | PVE (%) | <i>a</i> | <i>d</i> | <i>d/ a </i> | Gene action |
|-------------------------------------|----------|-----------------------------|--------------|-----|---------|----------|----------|--------------|--------------------|
| Pop1 (ICP 11605 × ICP 14209) | | | | | | | | | |
| Seed protein content | | | | | | | | | |
| <i>qPROT-cim-3.1</i> | 81.4 | S3_12113347 - S3_21274904 | 1.7 | 2.8 | 7.8 | 0.4 | -0.2 | -0.50 | recessive |
| <i>qPROT-cim-3.2</i> | 89.7 | S3_23699007 - S3_18226407 | 2.6 | 2.6 | 10.3 | -0.5 | 0.4 | 0.80 | dominant |
| <i>qPROT-icim-3.1</i> | 99.0 | S3_25565937 - S3_16199983 | 0.4 | 2.7 | 8.6 | -0.5 | 0.4 | 0.80 | dominant |
| <i>qPROT-cim-4.1</i> | 32.5 | S4_1586438 - S4_5314034 | 5.1 | 2.9 | 9.0 | -0.3 | 0.5 | 1.67 | over-dominant |
| <i>qPROT-cim-11.1</i> | 43.0 | S11_11249294 - S11_9768899 | 2.5 | 3.5 | 16.6 | -0.6 | 0.5 | 0.83 | dominant |
| <i>qPROT-cim-11.2</i> | 170.1 | S11_20646423 - S11_24857528 | 1.4 | 3.8 | 13.8 | -0.5 | 0.3 | 0.60 | partially dominant |
| 100-seed weight | | | | | | | | | |
| <i>qSW-icim-1.1</i> | 15.0 | S1_4374250 - S1_4757283 | 4.8 | 3.0 | 6.6 | -0.3 | 0.4 | 1.57 | over dominant |
| <i>qSW-icim-4.1</i> | 74.0 | S4_4734626 - S4_9854357 | 19.4 | 3.9 | 7.4 | -0.3 | -0.4 | -1.49 | recessive |
| <i>qSW-cim-6.1</i> | 16.7 | S6_14311667 - S6_14311546 | 4.1 | 3.0 | 4.7 | -0.3 | -0.2 | -0.47 | recessive |
| <i>qSW-cim-8.1</i> | 1.0 | S8_5787667 - S8_11399561 | 15.5 | 2.6 | 10.6 | 0.4 | -0.3 | -0.92 | recessive |
| <i>qSW-cim-8.2</i> | 100.3 | S8_13310192 - S8_4675310 | 2.1 | 4.3 | 12.3 | 0.4 | -0.3 | -0.82 | recessive |
| <i>qSW-icim-8.1</i> | 91.0 | S8_7083582 - S8_6388803 | 1.6 | 6.8 | 15.0 | 0.5 | -0.1 | -0.25 | recessive |
| <i>qSW-icim-10.1</i> | 60.0 | S10_1984771 - S10_1397376 | 2.5 | 2.9 | 6.4 | 0.1 | 0.6 | 5.27 | over dominant |
| <i>qSW-cim-11.1</i> | 102.3 | S11_23359277 - S11_10698003 | 0.2 | 2.6 | 3.6 | -0.4 | -0.2 | -0.40 | recessive |
| Seed yield | | | | | | | | | |
| <i>qSY-cim-3.1</i> | 130.0 | S3_14273504 - S3_24137311 | 1.4 | 2.6 | 6.1 | -0.8 | 22.0 | 27.21 | over dominant |
| <i>qSY-cim-3.2</i> | 135.6 | S3_8561649 - S3_8569720 | 5.2 | 3.0 | 5.2 | -12.2 | -3.7 | -0.30 | recessive |
| <i>qSY-icim-3.1</i> | 135.0 | S3_8561649 - S3_8569720 | 5.2 | 4.5 | 10.2 | -14.5 | -4.6 | -0.32 | recessive |
| <i>qSY-cim-5.1</i> | 14.2 | S5_4692888 - S5_4692888 | 0.0 | 2.5 | 5.6 | 1.0 | -16.3 | -16.64 | recessive |
| <i>qSY-cim-10.1</i> | 53.5 | S10_4202839 - S10_1984771 | 8.6 | 3.0 | 15.4 | 12.5 | -16.9 | -1.36 | recessive |
| <i>qSY-cim-11.1</i> | 49.2 | S11_46091155 - S11_33138038 | 1.5 | 2.6 | 7.5 | -6.4 | 18.7 | 2.92 | over dominant |
| <i>qSY-cim-11.2</i> | 152.1 | S11_38654219 - S11_11722207 | 0.7 | 2.8 | 9.6 | -11.2 | 7.3 | 0.65 | partially dominant |
| Growth habit | | | | | | | | | |

| QTL name | Position | Flanking markers | QTL interval | LOD | PVE (%) | <i>a</i> | <i>d</i> | <i>d</i> / <i> a </i> | Gene action |
|------------------------------------|----------|-----------------------------|--------------|------|---------|----------|----------|-----------------------|--------------------|
| <i>qGH-cim-3.1</i> | 56.2 | S3_28498782 - S3_21310513 | 2.7 | 3.2 | 10.9 | 0.15 | -0.08 | -0.53 | recessive |
| <i>qGH-cim-3.2</i> | 65.6 | S3_17441541 - S3_21244595 | 1.6 | 13.9 | 91.3 | 0.32 | -0.30 | -0.95 | recessive |
| <i>qGH-icim-3.1</i> | 66.0 | S3_17441541 - S3_21244595 | 1.6 | 17.3 | 41.3 | 0.32 | -0.29 | -0.91 | recessive |
| <i>qGH-cim-3.3</i> | 78.5 | S3_14813065 - S3_14778845 | 4.2 | 4.1 | 12.9 | 0.13 | -0.13 | -0.97 | recessive |
| <i>qGH-icim-3.2</i> | 79.0 | S3_14778845 - S3_14778845 | 1.0 | 2.9 | 8.6 | 0.11 | -0.18 | -1.65 | recessive |
| <i>qGH-icim-11.1</i> | 183.0 | S11_24857409 - S11_47336921 | 1.2 | 3.2 | 6.1 | -0.11 | 0.05 | 0.46 | partially dominant |
| Days to first flowering | | | | | | | | | |
| <i>qDFF-cim-3.1</i> | 56.2 | S3_28498782 - S3_21310513 | 2.7 | 5.4 | 14.5 | -6.0 | 0.6 | 0.10 | additive |
| <i>qDFF-cim-3.2</i> | 66.3 | S3_21244595 - S3_28538775 | 2.4 | 9.5 | 20.3 | -8.4 | 0.5 | 0.06 | additive |
| <i>qDFF-icim-3.1</i> | 67.0 | S3_21244595 - S3_28538775 | 2.4 | 11.1 | 25.4 | -9.4 | 2.8 | 0.30 | partially dominant |
| <i>qDFF-cim-3.3</i> | 75.5 | S3_14813065 - S3_14778845 | 4.2 | 3.1 | 7.4 | -4.4 | -0.3 | -0.06 | recessive |
| <i>qDFF-cim-3.4</i> | 91.0 | S3_18226407 - S3_5582712 | 0.8 | 2.9 | 5.7 | 4.3 | -0.4 | -0.09 | recessive |
| <i>qDFF-cim-11.1</i> | 124.2 | S11_39257442 - S11_29670540 | 0.9 | 2.5 | 6.5 | -2.3 | 5.7 | 2.44 | over dominant |
| <i>qDFF-cim-11.2</i> | 137.2 | S11_28741859 - S11_20235498 | 0.9 | 2.9 | 7.2 | 4.0 | -1.7 | -0.43 | recessive |
| Pop2 (ICP 8863 x ICP 11605) | | | | | | | | | |
| Seed protein content | | | | | | | | | |
| <i>qPROT-cim-1.1</i> | 20.2 | S1_15372966 - S1_5944791 | 1.1 | 2.6 | 7.7 | 0.4 | -0.3 | -0.75 | recessive |
| <i>qPROT-icim-3.1</i> | 2.0 | S3_22234078 - S3_19578263 | 2.2 | 2.7 | 6.9 | 0.3 | -0.5 | -1.67 | recessive |
| <i>qPROT-cim-3.1</i> | 55.9 | S3_17193829 - S3_14758073 | 11.8 | 3.8 | 12.8 | 0.7 | -0.3 | -0.43 | recessive |
| <i>qPROT-icim-3.2</i> | 56.0 | S3_17193829 - S3_14758073 | 11.8 | 2.9 | 7.4 | 0.6 | -0.3 | -0.50 | recessive |
| <i>qPROT-cim-9.1</i> | 67.4 | S9_10003418 - S9_10229309 | 1.4 | 3.6 | 5.7 | 0.1 | -0.8 | -8.00 | recessive |
| <i>qPROT-icim-11.1</i> | 46.0 | S11_2019429 - S11_22353396 | 2.0 | 2.7 | 12.3 | -0.7 | 0.5 | 0.71 | partially dominant |
| <i>qPROT-icim-11.2</i> | 126.0 | S11_21940736 - S11_30337876 | 1.0 | 2.9 | 9.4 | 0.6 | 0.4 | 0.67 | partially dominant |
| <i>qPROT-cim-11.1</i> | 126.1 | S11_30337876 - S11_45761666 | 1.6 | 3.4 | 0.7 | 0.4 | 0.5 | 1.25 | over-dominant |
| 100-seed weight | | | | | | | | | |
| <i>qSW-cim-1.1</i> | 7.4 | S1_4759267 - S1_15329865 | 4.6 | 4.6 | 6.1 | 0.6 | 0.2 | 0.36 | partially dominant |
| <i>qSW-cim-1.2</i> | 22.2 | S1_5944791 - S1_9033631 | 9.9 | 3.4 | 7.5 | 0.7 | 0.2 | 0.26 | partially dominant |
| <i>qSW-icim-1.1</i> | 22.0 | S1_5944791 - S1_9033631 | 9.9 | 9.9 | 29.1 | 1.0 | 0.2 | 0.20 | additive |

| QTL name | Position | Flanking markers | QTL interval | LOD | PVE (%) | <i>a</i> | <i>d</i> | <i>d</i> / <i> a</i> | Gene action |
|-------------------------|----------|-----------------------------|--------------|------|---------|----------|----------|----------------------|--------------------|
| qSW-icim-11.1 | 165.0 | S11_41096347 - S11_44938548 | 1.3 | 2.7 | 8.4 | 0.5 | -0.5 | -0.91 | recessive |
| Seed yield | | | | | | | | | |
| qSY-cim-1.1 | 9.4 | S1_4759267 - S1_15329865 | 4.6 | 2.9 | 7.1 | -14.0 | -5.0 | -0.36 | recessive |
| qSY-icim-1.1 | 36.0 | S1_12899653 - S1_11050274 | 3.2 | 4.8 | 9.8 | -11.3 | -7.0 | -0.62 | recessive |
| qSY-icim-2.1 | 171.0 | S2_13394818 - S2_26969919 | 2.3 | 3.5 | 7.3 | 2.2 | 14.8 | 6.77 | over dominant |
| qSY-icim-3.1 | 2.0 | S3_22234078 - S3_19578263 | 2.2 | 8.0 | 16.0 | -1.6 | 21.1 | 13.50 | over dominant |
| qSY-cim-3.1 | 3.2 | S3_19578263 - S3_21274904 | 3.8 | 5.3 | 11.8 | -2.0 | 21.0 | 10.56 | over dominant |
| qSY-icim-6.1 | 69.0 | S6_18322776 - S6_18322873 | 3.1 | 5.7 | 9.4 | -10.4 | 2.1 | 0.20 | additive |
| qSY-icim-7.1 | 71.0 | S7_6897487 - S7_14683829 | 11.5 | 3.6 | 5.9 | 9.2 | 3.3 | 0.36 | partially dominant |
| qSY-cim-11.1 | 28.8 | S11_9114357 - S11_4453854 | 5.2 | 3.0 | 10.6 | 9.8 | -22.6 | -2.30 | recessive |
| qSY-icim-11.1 | 31.0 | S11_9114357 - S11_4453854 | 5.2 | 4.6 | 11.3 | 4.6 | -18.5 | -4.00 | recessive |
| qSY-cim-11.2 | 125.1 | S11_21940736 - S11_30337876 | 1.0 | 4.1 | 1.7 | -9.2 | -10.2 | -1.11 | recessive |
| Growth habit | | | | | | | | | |
| qGH-cim-2.1 | 139.1 | S2_32727778 - S2_13394806 | 0.6 | 2.7 | 4.0 | -0.1 | 0.0 | -0.05 | recessive |
| qGH-cim-3.1 | 2.0 | S3_22234078 - S3_19578263 | 2.2 | 4.9 | 13.1 | 0.1 | -0.2 | -1.23 | recessive |
| qGH-cim-3.2 | 9.0 | S3_21274904 - S3_28538775 | 6.6 | 8.2 | 37.0 | 0.2 | -0.4 | -1.66 | recessive |
| qGH-icim-3.1 | 20.0 | S3_28933239 - S3_21244595 | 6.8 | 12.4 | 23.9 | 0.2 | -0.3 | -1.31 | recessive |
| qGH-cim-3.3 | 22.7 | S3_21244595 - S3_18933167 | 7.6 | 14.0 | 36.6 | 0.2 | -0.3 | -1.28 | recessive |
| qGH-icim-3.2 | 43.0 | S3_18929445 - S3_18929378 | 5.1 | 15.0 | 25.4 | 0.2 | -0.2 | -0.96 | recessive |
| qGH-cim-3.4 | 51.4 | S3_18929378 - S3_17193829 | 8.5 | 9.8 | 64.7 | 0.2 | -0.4 | -1.65 | recessive |
| Days to first flowering | | | | | | | | | |
| qDFF-icim-2.1 | 174.0 | S2_6037470 - S2_6037490 | 0.6 | 2.6 | 4.5 | 4.3 | -4.0 | -0.91 | recessive |
| qDFF-cim-3.1 | 1.0 | S3_22234078 - S3_19578263 | 2.2 | 4.0 | 16.0 | -3.9 | 5.6 | 1.44 | over dominant |
| qDFF-cim-3.2 | 25.7 | S3_21244595 - S3_18933167 | 7.6 | 6.2 | 19.1 | -5.5 | 2.4 | 0.44 | partially dominant |
| qDFF-cim-3.3 | 41.3 | S3_18929445 - S3_18929378 | 5.1 | 9.9 | 28.2 | -6.5 | 3.6 | 0.56 | partially dominant |
| qDFF-icim-3.1 | 42.0 | S3_18929445 - S3_18929378 | 5.1 | 11.7 | 26.6 | -7.8 | 1.5 | 0.19 | additive |
| qDFF-cim-11.1 | 56.3 | S11_42065843 - S11_26230931 | 2.3 | 2.9 | 4.0 | -4.4 | -3.2 | -0.74 | recessive |
| qDFF-cim-11.2 | 128.3 | S11_45761666 - S11_18137395 | 0.6 | 3.0 | 8.1 | 2.9 | -3.6 | -1.23 | recessive |

| QTL name | Position | Flanking markers | QTL interval | LOD | PVE (%) | <i>a</i> | <i>d</i> | <i>d/ a </i> | Gene action |
|----------------------------------|----------|-----------------------------|--------------|------|---------|----------|----------|--------------|--------------------|
| qDFF-cim-11.3 | 136.2 | S11_26422066 - S11_32080647 | 2.2 | 3.4 | 36.3 | 5.9 | -6.2 | -1.06 | recessive |
| qDFF-icim-11.1 | 137.0 | S11_26422066 - S11_32080647 | 2.2 | 3.1 | 7.9 | 2.9 | -5.7 | -1.98 | recessive |
| Pop3 (HPL 24 x ICP 11605) | | | | | | | | | |
| Seed protein content | | | | | | | | | |
| <i>qPROT-icim-2.1</i> | 20.0 | S2_17395609 - S2_17836619 | 5.7 | 3.7 | 7.9 | 0.6 | -0.1 | -0.17 | recessive |
| <i>qPROT-cim-2.1</i> | 28.6 | S2_18621223 - S2_5077845 | 4.1 | 4.1 | 23.5 | 0.9 | -0.6 | -0.67 | recessive |
| <i>qPROT-icim-2.2</i> | 67.0 | S2_17642300 - S2_27324059 | 1.6 | 3.4 | 10.0 | 0.8 | 0.0 | 0.00 | additive |
| <i>qPROT-cim-2.2</i> | 67.5 | S2_27324059 - S2_27324056 | 0.1 | 3.1 | 6.0 | 0.6 | 0.0 | 0.00 | additive |
| <i>qPROT-icim-3.1</i> | 10.0 | S3_28538775 - S3_21274904 | 10.0 | 3.0 | 5.8 | -0.6 | -0.1 | -0.17 | recessive |
| <i>qPROT-cim-3.1</i> | 40.8 | S3_17145449 - S3_18154873 | 3.4 | 4.4 | 4.1 | -0.6 | -0.5 | -0.83 | recessive |
| <i>qPROT-cim-3.2</i> | 46.7 | S3_18154848 - S3_17193829 | 3.4 | 4.6 | 3.8 | -0.6 | -0.6 | -1.00 | recessive |
| <i>qPROT-cim-3.3</i> | 55.1 | S3_18154875 - S3_14813065 | 4.7 | 3.2 | 5.6 | -0.7 | -0.2 | -0.29 | recessive |
| <i>qPROT-icim-3.2</i> | 102.0 | S3_6531705 - S3_24127268 | 1.8 | 2.5 | 6.7 | -0.4 | -0.6 | -1.50 | recessive |
| <i>qPROT-icim-6.1</i> | 75.0 | S6_14548839 - S6_6094182 | 7.0 | 3.8 | 9.2 | 0.6 | -0.5 | -0.83 | recessive |
| <i>qPROT-icim-10.1</i> | 21.0 | S10_6745618 - S10_18754549 | 20.7 | 2.8 | 5.1 | -0.2 | -0.7 | -3.50 | recessive |
| <i>qPROT-cim-11.1</i> | 82.6 | S11_17781645 - S11_39391791 | 0.3 | 3.0 | 7.4 | 0.4 | -0.6 | -1.50 | recessive |
| <i>qPROT-icim-11.1</i> | 119.0 | S11_45315652 - S11_32081128 | 0.7 | 2.7 | 9.5 | 0.7 | 0.7 | 1.00 | dominant |
| <i>qPROT-icim-11.2</i> | 123.0 | S11_7540489 - S11_21960241 | 0.4 | 4.2 | 8.5 | 0.8 | 1.0 | 1.25 | over-dominant |
| 100-seed weight | | | | | | | | | |
| qSW-cim-1.1 | 43.9 | S1_11314974 - S1_4759267 | 1.4 | 9.8 | 44.4 | -0.9 | 0.6 | 0.59 | partially dominant |
| qSW-cim-1.2 | 53.8 | S1_9401795 - S1_5944791 | 1.6 | 13.6 | 46.6 | -1.0 | 0.6 | 0.55 | partially dominant |
| qSW-icim-1.1 | 54.0 | S1_5944791 - S1_5441596 | 0.8 | 13.7 | 35.7 | -1.2 | 0.4 | 0.36 | partially dominant |
| qSW-cim-1.3 | 66.9 | S1_15394802 - S1_6218143 | 4.2 | 4.8 | 10.3 | -0.6 | -0.1 | -0.16 | recessive |
| qSW-cim-5.1 | 3.0 | S5_3437907 - S5_3437906 | 3.2 | 2.5 | 5.4 | -0.4 | 0.1 | 0.27 | partially dominant |
| qSW-icim-8.1 | 6.0 | S8_388862 - S8_648217 | 3.1 | 7.7 | 16.3 | -0.7 | 0.1 | 0.18 | additive |
| qSW-cim-8.1 | 7.0 | S8_388862 - S8_648217 | 3.1 | 7.4 | 16.0 | -0.7 | 0.1 | 0.11 | additive |
| Seed yield | | | | | | | | | |
| qSY-icim-1.1 | 92.0 | S1_12652912 - S1_556023 | 2.2 | 2.8 | 9.1 | -7.8 | -11.4 | -1.46 | recessive |

| QTL name | Position | Flanking markers | QTL interval | LOD | PVE (%) | <i>a</i> | <i>d</i> | <i>d</i> / <i> a</i> | Gene action |
|-------------------------|----------|-----------------------------|--------------|------|---------|----------|----------|----------------------|---------------|
| qSY-icim-2.1 | 106.0 | S2_33896199 - S2_36167974 | 1.1 | 2.5 | 4.5 | 4.1 | -9.2 | -2.27 | recessive |
| qSY-cim-2.1 | 106.0 | S2_33896199 - S2_36167974 | 1.1 | 3.6 | 16.0 | 9.2 | -9.7 | -1.06 | recessive |
| qSY-cim-2.2 | 152.4 | S2_19392910 - S2_6254553 | 6.1 | 3.3 | 14.4 | 6.4 | -13.5 | -2.10 | recessive |
| qSY-cim-2.3 | 210.8 | S2_22210488 - S2_3910532 | 5.1 | 2.7 | 8.9 | -0.8 | -14.7 | -17.30 | recessive |
| qSY-icim-3.1 | 48.0 | S3_18154848 - S3_17193829 | 3.4 | 3.6 | 7.1 | 1.0 | 11.3 | 11.64 | over dominant |
| qSY-icim-3.2 | 117.0 | S3_8766429 - S3_18226407 | 1.0 | 2.7 | 7.7 | 5.7 | -10.6 | -1.87 | recessive |
| qSY-icim-4.1 | 14.0 | S4_3592410 - S4_2761907 | 16.1 | 6.5 | 20.3 | -1.8 | 20.4 | 11.27 | over dominant |
| qSY-cim-4.1 | 16.1 | S4_3592410 - S4_2761907 | 16.1 | 5.4 | 5.9 | -2.3 | 16.7 | 7.18 | over dominant |
| qSY-cim-10.1 | 63.8 | S10_22177883 - S10_12463946 | 4.0 | 3.4 | 40.2 | 5.2 | -22.6 | -4.38 | recessive |
| qSY-cim-11.1 | 68.4 | S11_36998432 - S11_36724203 | 1.2 | 2.6 | 8.6 | 8.2 | -4.0 | -0.49 | recessive |
| qSY-icim-11.1 | 82.0 | S11_10013709 - S11_6081367 | 0.5 | 3.1 | 9.2 | 10.2 | -10.7 | -1.05 | recessive |
| qSY-cim-11.2 | 82.5 | S11_6081367 - S11_45330880 | 0.1 | 3.0 | 11.3 | 6.6 | -7.2 | -1.09 | recessive |
| qSY-cim-11.3 | 128.0 | S11_45580349 - S11_24800852 | 0.6 | 2.5 | 4.8 | -0.2 | -11.3 | -53.08 | recessive |
| Growth habit | | | | | | | | | |
| qGH-cim-3.1 | 14.7 | S3_21274904 - S3_21244595 | 4.7 | 25.3 | 6.4 | -0.4 | -0.4 | -0.96 | recessive |
| qGH-icim-3.1 | 16.0 | S3_21244595 - S3_22913898 | 6.9 | 31.4 | 54.4 | -0.4 | -0.4 | -1.21 | recessive |
| qGH-cim-3.2 | 22.1 | S3_19132565 - S3_25402258 | 0.4 | 20.3 | 6.5 | -0.4 | -0.4 | -1.10 | recessive |
| qGH-icim-3.2 | 37.0 | S3_17628375 - S3_17145449 | 6.3 | 10.8 | 14.3 | -0.2 | -0.1 | -0.64 | recessive |
| qGH-cim-3.3 | 46.7 | S3_18154848 - S3_17193829 | 3.4 | 13.1 | 13.3 | -0.3 | -0.4 | -1.62 | recessive |
| qGH-cim-3.4 | 55.1 | S3_18154875 - S3_14813065 | 4.7 | 7.8 | 5.8 | -0.1 | -0.4 | -3.03 | recessive |
| qGH-icim-4.1 | 0.0 | S4_3592410 - S4_2761907 | 16.1 | 3.6 | 4.1 | 0.0 | 0.2 | 5.34 | over dominant |
| qGH-icim-8.1 | 119.0 | S8_15841326 - S8_14899494 | 3.1 | 3.0 | 4.0 | 0.0 | -0.2 | -6.71 | recessive |
| qGH-cim-9.1 | 21.2 | S9_10003418 - S9_8998000 | 4.7 | 3.0 | 5.2 | 0.1 | -0.2 | -3.22 | recessive |
| Days to first flowering | | | | | | | | | |
| qDFF-icim-2.1 | 90.0 | S2_23123517 - S2_34204720 | 1.1 | 2.9 | 3.4 | -3.8 | -0.7 | -0.19 | recessive |
| qDFF-icim-2.2 | 188.0 | S2_3012518 - S2_36010450 | 8.8 | 2.7 | 4.1 | 1.8 | -5.9 | -3.34 | recessive |
| qDFF-icim-3.1 | 17.0 | S3_21244595 - S3_22913898 | 6.9 | 9.1 | 14.7 | 9.2 | 1.7 | 0.18 | additive |
| qDFF-cim-3.1 | 24.4 | S3_25402258 - S3_18933167 | 3.0 | 16.0 | 13.2 | 13.9 | 12.2 | 0.88 | dominant |

| QTL name | Position | Flanking markers | QTL interval | LOD | PVE (%) | <i>a</i> | <i>d</i> | <i>d</i> / <i> a </i> | Gene action |
|-------------------------------------|----------|-----------------------------|--------------|------|---------|----------|----------|-----------------------|--------------------|
| qDFF-icim-3.2 | 36.0 | S3_17628375 - S3_17145449 | 6.3 | 20.0 | 31.9 | 8.9 | 11.0 | 1.24 | over dominant |
| qDFF-cim-3.2 | 46.7 | S3_18154848 - S3_17193829 | 3.4 | 6.9 | 40.3 | 3.8 | 11.1 | 2.92 | over dominant |
| qDFF-cim-3.3 | 54.1 | S3_18154875 - S3_14813065 | 4.7 | 4.4 | 39.7 | -1.8 | 11.3 | 6.28 | over dominant |
| qDFF-icim-3.3 | 123.0 | S3_8040710 - S3_23698867 | 2.5 | 6.7 | 8.4 | 6.7 | -2.2 | -0.32 | recessive |
| qDFF-icim-11.1 | 22.0 | S11_27958079 - S11_24152343 | 0.2 | 2.6 | 4.8 | 0.6 | 6.7 | 11.71 | over dominant |
| | | | | | | | | | |
| Pop4 (ICP 8863 x ICPL 87119) | | | | | | | | | |
| Seed protein content | | | | | | | | | |
| <i>qPROT-cim-2.1</i> | 41.6 | S2_16460899 - S2_2144739 | 1.3 | 3.0 | 1.7 | 0.3 | 0.5 | 1.67 | overdominant |
| <i>qPROT-icim-2.1</i> | 42.0 | S2_16460899 - S2_2144739 | 1.3 | 2.7 | 8.5 | 0.4 | 0.5 | 1.25 | overdominant |
| <i>qPROT-icim-2.2</i> | 178.0 | S2_9426717 - S2_24073225 | 2.2 | 7.5 | 18.9 | 0.2 | 1.3 | 6.50 | overdominant |
| <i>qPROT-icim-6.1</i> | 83.0 | S6_20608121 - S6_12302413 | 5.3 | 4.3 | 10.6 | 0.1 | -0.8 | -8.00 | recessive |
| <i>qPROT-cim-6.1</i> | 83.8 | S6_12302413 - S6_1292942 | 4.4 | 4.2 | 16.3 | 0.5 | -0.6 | -1.20 | recessive |
| <i>qPROT-cim-6.2</i> | 154.4 | S6_11344426 - S6_1641606 | 7.3 | 3.3 | 8.3 | -0.1 | 0.8 | 8.00 | overdominant |
| <i>qPROT-cim-7.1</i> | 122.7 | S7_462935 - S7_1601723 | 1.6 | 3.3 | 11.3 | -0.2 | 0.9 | 4.50 | overdominant |
| <i>qPROT-cim-8.1</i> | 61.6 | S8_1988786 - S8_19001660 | 1.9 | 2.5 | 6.7 | 0.2 | -0.7 | -3.50 | recessive |
| <i>qPROT-icim-8.1</i> | 70.0 | S8_9578163 - S8_4817489 | 0.9 | 3.8 | 8.2 | -0.1 | 0.7 | 7.00 | overdominant |
| <i>qPROT-cim-10.1</i> | 95.8 | S10_17537652 - S10_632595 | 3.2 | 2.6 | 1.7 | 0.4 | 1.1 | 2.75 | overdominant |
| <i>qPROT-cim-11.1</i> | 2.0 | S11_38211354 - S11_36725317 | 5.4 | 3.0 | 8.1 | -0.2 | 0.9 | 4.50 | overdominant |
| <i>qPROT-cim-11.2</i> | 84.4 | S11_20139207 - S11_25774244 | 0.2 | 4.1 | 9.1 | -0.1 | 0.9 | 9.00 | overdominant |
| <i>qPROT-cim-11.3</i> | 100.4 | S11_24067221 - S11_26654392 | 0.2 | 2.6 | 1.8 | 0.2 | 0.7 | 3.50 | overdominant |
| <i>qPROT-cim-11.4</i> | 137.2 | S11_18198760 - S11_11799702 | 1.0 | 2.7 | 2.0 | 0.5 | 0.3 | 0.60 | partially dominant |
| 100-seed weight | | | | | | | | | |
| qSW-cim-2.1 | 37.7 | S2_28067626 - S2_2334639 | 1.8 | 3.5 | 26.7 | 0.5 | -0.5 | -1.05 | recessive |
| qSW-cim-2.2 | 90.7 | S2_11771536 - S2_10960200 | 0.1 | 2.7 | 10.1 | 0.2 | -0.5 | -2.15 | recessive |
| qSW-cim-2.3 | 118.2 | S2_6037523 - S2_5078598 | 2.4 | 2.8 | 14.3 | 0.3 | -0.6 | -1.90 | recessive |
| qSW-icim-3.1 | 60.0 | S3_7169453 - S3_6422339 | 2.8 | 3.7 | 9.4 | -0.4 | 0.2 | 0.41 | partially dominant |
| qSW-cim-3.1 | 60.8 | S3_6422339 - S3_16299670 | 0.1 | 4.8 | 16.9 | -0.6 | 0.1 | 0.21 | partially dominant |

| QTL name | Position | Flanking markers | QTL interval | LOD | PVE (%) | <i>a</i> | <i>d</i> | <i>d</i> / <i> a</i> | Gene action |
|-------------------------|----------|-----------------------------|--------------|-----|---------|----------|----------|----------------------|--------------------|
| qSW-icim-8.1 | 14.0 | S8_18946297 - S8_11986619 | 2.0 | 4.4 | 13.1 | -0.2 | 0.7 | 3.99 | over dominant |
| qSW-icim-10.1 | 153.0 | S10_15140940 - S10_632618 | 5.8 | 2.5 | 4.9 | 0.5 | -0.5 | -1.05 | recessive |
| qSW-cim-11.1 | 12.3 | S11_27825757 - S11_9769716 | 1.7 | 4.3 | 13.0 | 0.2 | -0.6 | -2.37 | recessive |
| qSW-icim-11.1 | 104.0 | S11_14467653 - S11_11799692 | 1.2 | 3.1 | 12.3 | 0.0 | -0.7 | -67.75 | recessive |
| qSW-cim-11.2 | 121.7 | S11_10013768 - S11_47645855 | 0.1 | 2.6 | 8.7 | 0.5 | 0.0 | 0.05 | additive |
| Seed yield | | | | | | | | | |
| qSY-icim-1.1 | 9.0 | S1_1145802 - S1_14036679 | 0.8 | 3.7 | 10.3 | 3.9 | -18.8 | -4.76 | recessive |
| qSY-icim-2.1 | 93.0 | S2_24889905 - S2_3670647 | 1.2 | 3.0 | 7.8 | -26.7 | -29.0 | -1.09 | recessive |
| qSY-cim-4.1 | 31.3 | S4_11052197 - S4_10704406 | 0.7 | 3.3 | 11.3 | -14.6 | 2.3 | 0.16 | additive |
| qSY-cim-5.1 | 20.6 | S5_2134830 - S5_2134832 | 6.1 | 3.9 | 39.0 | 55.1 | -41.4 | -0.75 | partially dominant |
| qSY-icim-7.1 | 17.0 | S7_8660317 - S7_1644160 | 13.8 | 3.3 | 10.7 | -11.4 | -13.7 | -1.20 | recessive |
| qSY-icim-7.2 | 111.0 | S7_908957 - S7_17105607 | 3.0 | 3.7 | 6.4 | -16.9 | -16.8 | -0.99 | recessive |
| qSY-icim-8.1 | 46.0 | S8_13861942 - S8_19001717 | 4.8 | 2.6 | 5.8 | -12.3 | -7.7 | -0.63 | recessive |
| qSY-cim-10.1 | 155.5 | S10_15140940 - S10_632618 | 5.8 | 3.0 | 53.0 | 19.1 | -41.0 | -2.15 | recessive |
| qSY-cim-11.1 | 84.6 | S11_39685164 - S11_2994853 | 0.7 | 3.9 | 6.7 | -2.4 | -22.9 | -9.49 | recessive |
| qSY-icim-11.1 | 85.0 | S11_39685164 - S11_2994853 | 0.7 | 3.1 | 10.7 | 0.3 | -23.0 | -69.84 | recessive |
| qSY-cim-11.2 | 197.6 | S11_10379800 - S11_39387203 | 14.8 | 4.0 | 10.3 | 51.3 | -51.6 | -1.00 | recessive |
| Days to first flowering | | | | | | | | | |
| qDFF-icim-1.1 | 14.0 | S1_14036679 - S1_11242012 | 4.6 | 6.8 | 15.2 | -5.3 | 1.7 | 0.32 | partially dominant |
| qDFF-cim-1.1 | 14.3 | S1_11242012 - S1_15951980 | 0.1 | 3.7 | 14.0 | -3.8 | 3.1 | 0.82 | dominant |
| qDFF-cim-1.2 | 29.1 | S1_16743053 - S1_11236611 | 0.3 | 2.8 | 11.1 | -2.4 | 4.3 | 1.77 | over dominant |
| qDFF-cim-1.3 | 75.1 | S1_1158266 - S1_12641760 | 9.1 | 2.8 | 2.3 | 1.4 | 5.9 | 4.29 | over dominant |
| qDFF-cim-2.1 | 41.0 | S2_2989918 - S2_16460899 | 0.6 | 4.4 | 4.2 | -0.1 | 6.3 | 76.31 | over dominant |
| qDFF-cim-2.2 | 90.7 | S2_11771536 - S2_10960200 | 0.1 | 3.0 | 11.2 | -1.7 | 5.2 | 3.04 | over dominant |
| qDFF-cim-2.3 | 133.3 | S2_2989899 - S2_1760098 | 0.1 | 4.2 | 4.5 | 0.6 | 6.5 | 11.68 | over dominant |
| qDFF-cim-3.1 | 2.9 | S3_6422190 - S3_10282824 | 6.7 | 2.8 | 7.8 | -0.9 | 4.3 | 4.97 | over dominant |
| qDFF-cim-3.2 | 143.4 | S3_4923672 - S3_4949379 | 1.9 | 2.9 | 2.1 | 3.1 | 4.5 | 1.44 | over dominant |
| qDFF-icim-6.1 | 72.0 | S6_18172388 - S6_12492736 | 1.4 | 5.1 | 14.9 | 1.3 | 7.0 | 5.36 | over dominant |

| QTL name | Position | Flanking markers | QTL interval | LOD | PVE (%) | <i>a</i> | <i>d</i> | <i>d/ a </i> | Gene action |
|------------------------------------|----------|-----------------------------|--------------|-----|---------|----------|----------|--------------|--------------------|
| qDFF-cim-6.1 | 72.5 | S6_18172388 - S6_12492736 | 1.4 | 3.2 | 2.5 | 1.1 | 6.6 | 6.25 | over dominant |
| qDFF-icim-6.2 | 95.0 | S6_21912913 - S6_11368997 | 2.0 | 3.0 | 10.9 | -3.0 | 5.1 | 1.72 | over dominant |
| qDFF-cim-6.2 | 100.8 | S6_11368993 - S6_16630543 | 1.0 | 3.2 | 14.2 | 3.9 | -2.6 | -0.67 | recessive |
| qDFF-icim-6.3 | 108.0 | S6_18172301 - S6_6790172 | 1.4 | 3.7 | 8.3 | 3.3 | 5.6 | 1.67 | over dominant |
| qDFF-icim-6.4 | 112.0 | S6_6790172 - S6_9119183 | 4.3 | 2.9 | 9.8 | 3.0 | 3.5 | 1.16 | over dominant |
| qDFF-icim-8.1 | 53.0 | S8_1870690 - S8_14893200 | 11.0 | 3.5 | 12.0 | -3.8 | 4.2 | 1.10 | over dominant |
| qDFF-cim-8.1 | 54.7 | S8_1870690 - S8_14893200 | 11.0 | 3.9 | 32.4 | -3.4 | 7.8 | 2.27 | over dominant |
| qDFF-cim-8.2 | 76.8 | S8_2216092 - S8_19416095 | 2.1 | 4.5 | 2.1 | 2.0 | 6.4 | 3.18 | over dominant |
| qDFF-cim-10.1 | 2.9 | S10_8436572 - S10_8682299 | 1.6 | 2.6 | 10.9 | -1.0 | 6.9 | 6.64 | over dominant |
| qDFF-cim-10.2 | 85.8 | S10_15140871 - S10_12011468 | 0.8 | 2.7 | 5.9 | -0.5 | 4.9 | 9.97 | over dominant |
| qDFF-icim-11.1 | 30.0 | S11_6866243 - S11_22800082 | 0.5 | 3.0 | 11.2 | -1.9 | 5.1 | 2.69 | over dominant |
| qDFF-cim-11.1 | 30.3 | S11_22800082 - S11_27825774 | 0.0 | 3.2 | 11.1 | -1.6 | 7.8 | 4.86 | over dominant |
| qDFF-cim-11.2 | 60.3 | S11_25088688 - S11_12824405 | 0.0 | 3.1 | 43.8 | -4.4 | 7.9 | 1.82 | over dominant |
| qDFF-cim-11.3 | 112.5 | S11_38856677 - S11_1583891 | 0.4 | 3.4 | 28.5 | -3.4 | 8.2 | 2.42 | over dominant |
| qDFF-cim-11.4 | 137.4 | S11_22689703 - S11_19044341 | 0.9 | 3.3 | 5.0 | 0.2 | 5.4 | 25.63 | over dominant |
| qDFF-cim-11.5 | 143.2 | S11_24070770 - S11_13882393 | 1.4 | 3.2 | 6.9 | 0.1 | 7.4 | 107.58 | over dominant |
| Pop5 (ICP 5529 x ICP 11605) | | | | | | | | | |
| Seed protein content | | | | | | | | | |
| <i>qPROT-cim-1.1</i> | 46.6 | S1_1798648 - S1_1798766 | 2.6 | 2.6 | 4.4 | 0.3 | 0.1 | 0.33 | partially dominant |
| <i>qPROT-cim-2.1</i> | 27.8 | S2_6930418 - S2_16133939 | 0.3 | 3.0 | 9.3 | -0.5 | 0.2 | 0.40 | partially dominant |
| <i>qPROT-icim-2.1</i> | 34.0 | S2_10279728 - S2_32698493 | 0.2 | 6.6 | 16.5 | -0.4 | 0.4 | 1.00 | dominant |
| <i>qPROT-cim-2.2</i> | 34.0 | S2_10279728 - S2_32698493 | 0.2 | 5.1 | 17.5 | -0.7 | 0.3 | 0.43 | partially dominant |
| <i>qPROT-cim-2.3</i> | 38.3 | S2_28049603 - S2_9984747 | 0.1 | 3.1 | 9.0 | -0.5 | 0.1 | 0.20 | additive |
| <i>qPROT-cim-2.4</i> | 102.9 | S2_4297468 - S2_13394656 | 0.4 | 4.0 | 11.8 | -0.5 | 0.4 | 0.80 | partially dominant |
| <i>qPROT-icim-2.2</i> | 121.0 | S2_16519107 - S2_16348673 | 4.9 | 7.2 | 11.5 | -0.2 | -0.5 | -2.50 | recessive |
| <i>qPROT-icim-3.1</i> | 77.0 | S3_23614170 - S3_8195933 | 2.3 | 4.9 | 9.0 | 0.6 | 0.1 | 0.17 | additive |
| <i>qPROT-icim-6.1</i> | 85.0 | S6_3630897 - S6_11140261 | 0.5 | 3.5 | 7.7 | -0.6 | 0.2 | 0.33 | partially dominant |
| <i>qPROT-cim-11.1</i> | 82.2 | S11_21017392 - S11_9883313 | 0.2 | 3.2 | 7.2 | -0.5 | 0.6 | 1.20 | dominant |

| QTL name | Position | Flanking markers | QTL interval | LOD | PVE (%) | <i>a</i> | <i>d</i> | <i>d</i> / <i> a </i> | Gene action |
|------------------------|----------|-----------------------------|--------------|------|---------|----------|----------|-----------------------|--------------------|
| <i>qPROT-icim-11.1</i> | 91.0 | S11_38887609 - S11_29943293 | 0.7 | 3.8 | 7.9 | -0.5 | 0.2 | 0.40 | partially dominant |
| <i>qPROT-cim-11.2</i> | 95.4 | S11_31519207 - S11_30807675 | 0.5 | 3.0 | 3.3 | -0.4 | 0.5 | 1.25 | over-dominant |
| 100-seed weight | | | | | | | | | |
| qSW-cim-1.1 | 16.4 | S1_7127752 - S1_5944791 | 14.7 | 7.4 | 10.4 | 0.9 | 0.4 | 0.42 | partially dominant |
| qSW-icim-1.1 | 20.0 | S1_5944791 - S1_5173345 | 11.2 | 15.0 | 31.5 | 1.1 | 0.4 | 0.38 | partially dominant |
| qSW-cim-6.1 | 26.4 | S6_4443721 - S6_4396204 | 3.1 | 3.4 | 8.3 | 0.5 | -0.2 | -0.32 | recessive |
| qSW-icim-6.1 | 95.0 | S6_14282225 - S6_14311546 | 0.8 | 2.7 | 4.8 | -0.2 | 0.5 | 2.21 | over dominant |
| qSW-icim-8.1 | 52.0 | S8_1664745 - S8_8700222 | 7.3 | 2.7 | 6.3 | 0.4 | -0.5 | -1.21 | recessive |
| qSW-icim-11.1 | 24.0 | S11_6210775 - S11_39507811 | 2.7 | 3.3 | 6.0 | 0.1 | 0.6 | 5.93 | over dominant |
| Seed yield | | | | | | | | | |
| qSY-icim-1.1 | 29.0 | S1_5944791 - S1_5173345 | 11.2 | 3.2 | 6.6 | 0.7 | 19.8 | 26.57 | over dominant |
| qSY-icim-1.2 | 74.0 | S1_3905217 - S1_17462230 | 7.3 | 3.8 | 14.8 | -13.6 | -26.7 | -1.97 | recessive |
| qSY-icim-2.1 | 46.0 | S2_28723848 - S2_11947232 | 1.7 | 4.2 | 8.9 | -1.1 | 23.3 | 22.04 | over dominant |
| qSY-cim-2.1 | 126.3 | S2_8504401 - S2_4442599 | 0.4 | 2.9 | 8.2 | -7.0 | 19.0 | 2.71 | over dominant |
| qSY-icim-6.1 | 101.0 | S6_14311667 - S6_14388845 | 1.1 | 4.1 | 8.8 | 15.9 | -0.9 | -0.06 | recessive |
| Growth habit | | | | | | | | | |
| qGH-cim-2.1 | 54.4 | S2_206675 - s2_1204754 | 0.5 | 2.8 | 20.7 | 0.2 | -0.2 | -1.04 | recessive |
| qGH-icim-2.1 | 64.0 | S2_9105026 - S2_22664490 | 0.2 | 2.7 | 3.9 | -0.1 | -0.2 | -1.27 | recessive |
| qGH-cim-3.1 | 5.0 | S3_21310513 - S3_28538775 | 7.5 | 2.9 | 9.3 | 0.1 | -0.2 | -2.02 | recessive |
| qGH-cim-3.2 | 14.5 | S3_28538775 - S3_21244595 | 10.4 | 4.9 | 19.6 | 0.1 | -0.3 | -3.45 | recessive |
| qGH-icim-3.1 | 20.0 | S3_24127385 - S3_21274904 | 1.4 | 4.4 | 12.0 | 0.1 | -0.2 | -1.62 | recessive |
| qGH-cim-3.3 | 23.7 | S3_20631155 - S3_22234078 | 2.4 | 15.2 | 47.0 | 0.3 | -0.3 | -0.94 | recessive |
| qGH-cim-3.4 | 34.3 | s3_20698771 - S3_18430894 | 2.3 | 22.1 | 5.0 | -0.3 | -0.3 | -0.98 | recessive |
| qGH-icim-3.2 | 35.0 | s3_20698771 - S3_18430894 | 2.3 | 29.1 | 61.6 | -0.4 | -0.3 | -0.80 | recessive |
| qGH-cim-3.5 | 46.6 | S3_18154848 - S3_17193829 | 6.0 | 11.3 | 42.1 | 0.3 | -0.2 | -0.72 | recessive |
| qGH-icim-4.1 | 27.0 | s4_496463 - S4_487510 | 2.1 | 2.6 | 13.1 | 0.3 | -0.2 | -0.70 | recessive |
| qGH-cim-11.1 | 24.9 | S11_6210775 - S11_39507811 | 2.7 | 4.6 | 27.2 | 0.2 | -0.3 | -1.98 | recessive |
| qGH-cim-11.2 | 54.6 | S11_4453854 - S11_4725362 | 0.8 | 3.0 | 3.4 | 0.1 | 0.0 | 0.35 | partially dominant |

| QTL name | Position | Flanking markers | QTL interval | LOD | PVE (%) | <i>a</i> | <i>d</i> | <i>d/ a </i> | Gene action |
|-------------------------|----------|----------------------------|--------------|-----|---------|----------|----------|--------------|--------------------|
| qGH-icim-11.1 | 64.0 | S11_8456082 - S11_44938548 | 0.6 | 4.1 | 14.0 | 0.2 | -0.4 | -1.73 | recessive |
| Days to first flowering | | | | | | | | | |
| qDFF-icim-3.1 | 24.0 | S3_22234078 - S3_16681929 | 5.7 | 6.6 | 12.6 | -4.7 | 2.2 | 0.48 | partially dominant |
| qDFF-cim-3.1 | 24.7 | S3_22234078 - S3_16681929 | 5.7 | 7.8 | 39.6 | -6.0 | 4.7 | 0.79 | partially dominant |
| qDFF-cim-3.2 | 34.3 | s3_20698771 - S3_18430894 | 2.3 | 7.8 | 4.6 | 5.2 | 4.0 | 0.76 | partially dominant |
| qDFF-cim-3.3 | 41.6 | S3_18430894 - S3_18154848 | 7.0 | 5.0 | 47.6 | -5.6 | 5.5 | 0.98 | dominant |
| qDFF-cim-3.4 | 46.6 | S3_18154848 - S3_17193829 | 6.0 | 4.0 | 16.2 | -4.0 | 2.7 | 0.66 | partially dominant |
| qDFF-icim-3.2 | 117.0 | S3_14754306 - S3_8040710 | 3.3 | 3.4 | 7.9 | -2.6 | 3.6 | 1.35 | over dominant |
| qDFF-icim-7.1 | 24.0 | S7_13036645 - S7_12034341 | 1.7 | 2.9 | 6.1 | 0.3 | -4.7 | -15.95 | recessive |

Supplementary Table S3. Epistatic QTLs for seed protein content and agronomic traits identified using inclusive composite interval mapping (ICIM) in five pigeonpea F₂ populations

| Trait | Chr1 | Pos1 | LM1 | RM1 | Chr2 | Pos2 | LM2 | RM2 | LOD | PVE (%) | [aa] | [ad] | [da] | [dd] |
|------------------------------|------|------|-------------|-------------|------|------|--------------|--------------|------|---------|-------|-------|-------|------|
| Pop1 (ICP 11605 × ICP 14209) | | | | | | | | | | | | | | |
| DFP | 1 | 65 | S1_1798766 | S1_1906557 | 11 | 30 | S11_47645855 | S11_36456560 | 5.2 | 16.6 | 7.2 | -4.1 | 9.8 | 6.3 |
| GH | 1 | 35 | S1_2693194 | S1_4757043 | 2 | 80 | S2_24059431 | S2_24764841 | 5.0 | 27.2 | -0.2 | -0.2 | 0.4 | -0.3 |
| GH | 1 | 55 | S1_1575466 | S1_1798766 | 1 | 60 | S1_1798766 | S1_1906557 | 8.4 | 37.3 | -0.2 | -0.1 | 0.6 | -0.7 |
| GH | 1 | 70 | S1_1798766 | S1_1906557 | 3 | 65 | S3_17441541 | S3_21244595 | 14.0 | 70.2 | 0.0 | -0.4 | 0.4 | -0.9 |
| GH | 1 | 25 | S1_5093650 | S1_2693194 | 10 | 5 | S10_4461663 | S10_8216833 | 5.1 | 31.7 | -0.1 | 0.3 | -0.4 | -0.4 |
| SPC | 1 | 30 | S1_2693194 | S1_4757043 | 2 | 75 | S2_7491873 | S2_36672875 | 5.0 | 18.0 | -0.4 | 0.4 | -0.9 | 1.5 |
| SPC | 1 | 45 | S1_4757043 | S1_1575466 | 7 | 25 | S7_3522458 | S7_12010754 | 5.1 | 15.5 | 0.1 | -0.7 | -0.5 | 1.5 |
| SPC | 1 | 45 | S1_4757043 | S1_1575466 | 8 | 100 | S8_13310192 | S8_4675310 | 6.6 | 23.8 | 0.5 | -1.9 | -0.2 | 0.9 |
| SW | 1 | 40 | S1_4757043 | S1_1575466 | 2 | 85 | S2_36121093 | S2_36167974 | 5.3 | 14.7 | 0.1 | -0.8 | -0.1 | 1.2 |
| SW | 1 | 40 | S1_4757043 | S1_1575466 | 6 | 95 | S6_21393668 | S6_3159471 | 5.5 | 18.2 | -0.5 | -1.1 | 0.8 | 0.7 |
| SW | 1 | 0 | S1_7045823 | S1_4374250 | 7 | 85 | S7_6037045 | S7_6897487 | 5.5 | 17.2 | -0.3 | -1.1 | 0.3 | -0.1 |
| SY | 1 | 45 | S1_4757043 | S1_1575466 | 3 | 20 | S3_12603960 | S3_23502392 | 6.1 | 22.7 | 0.8 | -4.4 | -52.4 | 47.1 |
| SY | 1 | 60 | S1_1798766 | S1_1906557 | 10 | 75 | S10_259572 | S10_371125 | 6.5 | 24.7 | 17.5 | -33.0 | -25.1 | 21.3 |
| SY | 1 | 20 | S1_4757283 | S1_5093650 | 8 | 125 | S8_9535782 | S8_9669552 | 5.7 | 19.1 | 12.7 | 16.1 | 40.6 | 7.4 |
| GH | 2 | 20 | S2_16997696 | S2_10643268 | 4 | 0 | S4_2222488 | S4_2168590 | 5.0 | 9.4 | 0.0 | 0.2 | 0.0 | -0.3 |
| GH | 2 | 65 | S2_22546301 | S2_7491873 | 2 | 80 | S2_24059431 | S2_24764841 | 5.5 | 34.5 | -0.4 | 0.0 | -0.4 | 0.1 |
| GH | 2 | 80 | S2_24059431 | S2_24764841 | 7 | 15 | S7_12804834 | S7_18463975 | 5.3 | 21.9 | 0.0 | 0.4 | 0.1 | -0.5 |
| GH | 2 | 80 | S2_24059431 | S2_24764841 | 8 | 50 | S8_5791445 | S8_912171 | 9.0 | 36.9 | 0.1 | 0.7 | 0.1 | -0.2 |
| GH | 2 | 80 | S2_24059431 | S2_24764841 | 10 | 90 | S10_371125 | S10_190277 | 9.8 | 33.6 | 0.2 | 0.6 | 0.3 | -0.4 |
| GH | 2 | 80 | S2_24059431 | S2_24764841 | 11 | 210 | S11_25877230 | S11_29782823 | 9.3 | 30.1 | -0.4 | 0.0 | 0.1 | 0.6 |
| GH | 2 | 90 | S2_36167974 | S2_25553275 | 3 | 65 | S3_17441541 | S3_21244595 | 10.0 | 66.7 | 0.0 | -0.3 | 0.5 | -0.6 |
| GH | 2 | 90 | S2_36167974 | S2_25553275 | 6 | 10 | S6_6060973 | S6_12750333 | 5.7 | 33.7 | -0.2 | -0.5 | 0.3 | -0.2 |
| SW | 2 | 125 | S2_28755005 | S2_28751418 | 6 | 10 | S6_6060973 | S6_12750333 | 5.6 | 18.8 | -0.6 | -0.3 | -0.2 | -1.0 |
| SY | 2 | 10 | S2_16348673 | S2_16348917 | 5 | 5 | S5_2580750 | S5_4692912 | 5.2 | 15.8 | -17.1 | 3.4 | -10.7 | 37.0 |
| SY | 2 | 15 | S2_16348917 | S2_16997696 | 8 | 35 | S8_2049156 | S8_5791461 | 6.0 | 23.3 | -16.6 | 32.6 | -22.8 | 14.4 |

| Trait | Chr1 | Pos1 | LM1 | RM1 | Chr2 | Pos2 | LM2 | RM2 | LOD | PVE (%) | [aa] | [ad] | [da] | [dd] |
|-------|------|------|-------------|-------------|------|------|--------------|--------------|------|---------|-------|-------|-------|-------|
| SY | 2 | 20 | S2_16997696 | S2_10643268 | 6 | 55 | S6_11455119 | S6_11140261 | 5.2 | 18.0 | 20.3 | 30.4 | 28.7 | -0.7 |
| SY | 2 | 55 | S2_29055808 | S2_15893512 | 10 | 85 | S10_371125 | S10_190277 | 6.2 | 23.0 | -0.8 | 17.5 | 26.6 | -43.8 |
| SY | 2 | 145 | S2_29614491 | S2_36085710 | 11 | 225 | S11_25050893 | S11_30337861 | 5.6 | 24.7 | 28.2 | 37.6 | 27.2 | -11.2 |
| DFF | 3 | 65 | S3_17441541 | S3_21244595 | 8 | 145 | S8_19166126 | S8_10333523 | 5.3 | 33.4 | 2.6 | 10.6 | 3.3 | -12.7 |
| DFF | 3 | 160 | S3_20357542 | S3_925667 | 6 | 45 | S6_14282207 | S6_14236163 | 5.0 | 10.4 | 4.3 | 7.9 | 0.6 | -0.1 |
| GH | 3 | 65 | S3_17441541 | S3_21244595 | 3 | 175 | S3_3913971 | S3_16727150 | 18.4 | 75.8 | 0.0 | 0.4 | 0.4 | -0.9 |
| GH | 3 | 65 | S3_17441541 | S3_21244595 | 5 | 55 | S5_1264439 | S5_624899 | 14.3 | 76.0 | 0.0 | 0.5 | 0.3 | -0.7 |
| GH | 3 | 65 | S3_17441541 | S3_21244595 | 6 | 90 | S6_21393668 | S6_3159471 | 7.8 | 56.2 | 0.1 | 0.2 | -0.2 | -0.3 |
| GH | 3 | 65 | S3_17441541 | S3_21244595 | 7 | 5 | S7_15796777 | S7_19089666 | 17.7 | 79.5 | 0.2 | -0.3 | 0.5 | 0.2 |
| GH | 3 | 65 | S3_17441541 | S3_21244595 | 8 | 25 | S8_11972776 | S8_2049156 | 11.9 | 76.4 | -0.2 | 0.1 | 0.6 | -0.7 |
| GH | 3 | 65 | S3_17441541 | S3_21244595 | 9 | 10 | S9_9689272 | S9_10221364 | 6.6 | 66.7 | -0.2 | 0.2 | 0.4 | -0.6 |
| GH | 3 | 65 | S3_17441541 | S3_21244595 | 10 | 5 | S10_4461663 | S10_8216833 | 14.0 | 79.6 | 0.0 | 0.3 | -0.4 | -0.9 |
| GH | 3 | 65 | S3_17441541 | S3_21244595 | 11 | 180 | S11_23458079 | S11_20186519 | 9.3 | 57.2 | -0.1 | 0.4 | 0.0 | -0.4 |
| SPC | 3 | 115 | S3_11310314 | S3_25423101 | 11 | 155 | S11_12420322 | S11_38211354 | 5.2 | 31.2 | -1.5 | -1.2 | -0.3 | 2.1 |
| SW | 3 | 45 | S3_21275059 | S3_28586858 | 4 | 25 | S4_1521545 | S4_1311883 | 5.0 | 16.5 | -0.6 | -0.2 | -0.5 | 0.0 |
| SW | 3 | 180 | S3_3913971 | S3_16727150 | 8 | 145 | S8_19166126 | S8_10333523 | 5.3 | 16.9 | -0.3 | -0.1 | -0.9 | 0.9 |
| SY | 3 | 35 | S3_16632580 | S3_22917964 | 3 | 115 | S3_11310314 | S3_25423101 | 5.4 | 23.9 | -19.0 | -19.8 | 19.7 | 20.7 |
| SY | 3 | 20 | S3_12603960 | S3_23502392 | 5 | 35 | S5_312017 | S5_1264439 | 5.1 | 27.2 | 9.4 | 35.3 | -9.5 | -43.0 |
| SY | 3 | 35 | S3_16632580 | S3_22917964 | 11 | 150 | S11_20646142 | S11_20816375 | 7.8 | 35.2 | -15.0 | -17.6 | 4.7 | 54.2 |
| SY | 3 | 170 | S3_16727124 | S3_8433349 | 6 | 60 | S6_21760159 | S6_11433399 | 5.2 | 18.1 | -10.8 | -33.9 | 20.2 | 13.9 |
| SY | 3 | 125 | S3_23737567 | S3_8040710 | 7 | 60 | S7_722957 | S7_14067075 | 6.1 | 27.6 | 18.9 | 3.5 | 34.4 | 49.0 |
| SY | 3 | 140 | S3_25398665 | S3_5325095 | 8 | 25 | S8_11972776 | S8_2049156 | 5.6 | 37.0 | -13.5 | -10.5 | 45.3 | -3.4 |
| SY | 3 | 0 | S3_26745908 | S3_23529670 | 10 | 15 | S10_8216833 | S10_14964979 | 6.5 | 15.9 | -30.6 | 35.5 | -21.5 | 17.0 |
| SPC | 4 | 55 | S4_4734626 | S4_9854357 | 6 | 95 | S6_21393668 | S6_3159471 | 5.1 | 17.3 | 0.0 | 1.0 | 0.8 | 1.0 |
| GH | 5 | 20 | S5_4692888 | S5_312017 | 5 | 50 | S5_1264439 | S5_624899 | 7.8 | 37.9 | 0.0 | -0.3 | 0.3 | -0.8 |
| GH | 5 | 55 | S5_1264439 | S5_624899 | 8 | 170 | S8_17346247 | S8_15097397 | 5.7 | 22.9 | 0.1 | 0.1 | 0.3 | -0.4 |
| GH | 5 | 55 | S5_1264439 | S5_624899 | 10 | 90 | S10_371125 | S10_190277 | 5.0 | 23.0 | 0.1 | 0.3 | -0.4 | -0.3 |
| GH | 5 | 45 | S5_312017 | S5_1264439 | 9 | 5 | S9_1280107 | S9_9689272 | 5.8 | 19.1 | 0.2 | -0.3 | 0.2 | -0.3 |

| Trait | Chr1 | Pos1 | LM1 | RM1 | Chr2 | Pos2 | LM2 | RM2 | LOD | PVE (%) | [aa] | [ad] | [da] | [dd] |
|-------|------|------|-------------|-------------|------|------|--------------|--------------|-----|---------|-------|-------|-------|-------|
| GH | 5 | 40 | S5_312017 | S5_1264439 | 11 | 50 | S11_33138038 | S11_39568168 | 5.8 | 20.6 | 0.2 | -0.2 | -0.5 | 0.0 |
| SPC | 5 | 20 | S5_4692888 | S5_312017 | 6 | 35 | S6_14335733 | S6_14282201 | 5.5 | 19.0 | 0.9 | 0.6 | -0.3 | 1.4 |
| SW | 5 | 60 | S5_1264439 | S5_624899 | 10 | 75 | S10_259572 | S10_371125 | 5.1 | 14.6 | 0.2 | -1.3 | -0.4 | 0.1 |
| SY | 5 | 0 | S5_2580221 | S5_2580750 | 8 | 95 | S8_6388803 | S8_9452602 | 5.3 | 20.7 | 41.5 | 4.1 | -0.6 | 22.0 |
| SY | 5 | 0 | S5_2580221 | S5_2580750 | 10 | 15 | S10_8216833 | S10_14964979 | 5.5 | 12.9 | -21.3 | 23.5 | -34.5 | 55.2 |
| GH | 6 | 45 | S6_14282207 | S6_14236163 | 6 | 80 | S6_14551548 | S6_22264720 | 5.2 | 12.5 | 0.0 | 0.2 | 0.3 | -0.2 |
| GH | 6 | 85 | S6_22264720 | S6_21393668 | 11 | 105 | S11_6013633 | S11_27172559 | 5.9 | 18.6 | -0.2 | 0.3 | -0.3 | -0.4 |
| GH | 6 | 10 | S6_6060973 | S6_12750333 | 9 | 5 | S9_1280107 | S9_9689272 | 5.1 | 19.3 | 0.1 | -0.2 | 0.5 | -0.3 |
| SPC | 6 | 15 | S6_14310524 | S6_14313152 | 8 | 185 | S8_14218715 | S8_15026624 | 5.2 | 16.7 | 0.3 | -0.6 | 1.0 | 0.5 |
| SPC | 6 | 60 | S6_21760159 | S6_11433399 | 6 | 85 | S6_22264720 | S6_21393668 | 5.4 | 25.7 | -1.0 | -2.9 | 0.5 | 0.2 |
| SW | 6 | 65 | S6_6237148 | S6_16682610 | 8 | 145 | S8_19166126 | S8_10333523 | 5.1 | 25.1 | -0.2 | -0.9 | -1.1 | 0.4 |
| SY | 6 | 60 | S6_21760159 | S6_11433399 | 8 | 35 | S8_2049156 | S8_5791461 | 6.4 | 23.9 | -9.9 | 14.4 | -28.0 | 36.1 |
| SY | 6 | 60 | S6_21760159 | S6_11433399 | 11 | 80 | S11_9768472 | S11_24859358 | 5.3 | 17.8 | -8.3 | 15.5 | -28.9 | 43.9 |
| SY | 6 | 85 | S6_22264720 | S6_21393668 | 10 | 5 | S10_4461663 | S10_8216833 | 5.6 | 22.3 | -17.3 | 23.8 | -29.3 | 13.0 |
| DFF | 7 | 20 | S7_3522458 | S7_12010754 | 9 | 60 | S9_8998000 | S9_5312289 | 5.4 | 18.2 | -4.8 | -0.6 | -8.4 | -13.3 |
| DFF | 7 | 20 | S7_3522458 | S7_12010754 | 11 | 70 | S11_14777000 | S11_30776997 | 5.5 | 17.6 | 2.9 | 4.9 | 9.7 | -5.4 |
| GH | 7 | 65 | S7_14067075 | S7_14683829 | 8 | 60 | S8_1666164 | S8_1664745 | 5.5 | 19.2 | 0.1 | 0.0 | -0.3 | -0.1 |
| GH | 7 | 5 | S7_15796777 | S7_19089666 | 7 | 25 | S7_3522458 | S7_12010754 | 5.3 | 32.8 | 0.0 | 0.5 | -0.1 | -0.3 |
| GH | 7 | 5 | S7_15796777 | S7_19089666 | 9 | 15 | S9_10221364 | S9_1358645 | 6.6 | 26.3 | 0.1 | -0.5 | 0.1 | -0.2 |
| GH | 7 | 20 | S7_3522458 | S7_12010754 | 10 | 5 | S10_4461663 | S10_8216833 | 8.9 | 35.3 | 0.1 | -0.3 | -0.5 | -0.3 |
| SPC | 7 | 30 | S7_18419460 | S7_15005750 | 8 | 85 | S8_10556549 | S8_19075759 | 5.2 | 12.8 | 0.1 | -0.9 | -1.3 | -1.0 |
| SPC | 7 | 75 | S7_6012566 | S7_9034247 | 11 | 90 | S11_23469021 | S11_46615058 | 5.6 | 22.3 | 0.8 | -0.2 | 0.2 | 1.4 |
| SY | 7 | 55 | S7_18464007 | S7_12836334 | 8 | 25 | S8_11972776 | S8_2049156 | 5.8 | 32.7 | 17.4 | -45.4 | -6.5 | -16.6 |
| SY | 7 | 60 | S7_722957 | S7_14067075 | 11 | 150 | S11_20646142 | S11_20816375 | 5.4 | 26.1 | 12.2 | 39.4 | 12.0 | 21.8 |
| GH | 8 | 30 | S8_11972776 | S8_2049156 | 10 | 20 | S10_14964979 | S10_7161105 | 7.8 | 29.3 | 0.2 | 0.3 | 0.6 | -0.3 |
| GH | 8 | 100 | S8_13310192 | S8_4675310 | 11 | 210 | S11_25877230 | S11_29782823 | 6.4 | 23.9 | 0.4 | 0.0 | 0.1 | 0.4 |
| GH | 8 | 135 | S8_4533965 | S8_14798091 | 9 | 25 | S9_9670150 | S9_9689983 | 5.5 | 17.4 | -0.3 | -0.2 | 0.1 | 0.5 |
| GH | 8 | 115 | S8_6353157 | S8_1284456 | 8 | 120 | S8_13150686 | S8_9535782 | 9.6 | 32.5 | -0.4 | 0.2 | 0.1 | 0.4 |

| Trait | Chr1 | Pos1 | LM1 | RM1 | Chr2 | Pos2 | LM2 | RM2 | LOD | PVE (%) | [aa] | [ad] | [da] | [dd] |
|-----------------------------|------|------|--------------|--------------|------|------|--------------|--------------|------|---------|-------|-------|-------|-------|
| SPC | 8 | 30 | S8_11972776 | S8_2049156 | 11 | 195 | S11_8456046 | S11_39507811 | 5.5 | 24.4 | -0.1 | -1.1 | -0.3 | -1.7 |
| SY | 8 | 25 | S8_11972776 | S8_2049156 | 8 | 95 | S8_6388803 | S8_9452602 | 6.4 | 31.0 | -16.6 | -44.0 | 1.7 | 56.8 |
| SY | 8 | 150 | S8_10333523 | S8_4867754 | 11 | 150 | S11_20646142 | S11_20816375 | 6.8 | 27.8 | -24.4 | -29.2 | 13.6 | 23.0 |
| SY | 8 | 35 | S8_2049156 | S8_5791461 | 9 | 40 | S9_10229309 | S9_7755937 | 6.9 | 38.7 | -30.0 | -3.9 | -13.5 | 72.0 |
| SY | 8 | 40 | S8_2049156 | S8_5791461 | 10 | 75 | S10_259572 | S10_371125 | 7.8 | 38.5 | 23.9 | -26.0 | -8.3 | 53.2 |
| GH | 9 | 5 | S9_1280107 | S9_9689272 | 10 | 20 | S10_14964979 | S10_7161105 | 7.5 | 31.6 | -0.3 | -0.3 | 0.7 | -0.5 |
| GH | 10 | 5 | S10_4461663 | S10_8216833 | 10 | 20 | S10_14964979 | S10_7161105 | 10.7 | 41.6 | 0.0 | -0.4 | 0.5 | -0.8 |
| GH | 10 | 5 | S10_4461663 | S10_8216833 | 11 | 145 | S11_32081128 | S11_5166783 | 6.2 | 35.7 | -0.2 | 0.5 | -0.1 | -0.2 |
| SY | 10 | 75 | S10_259572 | S10_371125 | 11 | 160 | S11_38929174 | S11_23233620 | 8.2 | 28.0 | -28.8 | -12.4 | 34.0 | 34.8 |
| SY | 10 | 15 | S10_8216833 | S10_14964979 | 10 | 50 | S10_4202839 | S10_1984771 | 6.2 | 16.8 | 28.2 | -27.8 | -40.0 | 16.0 |
| GH | 11 | 15 | S11_5868042 | S11_40289708 | 11 | 85 | S11_9768477 | S11_27172500 | 6.1 | 17.7 | 0.0 | 0.1 | -0.5 | -0.5 |
| SY | 11 | 95 | S11_11359055 | S11_7007425 | 11 | 150 | S11_20646142 | S11_20816375 | 5.3 | 36.4 | -3.3 | -19.5 | 23.7 | 65.8 |
| Pop2 (ICP 8863 × ICP 11605) | | | | | | | | | | | | | | |
| DFF | 1 | 35 | S1_12899653 | S1_11050274 | 7 | 55 | S7_12804834 | S7_6897487 | 5.1 | 20.7 | 4.9 | -11.7 | -0.5 | 9.8 |
| DFF | 1 | 170 | S1_13431148 | S1_14032441 | 10 | 50 | S10_21497752 | S10_18083837 | 6.8 | 20.4 | -1.9 | 1.5 | 12.1 | -19.8 |
| DFF | 1 | 85 | S1_14083660 | S1_3905212 | 2 | 140 | S2_13394806 | S2_35442671 | 5.3 | 16.9 | -4.9 | -8.2 | 3.7 | 13.0 |
| DFF | 1 | 80 | S1_652229 | S1_14083660 | 6 | 55 | S6_15449552 | S6_18295388 | 5.4 | 21.2 | -2.9 | -8.4 | 7.5 | 10.2 |
| DFF | 1 | 80 | S1_652229 | S1_14083660 | 9 | 50 | S9_7755937 | S9_7756050 | 5.7 | 21.9 | 6.6 | -7.5 | -6.1 | 2.7 |
| DFF | 1 | 80 | S1_652229 | S1_14083660 | 8 | 5 | S8_4714912 | S8_11776420 | 6.2 | 26.2 | 7.0 | -4.0 | -9.7 | -2.2 |
| DFF | 1 | 120 | S1_9842833 | S1_1158656 | 3 | 110 | S3_8040710 | S3_9200641 | 5.6 | 24.3 | 6.6 | -8.6 | -17.1 | -2.5 |
| GH | 1 | 140 | S1_10689415 | S1_556023 | 6 | 25 | S6_6237148 | S6_14282225 | 6.5 | 13.4 | 0.3 | -0.1 | 0.0 | 0.3 |
| GH | 1 | 135 | S1_10689415 | S1_556023 | 3 | 25 | S3_21244595 | S3_18933167 | 8.8 | 35.2 | -0.1 | 0.6 | 0.3 | -0.6 |
| GH | 1 | 155 | S1_12591177 | S1_13431089 | 10 | 135 | S10_17099642 | S10_6765628 | 11.1 | 18.9 | 0.1 | 0.1 | -0.6 | -0.4 |
| GH | 1 | 155 | S1_12591177 | S1_13431089 | 11 | 90 | S11_39309852 | S11_28894118 | 9.3 | 21.4 | 0.0 | 0.2 | -0.6 | -0.5 |
| GH | 1 | 5 | S1_16910575 | S1_16294075 | 2 | 15 | S2_20782748 | S2_36429055 | 9.0 | 16.9 | 0.3 | -0.2 | -0.3 | 0.1 |
| GH | 1 | 10 | S1_4759267 | S1_15329865 | 7 | 5 | S7_18419460 | S7_6037045 | 7.2 | 16.7 | 0.2 | -0.3 | -0.2 | 0.1 |
| GH | 1 | 10 | S1_4759267 | S1_15329865 | 8 | 60 | S8_11838449 | S8_11838448 | 5.9 | 19.2 | 0.2 | -0.3 | -0.1 | 0.5 |
| GH | 1 | 10 | S1_4759267 | S1_15329865 | 1 | 80 | S1_652229 | S1_14083660 | 6.4 | 20.9 | 0.2 | -0.3 | -0.1 | 0.5 |

| Trait | Chr1 | Pos1 | LM1 | RM1 | Chr2 | Pos2 | LM2 | RM2 | LOD | PVE (%) | [aa] | [ad] | [da] | [dd] |
|-------|------|------|-------------|-------------|------|------|--------------|--------------|------|---------|-------|------|-------|-------|
| GH | 1 | 80 | S1_652229 | S1_14083660 | 4 | 0 | S4_2849401 | S4_2014532 | 6.5 | 15.6 | 0.1 | -0.2 | -0.4 | 0.1 |
| GH | 1 | 80 | S1_652229 | S1_14083660 | 9 | 75 | S9_10177047 | S9_10172092 | 6.8 | 20.9 | -0.4 | 0.2 | -0.2 | 0.6 |
| GH | 1 | 80 | S1_652229 | S1_14083660 | 5 | 25 | S5_4692912 | S5_4199522 | 12.3 | 37.0 | -0.2 | 0.3 | -0.5 | 0.3 |
| SPC | 1 | 55 | S1_5552696 | S1_3905151 | 10 | 155 | S10_19001995 | S10_7783201 | 5.5 | 60.5 | -1.1 | 1.1 | 1.1 | 1.9 |
| SW | 1 | 75 | S1_10466763 | S1_3905220 | 2 | 120 | S2_21890021 | S2_7683449 | 16.2 | 34.0 | 0.2 | 0.2 | 5.1 | -5.5 |
| SW | 1 | 40 | S1_11050274 | S1_748256 | 3 | 0 | S3_22234078 | S3_19578263 | 13.8 | 31.9 | 0.1 | 5.2 | -0.4 | -5.0 |
| SW | 1 | 40 | S1_11050274 | S1_748256 | 6 | 70 | S6_18322873 | S6_18322737 | 11.4 | 32.0 | -0.2 | 5.2 | 0.4 | -4.7 |
| SW | 1 | 40 | S1_11050274 | S1_748256 | 4 | 15 | S4_1521545 | S4_1710877 | 9.8 | 32.9 | 2.6 | -2.2 | -2.3 | 2.3 |
| SW | 1 | 95 | S1_14067713 | S1_9603077 | 7 | 10 | S7_6037077 | S7_18542722 | 13.9 | 32.9 | -2.8 | 2.2 | -2.8 | 2.6 |
| SW | 1 | 95 | S1_14067713 | S1_9603077 | 8 | 10 | S8_4714912 | S8_11776420 | 10.6 | 39.0 | -2.1 | 3.3 | -2.2 | 2.9 |
| SW | 1 | 100 | S1_14069006 | S1_9863131 | 5 | 5 | S5_5120324 | S5_4692888 | 14.1 | 29.8 | -2.5 | -2.6 | 2.5 | 2.6 |
| SW | 1 | 85 | S1_14083660 | S1_3905212 | 11 | 110 | S11_27472029 | S11_20186519 | 15.1 | 36.1 | 2.6 | 2.9 | 3.1 | 2.3 |
| SW | 1 | 5 | S1_16910575 | S1_16294075 | 1 | 10 | S1_4759267 | S1_15329865 | 15.6 | 40.7 | -2.1 | 2.8 | -2.1 | 2.9 |
| SW | 1 | 10 | S1_4759267 | S1_15329865 | 9 | 25 | S9_1280000 | S9_7212583 | 16.7 | 39.8 | 2.6 | 3.0 | 2.1 | 2.0 |
| SW | 1 | 10 | S1_4759267 | S1_15329865 | 10 | 40 | S10_21497771 | S10_13762076 | 16.6 | 41.8 | 2.5 | 3.3 | 2.3 | 2.7 |
| SY | 1 | 10 | S1_4759267 | S1_15329865 | 10 | 200 | S10_7783201 | S10_5097784 | 6.2 | 35.6 | 14.3 | -0.2 | 31.8 | -13.1 |
| SY | 1 | 170 | S1_13431148 | S1_14032441 | 7 | 40 | S7_10467966 | S7_12804834 | 5.4 | 13.0 | 9.5 | 13.4 | 1.2 | 22.1 |
| SY | 1 | 95 | S1_14067713 | S1_9603077 | 1 | 140 | S1_10689415 | S1_556023 | 6.2 | 19.1 | 13.0 | 10.1 | 18.4 | 17.7 |
| SY | 1 | 60 | S1_3905151 | S1_5414823 | 3 | 20 | S3_28933239 | S3_21244595 | 5.1 | 11.5 | 2.8 | -0.7 | 11.2 | -29.7 |
| SY | 1 | 10 | S1_4759267 | S1_15329865 | 11 | 65 | S11_30337861 | S11_12765240 | 6.6 | 30.7 | -12.8 | 14.3 | -28.9 | -21.7 |
| DFF | 2 | 170 | S2_13394818 | S2_26969919 | 11 | 145 | S11_20304380 | S11_38654219 | 5.3 | 14.8 | -8.3 | 4.1 | -4.0 | 4.5 |
| DFF | 2 | 170 | S2_13394818 | S2_26969919 | 9 | 50 | S9_7755937 | S9_7756050 | 5.5 | 16.9 | -5.6 | 1.6 | -6.7 | 11.6 |
| DFF | 2 | 15 | S2_20782748 | S2_36429055 | 10 | 55 | S10_18083837 | S10_17801329 | 6.0 | 26.6 | -2.3 | -4.1 | 13.7 | -17.6 |
| DFF | 2 | 5 | S2_20782748 | S2_36429055 | 3 | 35 | S3_18933167 | S3_18929445 | 5.0 | 44.3 | 1.5 | 15.8 | 2.9 | -3.6 |
| DFF | 2 | 95 | S2_35584049 | S2_22473218 | 2 | 185 | S2_25523315 | S2_28049878 | 5.7 | 34.9 | -5.7 | 27.4 | 5.3 | -10.4 |
| GH | 2 | 130 | S2_10607410 | S2_32197339 | 11 | 90 | S11_39309852 | S11_28894118 | 8.5 | 17.4 | 0.3 | 0.4 | 0.4 | 0.1 |
| GH | 2 | 75 | S2_16111815 | S2_21929010 | 8 | 65 | S8_11838449 | S8_11838448 | 6.4 | 13.7 | 0.3 | -0.2 | -0.1 | 0.4 |
| GH | 2 | 60 | S2_19392675 | S2_13388933 | 7 | 90 | S7_14683829 | S7_9034247 | 6.6 | 13.8 | 0.1 | 0.4 | 0.0 | -0.6 |

| Trait | Chr1 | Pos1 | LM1 | RM1 | Chr2 | Pos2 | LM2 | RM2 | LOD | PVE (%) | [aa] | [ad] | [da] | [dd] |
|-------|------|------|-------------|-------------|------|------|--------------|--------------|------|---------|-------|-------|-------|-------|
| GH | 2 | 10 | S2_20782748 | S2_36429055 | 9 | 70 | S9_10229309 | S9_10177047 | 5.9 | 19.6 | 0.1 | -0.3 | 0.0 | 0.7 |
| GH | 2 | 15 | S2_20782748 | S2_36429055 | 2 | 35 | S2_36429066 | S2_19392689 | 7.0 | 22.4 | -0.2 | 0.5 | -0.2 | -0.4 |
| GH | 2 | 10 | S2_20782748 | S2_36429055 | 5 | 30 | S5_4692912 | S5_4199522 | 6.3 | 24.2 | 0.1 | -0.4 | -0.4 | 0.0 |
| GH | 2 | 115 | S2_21890021 | S2_7683449 | 10 | 135 | S10_17099642 | S10_6765628 | 11.4 | 20.7 | 0.0 | 0.1 | -0.6 | -0.6 |
| GH | 2 | 145 | S2_32807766 | S2_7683443 | 6 | 40 | S6_14282226 | S6_14335833 | 5.4 | 13.0 | 0.1 | -0.4 | 0.0 | -0.5 |
| GH | 2 | 90 | S2_35584049 | S2_22473218 | 4 | 0 | S4_2849401 | S4_2014532 | 6.5 | 10.4 | 0.3 | -0.2 | -0.3 | 0.2 |
| GH | 2 | 35 | S2_36429066 | S2_19392689 | 3 | 45 | S3_18929445 | S3_18929378 | 15.8 | 59.8 | -0.3 | 0.1 | 0.6 | -0.5 |
| SPC | 2 | 80 | S2_22473129 | S2_18386711 | 10 | 155 | S10_19001995 | S10_7783201 | 6.3 | 67.0 | 0.0 | -2.9 | 1.6 | 2.5 |
| SW | 2 | 80 | S2_22473129 | S2_18386711 | 3 | 0 | S3_22234078 | S3_19578263 | 14.6 | 31.9 | -0.2 | 5.2 | 0.2 | -4.5 |
| SW | 2 | 80 | S2_22473129 | S2_18386711 | 4 | 25 | S4_1710877 | S4_839628 | 15.3 | 33.7 | 2.7 | -2.1 | -2.1 | 2.1 |
| SW | 2 | 80 | S2_22473129 | S2_18386711 | 2 | 115 | S2_21890021 | S2_7683449 | 15.5 | 34.1 | -2.5 | -2.5 | 3.0 | 2.2 |
| SW | 2 | 55 | S2_19392675 | S2_13388933 | 9 | 75 | S9_10177047 | S9_10172092 | 13.6 | 32.2 | 0.3 | 4.8 | 0.0 | -5.7 |
| SW | 2 | 60 | S2_19392675 | S2_13388933 | 5 | 10 | S5_4692912 | S5_4199522 | 17.1 | 36.5 | -2.7 | -2.3 | 3.3 | 1.3 |
| SW | 2 | 115 | S2_21890021 | S2_7683449 | 6 | 65 | S6_18295384 | S6_18322776 | 13.9 | 35.8 | -2.4 | 2.9 | -2.4 | 3.2 |
| SW | 2 | 125 | S2_34204720 | S2_7683447 | 11 | 15 | S11_27612418 | S11_32832892 | 16.0 | 31.9 | -0.1 | 5.3 | -0.2 | -4.3 |
| SW | 2 | 125 | S2_34204720 | S2_7683447 | 7 | 5 | S7_18419460 | S7_6037045 | 15.8 | 32.7 | 2.7 | -2.1 | -2.8 | 2.7 |
| SW | 2 | 95 | S2_35584049 | S2_22473218 | 8 | 30 | S8_11776408 | S8_11838449 | 14.4 | 38.9 | 2.9 | -2.4 | -3.0 | 1.3 |
| SW | 2 | 40 | S2_36429066 | S2_19392689 | 10 | 130 | S10_18083991 | S10_17099642 | 13.9 | 34.8 | -2.6 | -2.7 | 3.0 | 1.5 |
| SY | 2 | 130 | S2_10607410 | S2_32197339 | 2 | 150 | S2_36008860 | S2_32734003 | 5.0 | 17.0 | 3.6 | 7.4 | -16.0 | -43.1 |
| SY | 2 | 0 | S2_20782748 | S2_36429055 | 6 | 5 | S6_2496170 | S6_6237148 | 5.3 | 14.0 | -6.5 | 2.4 | -12.5 | 23.7 |
| SY | 2 | 10 | S2_20782748 | S2_36429055 | 10 | 110 | S10_8438690 | S10_13626722 | 6.3 | 26.0 | -23.7 | 0.8 | -4.6 | 9.3 |
| SY | 2 | 15 | S2_20782748 | S2_36429055 | 11 | 110 | S11_27472029 | S11_20186519 | 5.5 | 27.3 | -8.7 | -0.5 | -39.8 | 2.2 |
| SY | 2 | 120 | S2_21890021 | S2_7683449 | 7 | 0 | S7_18419460 | S7_6037045 | 5.5 | 10.6 | -21.2 | 0.2 | 20.9 | 7.8 |
| SY | 2 | 120 | S2_21890021 | S2_7683449 | 8 | 25 | S8_11776420 | S8_11776408 | 5.2 | 11.4 | 5.6 | 30.3 | -18.8 | -11.8 |
| SY | 2 | 160 | S2_36164833 | S2_16111897 | 3 | 5 | S3_19578263 | S3_21274904 | 7.3 | 36.4 | -7.6 | -39.4 | 8.4 | -12.5 |
| DFF | 3 | 135 | S3_8772530 | S3_1358533 | 11 | 150 | S11_22893601 | S11_10881649 | 5.8 | 22.9 | -7.8 | -11.9 | 4.3 | 1.7 |
| DFF | 3 | 80 | S3_14758073 | S3_11310314 | 8 | 5 | S8_4714912 | S8_11776420 | 6.2 | 25.9 | -7.2 | 0.8 | -8.4 | 5.3 |
| DFF | 3 | 75 | S3_14758073 | S3_11310314 | 6 | 25 | S6_6237148 | S6_14282225 | 5.9 | 27.4 | 6.1 | 6.7 | 9.7 | 9.2 |

| Trait | Chr1 | Pos1 | LM1 | RM1 | Chr2 | Pos2 | LM2 | RM2 | LOD | PVE (%) | [aa] | [ad] | [da] | [dd] |
|-------|------|------|-------------|-------------|------|------|--------------|--------------|--------|---------|------|------|------|-------|
| DFP | 3 | 5 | S3_19578263 | S3_21274904 | 10 | 55 | S10_18083837 | S10_17801329 | 6.8 | 23.2 | 0.4 | 0.4 | 17.9 | -12.6 |
| GH | 3 | 45 | S3_18929445 | S3_18929378 | 6 | 25 | S6_6237148 | S6_14282225 | 5.3 | 39.1 | 0.0 | -0.4 | 0.0 | 0.2 |
| GH | 3 | 45 | S3_18929445 | S3_18929378 | 11 | 55 | S11_33954110 | S11_42065843 | 12.9 | 55.4 | 0.3 | 0.6 | 0.3 | -0.1 |
| GH | 3 | 45 | S3_18929445 | S3_18929378 | 5 | 25 | S5_4692912 | S5_4199522 | 15.4 | 63.7 | 0.0 | 0.4 | -0.5 | 0.1 |
| GH | 3 | 30 | S3_21244595 | S3_18933167 | 8 | 60 | S8_11838449 | S8_11838448 | 7.5 | 38.2 | 0.0 | 0.3 | 0.4 | -0.7 |
| GH | 3 | 25 | S3_21244595 | S3_18933167 | 10 | 25 | S10_14148444 | S10_12011468 | 14.1 | 45.2 | -0.2 | 0.2 | -0.5 | -0.4 |
| GH | 3 | 20 | S3_28933239 | S3_21244595 | 9 | 35 | S9_7212583 | S9_7755937 | 7.0 | 47.3 | 0.2 | 0.1 | -0.5 | -0.5 |
| GH | 3 | 20 | S3_28933239 | S3_21244595 | 3 | 45 | S3_18929445 | S3_18929378 | 1132.5 | 99.4 | 0.0 | 0.0 | -1.0 | 0.0 |
| SPC | 3 | 130 | S3_8772530 | S3_1358533 | 10 | 155 | S10_19001995 | S10_7783201 | 5.5 | 67.4 | -1.1 | -0.1 | 1.1 | -0.6 |
| SW | 3 | 90 | S3_11310314 | S3_10301855 | 9 | 20 | S9_1280000 | S9_7212583 | 13.1 | 31.4 | 2.6 | 2.5 | 2.5 | 2.6 |
| SW | 3 | 90 | S3_11310314 | S3_10301855 | 11 | 110 | S11_27472029 | S11_20186519 | 14.6 | 32.4 | 2.7 | 2.5 | 3.0 | 3.0 |
| SW | 3 | 70 | S3_14758073 | S3_11310314 | 4 | 15 | S4_1521545 | S4_1710877 | 11.1 | 34.6 | 2.4 | -1.9 | -2.3 | 2.6 |
| SW | 3 | 75 | S3_14758073 | S3_11310314 | 7 | 50 | S7_12804834 | S7_6897487 | 10.1 | 35.0 | 0.1 | 5.3 | 0.1 | -4.7 |
| SW | 3 | 80 | S3_14758073 | S3_11310314 | 10 | 25 | S10_14148444 | S10_12011468 | 15.2 | 35.7 | 2.5 | 3.0 | 2.0 | 2.8 |
| SW | 3 | 75 | S3_14758073 | S3_11310314 | 6 | 0 | S6_2496170 | S6_6237148 | 7.8 | 35.8 | -2.8 | 2.9 | -2.5 | 2.0 |
| SW | 3 | 30 | S3_21244595 | S3_18933167 | 3 | 45 | S3_18929445 | S3_18929378 | 14.5 | 31.1 | -2.6 | -2.7 | 2.8 | 3.2 |
| SW | 3 | 10 | S3_21274904 | S3_28538775 | 8 | 40 | S8_11776408 | S8_11838449 | 14.4 | 34.6 | -0.1 | -0.5 | 5.0 | -5.5 |
| SW | 3 | 0 | S3_22234078 | S3_19578263 | 5 | 35 | S5_4692912 | S5_4199522 | 14.7 | 33.6 | 0.3 | 0.1 | -5.2 | -5.1 |
| SY | 3 | 5 | S3_19578263 | S3_21274904 | 10 | 120 | S10_13626722 | S10_18083991 | 5.5 | 32.3 | 7.0 | 7.1 | 23.0 | -42.2 |
| SY | 3 | 0 | S3_22234078 | S3_19578263 | 3 | 25 | S3_21244595 | S3_18933167 | 5.3 | 19.1 | 6.8 | 2.3 | 30.9 | -54.8 |
| GH | 4 | 10 | S4_2849401 | S4_2014532 | 4 | 25 | S4_1710877 | S4_839628 | 5.7 | 10.8 | -0.1 | -0.6 | 0.4 | 0.0 |
| GH | 4 | 5 | S4_2849401 | S4_2014532 | 9 | 70 | S9_10229309 | S9_10177047 | 6.0 | 10.9 | 0.2 | -0.2 | -0.1 | 0.2 |
| GH | 4 | 0 | S4_2849401 | S4_2014532 | 11 | 90 | S11_39309852 | S11_28894118 | 9.1 | 14.5 | -0.3 | -0.3 | 0.3 | 0.4 |
| GH | 4 | 5 | S4_2849401 | S4_2014532 | 7 | 5 | S7_18419460 | S7_6037045 | 5.7 | 15.8 | 0.2 | -0.2 | -0.3 | -0.1 |
| GH | 4 | 5 | S4_2849401 | S4_2014532 | 10 | 135 | S10_17099642 | S10_6765628 | 8.1 | 16.6 | -0.3 | -0.3 | 0.4 | 0.3 |
| GH | 4 | 5 | S4_2849401 | S4_2014532 | 6 | 25 | S6_6237148 | S6_14282225 | 5.7 | 20.1 | 0.2 | -0.1 | -0.2 | 0.6 |
| GH | 4 | 5 | S4_2849401 | S4_2014532 | 5 | 25 | S5_4692912 | S5_4199522 | 5.0 | 20.6 | 0.1 | -0.5 | -0.3 | 0.0 |
| SW | 4 | 15 | S4_1521545 | S4_1710877 | 5 | 35 | S5_4692912 | S5_4199522 | 11.6 | 33.5 | -2.5 | -2.9 | 2.3 | 2.2 |

| Trait | Chr1 | Pos1 | LM1 | RM1 | Chr2 | Pos2 | LM2 | RM2 | LOD | PVE (%) | [aa] | [ad] | [da] | [dd] |
|-------|------|------|-------------|-------------|------|------|--------------|--------------|------|---------|------|-------|------|------|
| SW | 4 | 15 | S4_1521545 | S4_1710877 | 4 | 25 | S4_1710877 | S4_839628 | 15.4 | 35.3 | -2.5 | -3.3 | 2.2 | 2.7 |
| SW | 4 | 20 | S4_1710877 | S4_839628 | 10 | 40 | S10_21497771 | S10_13762076 | 11.7 | 32.6 | -2.4 | -2.2 | 2.4 | 3.0 |
| SW | 4 | 20 | S4_1710877 | S4_839628 | 9 | 20 | S9_1280000 | S9_7212583 | 11.7 | 36.0 | -2.3 | -1.9 | 2.9 | 3.4 |
| SW | 4 | 25 | S4_1710877 | S4_839628 | 11 | 55 | S11_33954110 | S11_42065843 | 12.0 | 36.0 | -3.0 | -2.5 | 2.1 | 1.7 |
| GH | 5 | 10 | S5_4692912 | S5_4199522 | 11 | 90 | S11_39309852 | S11_28894118 | 8.8 | 15.1 | -0.2 | -0.3 | 0.4 | 0.2 |
| GH | 5 | 20 | S5_4692912 | S5_4199522 | 5 | 35 | S5_4692912 | S5_4199522 | 8.8 | 27.6 | 0.1 | 0.4 | -0.3 | -0.7 |
| GH | 5 | 30 | S5_4692912 | S5_4199522 | 10 | 150 | S10_19001995 | S10_7783201 | 12.0 | 40.7 | -0.2 | -0.6 | 0.5 | 0.1 |
| SPC | 5 | 30 | S5_4692912 | S5_4199522 | 6 | 5 | S6_2496170 | S6_6237148 | 6.0 | 55.0 | 0.0 | 1.5 | -0.6 | 3.6 |
| SPC | 5 | 25 | S5_4692912 | S5_4199522 | 10 | 155 | S10_19001995 | S10_7783201 | 6.1 | 64.8 | -0.2 | 0.9 | 0.6 | 4.1 |
| SW | 5 | 20 | S5_4692912 | S5_4199522 | 10 | 115 | S10_13626722 | S10_18083991 | 15.0 | 32.5 | -2.5 | 2.5 | -2.8 | 3.2 |
| SW | 5 | 20 | S5_4692912 | S5_4199522 | 6 | 0 | S6_2496170 | S6_6237148 | 12.8 | 32.8 | -2.5 | 2.4 | -2.3 | 3.2 |
| SW | 5 | 25 | S5_4692912 | S5_4199522 | 7 | 5 | S7_18419460 | S7_6037045 | 15.3 | 36.9 | -2.7 | 2.4 | -2.8 | 3.5 |
| SW | 5 | 15 | S5_4692912 | S5_4199522 | 8 | 40 | S8_11776408 | S8_11838449 | 15.6 | 37.5 | -2.6 | 2.7 | -1.9 | 3.5 |
| SW | 5 | 25 | S5_4692912 | S5_4199522 | 11 | 50 | S11_3238944 | S11_3724414 | 16.4 | 38.7 | -2.4 | 2.8 | -3.2 | 1.6 |
| SW | 5 | 0 | S5_5120324 | S5_4692888 | 5 | 15 | S5_4692912 | S5_4199522 | 15.2 | 36.2 | -2.0 | 2.9 | -4.0 | 3.4 |
| SW | 5 | 5 | S5_5120324 | S5_4692888 | 9 | 50 | S9_7755937 | S9_7756050 | 16.4 | 32.9 | -2.6 | 2.4 | -2.1 | 3.2 |
| DFE | 6 | 50 | S6_14335778 | S6_15449552 | 10 | 95 | S10_21365631 | S10_16278049 | 5.5 | 17.3 | 6.4 | 4.5 | 7.1 | 14.3 |
| DFE | 6 | 90 | S6_22082423 | S6_22394558 | 11 | 215 | S11_10013681 | S11_32879360 | 5.4 | 27.1 | -9.4 | 6.6 | 0.2 | 9.8 |
| DFE | 6 | 10 | S6_6237148 | S6_14282225 | 6 | 20 | S6_6237148 | S6_14282225 | 5.0 | 34.7 | -4.3 | -18.7 | 6.2 | -8.9 |
| GH | 6 | 0 | S6_2496170 | S6_6237148 | 7 | 5 | S7_18419460 | S7_6037045 | 5.7 | 11.6 | -0.2 | 0.1 | -0.1 | 0.4 |
| GH | 6 | 5 | S6_2496170 | S6_6237148 | 10 | 135 | S10_17099642 | S10_6765628 | 7.9 | 18.9 | 0.1 | 0.1 | -0.5 | -0.5 |
| GH | 6 | 15 | S6_6237148 | S6_14282225 | 11 | 90 | S11_39309852 | S11_28894118 | 6.2 | 16.3 | 0.0 | 0.1 | -0.6 | -0.5 |
| GH | 6 | 30 | S6_6237148 | S6_14282225 | 6 | 45 | S6_14336019 | S6_14388845 | 5.3 | 19.1 | 0.0 | 0.7 | -0.1 | 0.0 |
| GH | 6 | 25 | S6_6237148 | S6_14282225 | 9 | 20 | S9_1280000 | S9_7212583 | 5.4 | 21.0 | 0.2 | -0.2 | -0.2 | 0.1 |
| SW | 6 | 60 | S6_15449552 | S6_18295388 | 10 | 205 | S10_7783201 | S10_5097784 | 13.1 | 33.0 | -2.5 | 2.2 | -2.7 | 3.2 |
| SW | 6 | 60 | S6_15449552 | S6_18295388 | 6 | 65 | S6_18295384 | S6_18322776 | 13.3 | 33.9 | -2.0 | 2.6 | -2.4 | 2.7 |
| SW | 6 | 60 | S6_15449552 | S6_18295388 | 11 | 110 | S11_27472029 | S11_20186519 | 14.3 | 34.0 | 2.2 | 1.7 | 3.2 | 3.4 |
| SW | 6 | 0 | S6_2496170 | S6_6237148 | 9 | 20 | S9_1280000 | S9_7212583 | 13.0 | 31.5 | -2.5 | -2.5 | 2.0 | 2.6 |

| Trait | Chr1 | Pos1 | LM1 | RM1 | Chr2 | Pos2 | LM2 | RM2 | LOD | PVE (%) | [aa] | [ad] | [da] | [dd] |
|-------|------|------|-------------|-------------|------|------|--------------|--------------|------|---------|-------|-------|-------|-------|
| SW | 6 | 5 | S6_2496170 | S6_6237148 | 7 | 5 | S7_18419460 | S7_6037045 | 6.6 | 34.2 | -2.7 | 2.6 | -2.3 | 3.0 |
| SW | 6 | 15 | S6_6237148 | S6_14282225 | 8 | 35 | S8_11776408 | S8_11838449 | 9.6 | 35.3 | -0.1 | -0.2 | 4.6 | -5.0 |
| SY | 6 | 15 | S6_6237148 | S6_14282225 | 10 | 105 | S10_16278049 | S10_8438690 | 6.3 | 25.4 | 20.8 | 3.2 | 2.9 | 28.4 |
| GH | 7 | 85 | S7_14683829 | S7_9034247 | 8 | 60 | S8_11838449 | S8_11838448 | 5.3 | 17.7 | 0.0 | -0.1 | 0.4 | -0.5 |
| GH | 7 | 5 | S7_18419460 | S7_6037045 | 11 | 90 | S11_39309852 | S11_28894118 | 7.3 | 15.9 | -0.2 | -0.3 | 0.2 | 0.4 |
| GH | 7 | 5 | S7_18419460 | S7_6037045 | 10 | 135 | S10_17099642 | S10_6765628 | 9.5 | 17.9 | -0.3 | -0.3 | 0.3 | 0.2 |
| GH | 7 | 70 | S7_6897487 | S7_14683829 | 7 | 80 | S7_14683829 | S7_9034247 | 5.7 | 18.4 | -0.2 | 0.3 | -0.3 | -0.5 |
| SW | 7 | 50 | S7_12804834 | S7_6897487 | 8 | 40 | S8_11776408 | S8_11838449 | 14.1 | 37.2 | 0.4 | 0.0 | 4.9 | -5.8 |
| SW | 7 | 5 | S7_18419460 | S7_6037045 | 10 | 135 | S10_17099642 | S10_6765628 | 14.6 | 32.6 | -2.7 | -2.8 | 2.2 | 2.6 |
| SW | 7 | 5 | S7_18419460 | S7_6037045 | 11 | 110 | S11_27472029 | S11_20186519 | 14.6 | 33.1 | -2.8 | -2.8 | 2.9 | 2.4 |
| SW | 7 | 0 | S7_18419460 | S7_6037045 | 7 | 10 | S7_6037077 | S7_18542722 | 13.0 | 34.3 | -2.7 | -2.1 | 1.2 | 3.2 |
| SW | 7 | 5 | S7_18419460 | S7_6037045 | 9 | 20 | S9_1280000 | S9_7212583 | 14.2 | 35.1 | -2.5 | -2.1 | 2.6 | 3.3 |
| SY | 7 | 5 | S7_18419460 | S7_6037045 | 10 | 205 | S10_7783201 | S10_5097784 | 6.5 | 31.5 | -17.3 | -32.0 | 32.4 | -17.4 |
| DFF | 8 | 15 | S8_4714912 | S8_11776420 | 10 | 55 | S10_18083837 | S10_17801329 | 5.2 | 21.9 | -0.8 | -2.3 | 15.6 | -17.1 |
| DFF | 8 | 15 | S8_4714912 | S8_11776420 | 8 | 20 | S8_11776420 | S8_11776408 | 5.9 | 28.6 | -1.0 | 21.4 | -22.9 | -15.9 |
| GH | 8 | 65 | S8_11838449 | S8_11838448 | 11 | 90 | S11_39309852 | S11_28894118 | 10.2 | 19.3 | -0.2 | -0.2 | 0.3 | 0.5 |
| GH | 8 | 60 | S8_11838449 | S8_11838448 | 10 | 135 | S10_17099642 | S10_6765628 | 10.3 | 20.3 | 0.0 | -0.1 | -0.6 | -0.5 |
| GH | 8 | 15 | S8_4714912 | S8_11776420 | 8 | 25 | S8_11776420 | S8_11776408 | 5.4 | 22.2 | 0.0 | -0.2 | 0.3 | -0.8 |
| SW | 8 | 25 | S8_11776420 | S8_11776408 | 8 | 35 | S8_11776408 | S8_11838449 | 13.9 | 38.0 | -2.0 | -3.3 | 2.7 | 0.8 |
| SW | 8 | 50 | S8_11838449 | S8_11838448 | 10 | 25 | S10_14148444 | S10_12011468 | 11.4 | 32.2 | 0.3 | -0.1 | -4.8 | -4.6 |
| SW | 8 | 5 | S8_4714912 | S8_11776420 | 11 | 5 | S11_2882386 | S11_27612418 | 13.6 | 35.3 | 2.4 | -2.8 | -2.7 | 1.4 |
| SW | 8 | 10 | S8_4714912 | S8_11776420 | 9 | 15 | S9_1280000 | S9_7212583 | 13.7 | 39.7 | -2.0 | -2.7 | 2.8 | 2.5 |
| DFF | 9 | 45 | S9_7212583 | S9_7755937 | 10 | 100 | S10_21365631 | S10_16278049 | 5.8 | 18.8 | -3.4 | -9.1 | 5.7 | 18.0 |
| DFF | 9 | 75 | S9_10177047 | S9_10172092 | 11 | 55 | S11_33954110 | S11_42065843 | 6.6 | 23.9 | 5.9 | -4.9 | -15.0 | 4.8 |
| GH | 9 | 35 | S9_7212583 | S9_7755937 | 10 | 135 | S10_17099642 | S10_6765628 | 8.3 | 21.2 | -0.2 | -0.4 | 0.4 | 0.1 |
| GH | 9 | 20 | S9_1280000 | S9_7212583 | 11 | 90 | S11_39309852 | S11_28894118 | 9.2 | 20.5 | -0.3 | -0.1 | 0.3 | 0.7 |
| GH | 9 | 20 | S9_1280000 | S9_7212583 | 9 | 40 | S9_7212583 | S9_7755937 | 7.3 | 27.1 | 0.1 | -0.2 | 0.3 | -0.6 |
| SPC | 9 | 35 | S9_7212583 | S9_7755937 | 10 | 170 | S10_19001995 | S10_7783201 | 5.2 | 56.6 | 0.0 | 0.5 | 0.2 | 5.1 |

| Trait | Chr1 | Pos1 | LM1 | RM1 | Chr2 | Pos2 | LM2 | RM2 | LOD | PVE (%) | [aa] | [ad] | [da] | [dd] |
|---------------------------|------|------|--------------|--------------|------|------|--------------|--------------|------|---------|-------|-------|------|-------|
| SW | 9 | 20 | S9_1280000 | S9_7212583 | 10 | 165 | S10_19001995 | S10_7783201 | 13.7 | 41.4 | -2.4 | 3.1 | -1.8 | 3.9 |
| SW | 9 | 55 | S9_7756050 | S9_9689983 | 9 | 65 | S9_9689983 | S9_10003418 | 14.4 | 31.7 | -2.8 | -2.1 | 1.8 | 2.8 |
| SW | 9 | 55 | S9_7756050 | S9_9689983 | 11 | 170 | S11_47251892 | S11_7007425 | 15.3 | 35.6 | -2.6 | 2.5 | -2.1 | 3.8 |
| SY | 9 | 15 | S9_1280000 | S9_7212583 | 10 | 150 | S10_19001995 | S10_7783201 | 5.3 | 30.1 | 9.6 | 2.3 | 40.4 | 3.1 |
| DFE | 10 | 55 | S10_18083837 | S10_17801329 | 10 | 70 | S10_17702463 | S10_21497805 | 6.4 | 26.3 | -9.6 | -7.3 | 5.0 | 15.7 |
| DFE | 10 | 55 | S10_18083837 | S10_17801329 | 11 | 25 | S11_27612418 | S11_32832892 | 8.9 | 29.2 | 2.0 | 17.3 | 6.6 | -15.6 |
| GH | 10 | 140 | S10_19001995 | S10_7783201 | 10 | 150 | S10_19001995 | S10_7783201 | 12.7 | 36.6 | -0.1 | -0.5 | -0.5 | -0.6 |
| GH | 10 | 135 | S10_17099642 | S10_6765628 | 11 | 150 | S11_22893601 | S11_10881649 | 10.2 | 18.9 | 0.0 | 0.5 | 0.1 | 0.6 |
| SPC | 10 | 155 | S10_19001995 | S10_7783201 | 11 | 5 | S11_2882386 | S11_27612418 | 7.5 | 66.4 | 0.3 | 1.1 | -2.5 | 2.7 |
| SPC | 10 | 160 | S10_19001995 | S10_7783201 | 10 | 195 | S10_7783201 | S10_5097784 | 6.1 | 69.8 | 0.8 | 1.7 | -0.1 | -0.6 |
| SW | 10 | 40 | S10_21497771 | S10_13762076 | 11 | 50 | S11_3238944 | S11_3724414 | 15.4 | 33.7 | -2.3 | 2.6 | -2.8 | 3.1 |
| SW | 10 | 10 | S10_8791174 | S10_14148444 | 10 | 15 | S10_8791174 | S10_14148444 | 14.8 | 32.8 | -2.7 | -2.8 | 2.4 | 2.4 |
| SY | 10 | 95 | S10_21365631 | S10_16278049 | 11 | 65 | S11_30337861 | S11_12765240 | 6.7 | 24.2 | -7.7 | -16.2 | 28.8 | -6.2 |
| DFE | 11 | 55 | S11_33954110 | S11_42065843 | 11 | 215 | S11_10013681 | S11_32879360 | 5.7 | 29.1 | 11.8 | -6.8 | -2.0 | 12.2 |
| GH | 11 | 90 | S11_39309852 | S11_28894118 | 11 | 105 | S11_28846566 | S11_25427809 | 9.5 | 18.4 | -0.3 | 0.3 | -0.2 | 0.5 |
| SPC | 11 | 20 | S11_27612418 | S11_32832892 | 11 | 215 | S11_10013681 | S11_32879360 | 7.1 | 59.8 | 0.4 | -1.5 | -0.6 | 3.1 |
| SW | 11 | 40 | S11_177204 | S11_250057 | 11 | 55 | S11_33954110 | S11_42065843 | 15.6 | 32.0 | -2.6 | -2.9 | 2.5 | 2.5 |
| SY | 11 | 165 | S11_41096347 | S11_44938548 | 11 | 215 | S11_10013681 | S11_32879360 | 6.2 | 34.0 | -14.9 | 7.7 | 36.1 | -13.6 |
| Pop3 (HPL 24 × ICP 11605) | | | | | | | | | | | | | | |
| DFE | 1 | 120 | S1_4961612 | S1_679068 | 6 | 15 | S6_20778715 | S6_21140545 | 5.4 | 10.9 | -3.0 | 2.5 | 10.2 | 7.9 |
| DFE | 1 | 105 | S1_12001647 | S1_14036679 | 7 | 85 | S7_15005750 | S7_18208587 | 5.5 | 8.8 | 2.7 | -6.0 | -1.5 | -11.7 |
| DFE | 1 | 100 | S1_12001584 | S1_12001647 | 8 | 100 | S8_18579673 | S8_15137210 | 5.0 | 6.9 | 2.5 | -1.2 | -9.0 | 5.8 |
| GH | 1 | 20 | S1_887236 | S1_3399209 | 2 | 80 | S2_28723848 | S2_6405369 | 6.5 | 15.7 | 0.1 | -0.1 | -0.5 | -0.4 |
| GH | 1 | 115 | S1_14036679 | S1_4961612 | 1 | 125 | S1_679069 | S1_5445088 | 5.4 | 17.5 | -0.2 | 0.1 | -0.3 | 0.3 |
| GH | 1 | 120 | S1_4961612 | S1_679068 | 3 | 20 | S3_21244595 | S3_22913898 | 17.1 | 67.1 | 0.0 | 0.1 | 0.4 | -0.3 |
| GH | 1 | 125 | S1_679069 | S1_5445088 | 4 | 5 | S4_3592410 | S4_2761907 | 15.0 | 31.0 | 0.1 | 0.5 | -0.2 | -0.7 |
| GH | 1 | 50 | S1_11314978 | S1_9401795 | 6 | 95 | S6_6094182 | S6_3447497 | 9.3 | 18.8 | 0.4 | 0.2 | 0.0 | 0.6 |
| GH | 1 | 115 | S1_14036679 | S1_4961612 | 8 | 85 | S8_10333523 | S8_18579673 | 7.6 | 18.2 | -0.3 | 0.3 | -0.2 | -0.1 |

| Trait | Chr1 | Pos1 | LM1 | RM1 | Chr2 | Pos2 | LM2 | RM2 | LOD | PVE(%) | [aa] | [ad] | [da] | [dd] |
|-------|------|------|-------------|-------------|------|------|--------------|--------------|------|--------|-------|------|-------|------|
| GH | 1 | 50 | S1_11314978 | S1_9401795 | 9 | 20 | S9_10003418 | S9_8998000 | 6.9 | 14.0 | 0.3 | 0.4 | 0.1 | 0.6 |
| GH | 1 | 100 | S1_12001584 | S1_12001647 | 10 | 10 | S10_6745618 | S10_18754549 | 6.5 | 14.1 | 0.0 | 0.0 | 0.5 | -0.4 |
| GH | 1 | 95 | S1_4066143 | S1_12001584 | 11 | 50 | S11_10798039 | S11_27887408 | 5.2 | 17.8 | 0.0 | -0.1 | 0.5 | -0.3 |
| SPC | 1 | 20 | S1_887236 | S1_3399209 | 3 | 235 | S3_11414215 | S3_19102565 | 5.5 | 19.3 | 0.1 | 0.9 | -1.4 | -2.3 |
| SW | 1 | 20 | S1_887236 | S1_3399209 | 2 | 75 | S2_23068242 | S2_36264850 | 9.0 | 24.6 | -0.9 | -0.5 | 2.6 | 2.7 |
| SW | 1 | 25 | S1_1798766 | S1_1575466 | 1 | 35 | S1_11361258 | S1_3361403 | 6.5 | 20.1 | -0.5 | 0.3 | 1.9 | 2.7 |
| SW | 1 | 35 | S1_11361258 | S1_3361403 | 3 | 160 | S3_23347149 | S3_5324878 | 7.6 | 20.0 | -1.6 | -1.0 | -1.4 | -1.5 |
| SW | 1 | 110 | S1_12001647 | S1_14036679 | 4 | 70 | S4_839628 | S4_1521545 | 6.1 | 16.5 | 1.3 | 1.9 | -1.4 | -2.0 |
| SW | 1 | 120 | S1_4961612 | S1_679068 | 6 | 100 | S6_6094182 | S6_3447497 | 6.1 | 21.3 | -1.0 | 0.6 | 1.7 | -2.4 |
| SW | 1 | 35 | S1_11361258 | S1_3361403 | 7 | 80 | S7_15005750 | S7_18208587 | 5.4 | 18.8 | 1.4 | -1.1 | 1.1 | -0.9 |
| SW | 1 | 35 | S1_11361258 | S1_3361403 | 8 | 55 | S8_7083582 | S8_6798921 | 6.7 | 19.0 | -1.3 | -1.2 | -1.3 | -0.8 |
| SW | 1 | 35 | S1_11361258 | S1_3361403 | 9 | 25 | S9_7756050 | S9_8995134 | 8.1 | 21.3 | 1.2 | -1.2 | 1.3 | -2.1 |
| SW | 1 | 95 | S1_4066143 | S1_12001584 | 10 | 20 | S10_6745618 | S10_18754549 | 7.4 | 15.1 | 1.7 | -1.5 | 1.3 | -1.1 |
| SW | 1 | 75 | S1_7127752 | S1_8856852 | 11 | 165 | S11_48519738 | S11_22689710 | 7.3 | 24.9 | -0.8 | 1.0 | 2.2 | -2.2 |
| SY | 1 | 155 | S1_17365797 | S1_16757180 | 2 | 225 | S2_9110747 | S2_20521571 | 5.6 | 23.6 | 20.1 | 8.1 | 0.9 | 15.9 |
| SY | 1 | 85 | S1_381039 | S1_9111014 | 6 | 40 | S6_14282200 | S6_14335733 | 5.8 | 18.7 | 8.4 | 15.8 | 13.5 | 31.5 |
| SY | 1 | 155 | S1_17365797 | S1_16757180 | 7 | 80 | S7_15005750 | S7_18208587 | 5.1 | 14.1 | -10.6 | 6.8 | -14.1 | 17.3 |
| SY | 1 | 95 | S1_4066143 | S1_12001584 | 8 | 110 | S8_14218715 | S8_15841326 | 7.8 | 26.0 | 3.7 | -7.0 | -2.5 | 38.6 |
| SY | 1 | 155 | S1_17365797 | S1_16757180 | 10 | 10 | S10_6745618 | S10_18754549 | 6.3 | 20.6 | 15.9 | 7.1 | 21.5 | 28.9 |
| SY | 1 | 155 | S1_17365797 | S1_16757180 | 11 | 110 | S11_26654248 | S11_39257707 | 5.7 | 18.9 | 12.5 | 14.1 | 17.2 | -1.9 |
| DFF | 2 | 120 | S2_24924004 | S2_11759659 | 3 | 180 | S3_18695411 | S3_22966656 | 5.7 | 6.3 | -4.6 | 1.8 | -3.2 | 16.4 |
| DFF | 2 | 170 | S2_6037490 | S2_14842741 | 5 | 15 | S5_4108250 | S5_4692888 | 5.4 | 13.7 | -9.0 | -9.5 | 0.0 | 3.2 |
| DFF | 2 | 110 | S2_36167974 | S2_33146528 | 10 | 10 | S10_6745618 | S10_18754549 | 6.1 | 14.6 | -0.9 | 4.3 | -13.0 | 17.2 |
| GH | 2 | 55 | S2_7373516 | S2_26876108 | 2 | 60 | S2_26876108 | S2_36085710 | 6.8 | 17.4 | -0.1 | -0.4 | 0.1 | -0.4 |
| GH | 2 | 185 | S2_3012518 | S2_36010450 | 3 | 20 | S3_21244595 | S3_22913898 | 16.2 | 67.1 | 0.2 | 0.3 | 0.2 | -0.5 |
| GH | 2 | 155 | S2_34522392 | S2_6500923 | 4 | 5 | S4_3592410 | S4_2761907 | 11.8 | 25.8 | 0.0 | 0.1 | 0.0 | 0.9 |
| GH | 2 | 80 | S2_28723848 | S2_6405369 | 5 | 70 | S5_4199522 | S5_624899 | 5.7 | 16.7 | 0.2 | 0.3 | 0.1 | 0.2 |
| GH | 2 | 35 | S2_5077845 | S2_26647031 | 6 | 95 | S6_6094182 | S6_3447497 | 5.5 | 20.1 | -0.2 | -0.1 | 0.6 | -0.3 |

| Trait | Chr1 | Pos1 | LM1 | RM1 | Chr2 | Pos2 | LM2 | RM2 | LOD | PVE (%) | [aa] | [ad] | [da] | [dd] |
|-------|------|------|-------------|-------------|------|------|--------------|--------------|------|---------|------|------|-------|-------|
| GH | 2 | 170 | S2_6037490 | S2_14842741 | 7 | 30 | S7_1393902 | S7_2664466 | 5.1 | 16.2 | 0.1 | -0.4 | 0.0 | -0.5 |
| GH | 2 | 80 | S2_28723848 | S2_6405369 | 8 | 50 | S8_7083582 | S8_6798921 | 7.8 | 19.0 | -0.1 | -0.3 | 0.1 | -0.7 |
| GH | 2 | 225 | S2_9110747 | S2_20521571 | 9 | 70 | S9_1280107 | S9_1272426 | 5.5 | 16.5 | 0.2 | -0.3 | -0.2 | 0.2 |
| GH | 2 | 55 | S2_7373516 | S2_26876108 | 10 | 40 | S10_9867010 | S10_18754605 | 13.7 | 27.4 | 0.0 | -0.1 | 0.6 | -0.2 |
| GH | 2 | 185 | S2_3012518 | S2_36010450 | 11 | 120 | S11_32081128 | S11_16965469 | 7.3 | 21.1 | -0.6 | 0.0 | 0.0 | 0.2 |
| SW | 2 | 60 | S2_26876108 | S2_36085710 | 2 | 115 | S2_33146528 | S2_31710312 | 9.7 | 22.0 | 1.4 | 1.4 | -1.2 | -0.1 |
| SW | 2 | 185 | S2_3012518 | S2_36010450 | 3 | 35 | S3_17628375 | S3_17145449 | 9.9 | 37.1 | 1.7 | 0.0 | -3.2 | -0.6 |
| SW | 2 | 75 | S2_23068242 | S2_36264850 | 4 | 5 | S4_3592410 | S4_2761907 | 9.5 | 28.4 | 1.7 | -2.6 | 0.7 | -3.7 |
| SW | 2 | 75 | S2_23068242 | S2_36264850 | 5 | 10 | S5_4108250 | S5_4692888 | 7.8 | 21.8 | -0.9 | 3.3 | -1.0 | 2.6 |
| SW | 2 | 115 | S2_33146528 | S2_31710312 | 6 | 55 | S6_14316872 | S6_12750333 | 7.6 | 20.3 | 1.2 | -1.9 | 1.1 | -1.5 |
| SW | 2 | 105 | S2_14274387 | S2_20017568 | 7 | 45 | S7_2664466 | S7_2709523 | 6.5 | 22.4 | -0.5 | -2.0 | -1.4 | -2.0 |
| SW | 2 | 105 | S2_14274387 | S2_20017568 | 8 | 35 | S8_5590896 | S8_7083582 | 8.5 | 25.2 | -1.3 | 0.2 | -1.1 | -1.6 |
| SW | 2 | 105 | S2_14274387 | S2_20017568 | 9 | 10 | S9_10221364 | S9_10172092 | 9.5 | 24.2 | 1.3 | -1.6 | 0.7 | -0.4 |
| SW | 2 | 180 | S2_20785495 | S2_3012518 | 10 | 60 | S10_4935601 | S10_22177883 | 8.0 | 18.3 | 1.7 | 1.9 | -1.3 | 0.0 |
| SW | 2 | 115 | S2_33146528 | S2_31710312 | 11 | 130 | S11_27400742 | S11_39685563 | 8.6 | 20.3 | 1.5 | -1.3 | 1.2 | -0.7 |
| SY | 2 | 70 | S2_27324056 | S2_17356325 | 2 | 175 | S2_36429055 | S2_29055889 | 6.0 | 22.1 | 0.6 | 3.0 | -30.2 | -37.7 |
| SY | 2 | 175 | S2_36429055 | S2_29055889 | 3 | 45 | S3_18154848 | S3_17193829 | 6.2 | 23.6 | 19.1 | -3.1 | 14.0 | 12.5 |
| SY | 2 | 175 | S2_36429055 | S2_29055889 | 6 | 45 | S6_14202383 | S6_14380087 | 6.4 | 17.5 | 13.6 | 18.1 | 16.5 | 12.9 |
| SY | 2 | 245 | S2_11771536 | S2_206842 | 7 | 80 | S7_15005750 | S7_18208587 | 8.0 | 21.8 | 15.5 | 2.8 | -3.6 | 27.2 |
| SY | 2 | 230 | S2_20521571 | S2_15866804 | 10 | 20 | S10_6745618 | S10_18754549 | 7.3 | 21.0 | 7.3 | 18.1 | 16.7 | 30.8 |
| SY | 2 | 10 | S2_17095395 | S2_16997696 | 11 | 55 | S11_8456028 | S11_24859368 | 5.5 | 25.8 | 19.4 | -8.8 | -14.2 | 41.5 |
| DFF | 3 | 110 | S3_9468971 | S3_8772530 | 3 | 200 | S3_1763820 | S3_3640530 | 5.4 | 10.5 | 3.2 | -8.7 | 8.9 | 2.3 |
| DFF | 3 | 155 | S3_24585116 | S3_6422296 | 11 | 35 | S11_13558980 | S11_24859357 | 6.2 | 8.7 | 2.6 | 1.1 | 10.8 | -9.6 |
| GH | 3 | 20 | S3_21244595 | S3_22913898 | 3 | 40 | S3_17145449 | S3_18154873 | 41.8 | 96.0 | 0.0 | 0.5 | 0.5 | 0.0 |
| GH | 3 | 20 | S3_21244595 | S3_22913898 | 4 | 5 | S4_3592410 | S4_2761907 | 30.7 | 69.0 | 0.0 | 0.4 | 0.0 | -0.4 |
| GH | 3 | 20 | S3_21244595 | S3_22913898 | 5 | 30 | S5_4692912 | S5_1202286 | 8.9 | 61.5 | 0.2 | -0.2 | -0.2 | 0.1 |
| GH | 3 | 20 | S3_21244595 | S3_22913898 | 6 | 95 | S6_6094182 | S6_3447497 | 19.0 | 65.9 | -0.1 | -0.4 | 0.8 | -0.4 |
| GH | 3 | 20 | S3_21244595 | S3_22913898 | 7 | 45 | S7_2664466 | S7_2709523 | 11.4 | 65.1 | 0.0 | 0.4 | 0.1 | -0.4 |

| Trait | Chr1 | Pos1 | LM1 | RM1 | Chr2 | Pos2 | LM2 | RM2 | LOD | PVE (%) | [aa] | [ad] | [da] | [dd] |
|-------|------|------|-------------|-------------|------|------|--------------|--------------|------|---------|-------|-------|-------|-------|
| GH | 3 | 20 | S3_21244595 | S3_22913898 | 8 | 20 | S8_648217 | S8_5590896 | 17.4 | 66.4 | 0.0 | 0.4 | 0.1 | -0.3 |
| GH | 3 | 20 | S3_21244595 | S3_22913898 | 9 | 50 | S9_5329954 | S9_1280000 | 14.9 | 66.2 | 0.0 | 0.8 | -0.1 | 0.0 |
| GH | 3 | 20 | S3_21244595 | S3_22913898 | 10 | 10 | S10_6745618 | S10_18754549 | 15.6 | 65.8 | 0.2 | -0.2 | 0.6 | -0.6 |
| GH | 3 | 20 | S3_21244595 | S3_22913898 | 11 | 50 | S11_10798039 | S11_27887408 | 17.5 | 65.6 | -0.2 | -0.2 | 0.6 | -0.2 |
| SPC | 3 | 190 | S3_23950418 | S3_23900756 | 11 | 30 | S11_34926164 | S11_14777000 | 5.3 | 21.2 | -0.9 | 1.2 | 0.7 | 1.4 |
| SW | 3 | 25 | S3_25402258 | S3_18933167 | 3 | 160 | S3_23347149 | S3_5324878 | 7.1 | 21.6 | -1.3 | -0.5 | -2.2 | -1.2 |
| SW | 3 | 160 | S3_23347149 | S3_5324878 | 4 | 60 | S4_5232181 | S4_839628 | 8.8 | 23.7 | -1.1 | -0.1 | -2.1 | -1.5 |
| SW | 3 | 160 | S3_23347149 | S3_5324878 | 5 | 10 | S5_4108250 | S5_4692888 | 6.4 | 18.4 | -0.2 | 3.1 | 0.0 | 2.2 |
| SW | 3 | 160 | S3_23347149 | S3_5324878 | 6 | 90 | S6_6094182 | S6_3447497 | 6.9 | 21.4 | 1.5 | -1.9 | 0.9 | -0.6 |
| SW | 3 | 160 | S3_23347149 | S3_5324878 | 7 | 55 | S7_14683829 | S7_19171518 | 6.3 | 18.3 | 1.0 | -1.5 | 0.9 | 1.0 |
| SW | 3 | 90 | S3_24127310 | S3_24126743 | 8 | 120 | S8_14899494 | S8_15315643 | 5.4 | 15.7 | 0.3 | 2.5 | -0.3 | 3.4 |
| SW | 3 | 235 | S3_11414215 | S3_19102565 | 9 | 5 | S9_10221364 | S9_10172092 | 9.4 | 26.3 | 1.3 | -1.8 | 1.0 | -0.3 |
| SW | 3 | 35 | S3_17628375 | S3_17145449 | 10 | 15 | S10_6745618 | S10_18754549 | 8.7 | 24.8 | 1.9 | -1.6 | 0.7 | -0.3 |
| SW | 3 | 160 | S3_23347149 | S3_5324878 | 11 | 165 | S11_48519738 | S11_22689710 | 7.2 | 22.5 | 1.3 | -2.1 | 1.5 | -0.7 |
| SY | 3 | 65 | S3_1296061 | S3_16632579 | 6 | 25 | S6_18663394 | S6_14282225 | 5.7 | 17.3 | -12.0 | -12.0 | 19.3 | 6.6 |
| SY | 3 | 105 | S3_24127268 | S3_3362024 | 7 | 10 | S7_6043293 | S7_1393902 | 5.2 | 15.4 | -18.1 | 10.2 | -12.4 | 16.9 |
| SY | 3 | 200 | S3_1763820 | S3_3640530 | 10 | 10 | S10_6745618 | S10_18754549 | 6.1 | 31.7 | 28.7 | 1.1 | -6.5 | 16.0 |
| SY | 3 | 165 | S3_7903058 | S3_16519959 | 11 | 75 | S11_26490677 | S11_24186931 | 5.8 | 24.5 | 4.5 | -6.8 | -34.7 | -16.0 |
| GH | 4 | 5 | S4_3592410 | S4_2761907 | 4 | 85 | S4_2222481 | S4_2761945 | 7.9 | 19.5 | 0.0 | -0.1 | -0.4 | -0.4 |
| GH | 4 | 5 | S4_3592410 | S4_2761907 | 5 | 75 | S5_4199522 | S5_624899 | 10.1 | 24.4 | 0.1 | 0.0 | -0.4 | -0.4 |
| GH | 4 | 0 | S4_3592410 | S4_2761907 | 6 | 90 | S6_6094182 | S6_3447497 | 7.6 | 17.9 | 0.0 | 0.0 | 0.4 | -0.5 |
| GH | 4 | 5 | S4_3592410 | S4_2761907 | 7 | 60 | S7_19171518 | S7_10467966 | 7.6 | 24.5 | -0.1 | 0.1 | 0.4 | -0.4 |
| GH | 4 | 5 | S4_3592410 | S4_2761907 | 8 | 50 | S8_7083582 | S8_6798921 | 13.8 | 28.6 | -0.1 | 0.1 | 0.1 | 0.8 |
| GH | 4 | 5 | S4_3592410 | S4_2761907 | 10 | 40 | S10_9867010 | S10_18754605 | 15.5 | 32.7 | 0.0 | 0.1 | 0.2 | -0.7 |
| GH | 4 | 5 | S4_3592410 | S4_2761907 | 11 | 165 | S11_48519738 | S11_22689710 | 9.2 | 26.4 | 0.0 | 0.0 | -0.1 | 0.8 |
| SW | 4 | 15 | S4_3592410 | S4_2761907 | 4 | 55 | S4_5573457 | S4_5232181 | 7.1 | 21.3 | -0.9 | -0.7 | 3.0 | 2.9 |
| SW | 4 | 45 | S4_5991509 | S4_5573457 | 6 | 100 | S6_6094182 | S6_3447497 | 5.1 | 16.3 | 1.9 | -1.9 | 1.0 | -1.4 |
| SW | 4 | 90 | S4_2222481 | S4_2761945 | 8 | 0 | S8_879539 | S8_388862 | 5.2 | 20.3 | -0.9 | 1.3 | -0.3 | -2.4 |

| Trait | Chr1 | Pos1 | LM1 | RM1 | Chr2 | Pos2 | LM2 | RM2 | LOD | PVE (%) | [aa] | [ad] | [da] | [dd] |
|-------|------|------|-------------|-------------|------|------|--------------|--------------|-----|---------|-------|-------|-------|-------|
| SW | 4 | 55 | S4_5573457 | S4_5232181 | 10 | 75 | S10_12011472 | S10_17897318 | 8.8 | 18.8 | -1.2 | -1.0 | -1.0 | -0.6 |
| SW | 4 | 55 | S4_5573457 | S4_5232181 | 11 | 200 | S11_3246235 | S11_3725161 | 6.1 | 14.6 | 0.2 | 1.4 | -0.1 | 0.9 |
| SY | 4 | 30 | S4_9442019 | S4_7998411 | 4 | 85 | S4_2222481 | S4_2761945 | 5.1 | 21.6 | -7.2 | -21.8 | 7.7 | 14.2 |
| SY | 4 | 30 | S4_9442019 | S4_7998411 | 10 | 10 | S10_6745618 | S10_18754549 | 6.9 | 22.6 | -15.5 | -7.7 | 14.4 | 11.0 |
| GH | 5 | 35 | S5_4692912 | S5_1202286 | 5 | 70 | S5_4199522 | S5_624899 | 8.9 | 24.2 | 0.1 | 0.2 | -0.6 | -0.4 |
| GH | 5 | 70 | S5_4199522 | S5_624899 | 11 | 170 | S11_22689710 | S11_4453854 | 6.3 | 18.9 | 0.0 | -0.4 | 0.0 | -0.2 |
| SW | 5 | 50 | S5_1202286 | S5_514608 | 6 | 100 | S6_6094182 | S6_3447497 | 5.2 | 17.0 | 1.1 | -1.3 | 0.7 | -0.8 |
| SW | 5 | 5 | S5_3437906 | S5_4108250 | 10 | 60 | S10_4935601 | S10_22177883 | 5.9 | 16.7 | 1.5 | 2.1 | -0.9 | -1.3 |
| SW | 5 | 0 | S5_3437907 | S5_3437906 | 11 | 45 | S11_11249294 | S11_25591691 | 5.5 | 14.6 | 1.3 | 1.4 | -1.7 | -1.5 |
| SY | 5 | 75 | S5_4199522 | S5_624899 | 10 | 10 | S10_6745618 | S10_18754549 | 7.4 | 23.3 | -1.7 | -1.8 | -28.6 | -23.8 |
| DFE | 6 | 90 | S6_6094182 | S6_3447497 | 7 | 85 | S7_15005750 | S7_18208587 | 5.4 | 10.7 | -6.3 | 9.0 | 6.1 | -13.1 |
| GH | 6 | 95 | S6_6094182 | S6_3447497 | 7 | 15 | S7_6043293 | S7_1393902 | 7.9 | 14.6 | 0.1 | 0.5 | 0.0 | -0.3 |
| GH | 6 | 20 | S6_21140545 | S6_18663445 | 10 | 45 | S10_9867010 | S10_18754605 | 6.3 | 17.3 | 0.1 | 0.0 | -0.6 | -0.5 |
| GH | 6 | 95 | S6_6094182 | S6_3447497 | 11 | 20 | S11_29782754 | S11_40540329 | 7.0 | 20.6 | 0.2 | 0.6 | 0.1 | -0.1 |
| SW | 6 | 35 | S6_14335833 | S6_14385396 | 6 | 45 | S6_14202383 | S6_14380087 | 8.2 | 17.3 | 1.5 | 3.0 | -1.7 | -0.2 |
| SW | 6 | 100 | S6_6094182 | S6_3447497 | 7 | 60 | S7_19171518 | S7_10467966 | 5.9 | 23.1 | -0.8 | -2.4 | 0.6 | 2.6 |
| SW | 6 | 95 | S6_6094182 | S6_3447497 | 8 | 15 | S8_648217 | S8_5590896 | 6.7 | 39.8 | 1.1 | 2.0 | -1.5 | -2.3 |
| SW | 6 | 95 | S6_6094182 | S6_3447497 | 9 | 10 | S9_10221364 | S9_10172092 | 5.0 | 17.7 | -0.8 | 1.3 | 1.0 | -1.5 |
| SW | 6 | 95 | S6_6094182 | S6_3447497 | 10 | 10 | S10_6745618 | S10_18754549 | 7.6 | 26.8 | -1.8 | 1.6 | 1.4 | -0.1 |
| SW | 6 | 95 | S6_6094182 | S6_3447497 | 11 | 45 | S11_11249294 | S11_25591691 | 6.6 | 19.3 | 1.3 | 0.8 | -1.1 | -0.3 |
| SY | 6 | 20 | S6_21140545 | S6_18663445 | 7 | 10 | S7_6043293 | S7_1393902 | 7.2 | 19.8 | -15.5 | 16.2 | -24.1 | -0.3 |
| SY | 6 | 100 | S6_6094182 | S6_3447497 | 10 | 10 | S10_6745618 | S10_18754549 | 5.4 | 18.4 | -6.8 | -8.7 | 29.5 | 25.6 |
| SY | 6 | 40 | S6_14282200 | S6_14335733 | 11 | 75 | S11_26490677 | S11_24186931 | 6.4 | 14.7 | 14.1 | 18.2 | 16.2 | 8.5 |
| DFE | 7 | 85 | S7_15005750 | S7_18208587 | 9 | 5 | S9_10221364 | S9_10172092 | 5.7 | 10.5 | 4.9 | 6.3 | -5.2 | -15.1 |
| GH | 7 | 30 | S7_1393902 | S7_2664466 | 7 | 35 | S7_1393902 | S7_2664466 | 8.1 | 21.0 | 0.1 | -0.3 | 0.2 | -0.9 |
| GH | 7 | 65 | S7_19171518 | S7_10467966 | 8 | 95 | S8_18579673 | S8_15137210 | 5.7 | 18.4 | 0.3 | -0.1 | -0.1 | 0.3 |
| GH | 7 | 30 | S7_1393902 | S7_2664466 | 10 | 10 | S10_6745618 | S10_18754549 | 6.7 | 20.5 | -0.1 | -0.1 | 0.3 | -0.4 |
| SW | 7 | 65 | S7_19171518 | S7_10467966 | 7 | 70 | S7_10467966 | S7_15005750 | 6.3 | 30.2 | -0.8 | 0.9 | -3.8 | 1.1 |

| Trait | Chr1 | Pos1 | LM1 | RM1 | Chr2 | Pos2 | LM2 | RM2 | LOD | PVE (%) | [aa] | [ad] | [da] | [dd] |
|------------------------------|------|------|--------------|--------------|------|------|--------------|--------------|------|---------|-------|-------|-------|-------|
| SW | 7 | 5 | S7_6043293 | S7_1393902 | 10 | 60 | S10_4935601 | S10_22177883 | 6.1 | 17.6 | -1.1 | -2.2 | -1.3 | -1.2 |
| SY | 7 | 75 | S7_10467966 | S7_15005750 | 10 | 20 | S10_6745618 | S10_18754549 | 7.2 | 17.7 | -16.5 | -3.4 | 12.5 | 14.9 |
| SY | 7 | 10 | S7_6043293 | S7_1393902 | 11 | 195 | S11_3724414 | S11_366844 | 8.5 | 24.1 | -1.0 | 35.6 | 8.6 | -28.8 |
| GH | 8 | 55 | S8_7083582 | S8_6798921 | 8 | 60 | S8_6798921 | S8_19450430 | 11.7 | 24.7 | -0.4 | 0.0 | -0.6 | 0.2 |
| GH | 8 | 50 | S8_7083582 | S8_6798921 | 10 | 45 | S10_9867010 | S10_18754605 | 7.5 | 22.8 | 0.1 | 0.1 | -0.5 | -0.6 |
| SW | 8 | 50 | S8_7083582 | S8_6798921 | 10 | 10 | S10_6745618 | S10_18754549 | 7.9 | 26.4 | 1.1 | -0.9 | 2.4 | -1.8 |
| SW | 8 | 15 | S8_648217 | S8_5590896 | 11 | 50 | S11_10798039 | S11_27887408 | 6.0 | 35.4 | 0.9 | -1.7 | 1.5 | -1.7 |
| SY | 8 | 20 | S8_648217 | S8_5590896 | 10 | 10 | S10_6745618 | S10_18754549 | 5.1 | 26.9 | 6.9 | 15.4 | 14.9 | 32.1 |
| SY | 8 | 60 | S8_6798921 | S8_19450430 | 11 | 55 | S11_8456028 | S11_24859368 | 5.0 | 20.7 | -25.7 | 7.9 | -10.2 | 39.4 |
| GH | 9 | 55 | S9_5329954 | S9_1280000 | 9 | 70 | S9_1280107 | S9_1272426 | 11.8 | 25.6 | 0.1 | -0.4 | 0.6 | -0.2 |
| GH | 9 | 70 | S9_1280107 | S9_1272426 | 10 | 40 | S10_9867010 | S10_18754605 | 11.3 | 26.1 | 0.0 | 0.3 | 0.3 | -0.2 |
| SW | 9 | 25 | S9_7756050 | S9_8995134 | 9 | 35 | S9_7755937 | S9_7993111 | 6.8 | 16.3 | 0.1 | -2.4 | 0.0 | 2.5 |
| SW | 9 | 25 | S9_7756050 | S9_8995134 | 10 | 120 | S10_17800762 | S10_20225996 | 8.9 | 19.0 | 1.0 | 1.2 | -1.0 | -2.0 |
| SW | 9 | 45 | S9_5329954 | S9_1280000 | 11 | 60 | S11_2583306 | S11_36601967 | 7.1 | 19.4 | 1.0 | 1.2 | -0.7 | -1.7 |
| SY | 9 | 20 | S9_10003418 | S9_8998000 | 10 | 5 | S10_6745618 | S10_18754549 | 7.3 | 22.7 | -5.9 | 0.9 | -30.8 | -16.4 |
| GH | 10 | 35 | S10_9867010 | S10_18754605 | 10 | 40 | S10_9867010 | S10_18754605 | 13.6 | 27.3 | 0.1 | 0.1 | 0.2 | -0.6 |
| GH | 10 | 10 | S10_6745618 | S10_18754549 | 11 | 65 | S11_25591551 | S11_36998432 | 11.7 | 23.0 | 0.2 | 0.2 | 0.0 | -0.5 |
| SW | 10 | 15 | S10_6745618 | S10_18754549 | 10 | 75 | S10_12011472 | S10_17897318 | 8.9 | 23.3 | 1.5 | 0.4 | -1.4 | -0.8 |
| SW | 10 | 75 | S10_12011472 | S10_17897318 | 11 | 165 | S11_48519738 | S11_22689710 | 8.7 | 19.5 | 1.4 | -1.2 | 1.4 | -1.2 |
| SY | 10 | 15 | S10_6745618 | S10_18754549 | 10 | 45 | S10_9867010 | S10_18754605 | 6.7 | 33.1 | -23.0 | 8.8 | 3.0 | 22.4 |
| SY | 10 | 10 | S10_6745618 | S10_18754549 | 11 | 180 | S11_9114357 | S11_2019429 | 7.7 | 27.1 | 7.3 | -18.8 | 2.5 | -38.0 |
| GH | 11 | 165 | S11_48519738 | S11_22689710 | 11 | 170 | S11_22689710 | S11_4453854 | 7.1 | 16.0 | -0.2 | -0.1 | 0.3 | 0.3 |
| SW | 11 | 60 | S11_2583306 | S11_36601967 | 11 | 125 | S11_7565026 | S11_20087622 | 7.1 | 19.4 | -0.6 | -1.3 | -1.6 | -1.1 |
| SY | 11 | 55 | S11_8456028 | S11_24859368 | 11 | 160 | S11_29845620 | S11_23864521 | 5.4 | 20.0 | 16.3 | -7.2 | 0.3 | 19.7 |
| Pop4 (ICP 8863 × ICPL 87119) | | | | | | | | | | | | | | |
| DFP | 1 | 25 | S1_1285564 | S1_16743053 | 1 | 120 | S1_1954810 | S1_12641799 | 5.4 | 16.2 | 3.9 | -7.7 | 3.6 | -0.3 |
| DFP | 1 | 75 | S1_1158266 | S1_12641760 | 3 | 145 | S3_4949379 | S3_15768334 | 5.3 | 19.2 | 1.8 | -1.0 | -7.4 | 5.5 |
| SPC | 1 | 0 | S1_3518364 | S1_8912598 | 10 | 165 | S10_11797822 | S10_22177616 | 5.3 | 9.8 | 0.5 | -0.5 | 0.8 | 0.5 |

| Trait | Chr1 | Pos1 | LM1 | RM1 | Chr2 | Pos2 | LM2 | RM2 | LOD | PVE (%) | [aa] | [ad] | [da] | [dd] |
|-------|------|------|-------------|-------------|------|------|--------------|--------------|-----|---------|-------|-------|-------|-------|
| SW | 1 | 105 | S1_2823169 | S1_11795390 | 3 | 105 | S3_27536189 | S3_13210310 | 5.3 | 21.9 | 0.6 | -0.4 | -0.2 | -1.5 |
| SW | 1 | 110 | S1_9402663 | S1_11824695 | 4 | 55 | S4_3978352 | S4_3978307 | 5.1 | 23.8 | -0.2 | -1.1 | -0.8 | 0.3 |
| SW | 1 | 110 | S1_9402663 | S1_11824695 | 8 | 50 | S8_1870690 | S8_14893200 | 5.1 | 20.9 | 0.0 | -1.2 | 0.4 | -0.4 |
| SW | 1 | 45 | S1_11236615 | S1_9402646 | 11 | 190 | S11_10379800 | S11_39387203 | 5.2 | 19.6 | 0.1 | 0.3 | -0.8 | -1.1 |
| SY | 1 | 5 | S1_3518364 | S1_8912598 | 11 | 200 | S11_10379800 | S11_39387203 | 6.3 | 23.8 | 1.8 | -20.4 | 16.8 | -63.8 |
| SY | 1 | 45 | S1_11236615 | S1_9402646 | 2 | 20 | S2_5465513 | S2_27251002 | 5.3 | 17.8 | -1.0 | 13.5 | 16.0 | -44.4 |
| SY | 1 | 15 | S1_15951980 | S1_15951983 | 7 | 45 | S7_11292795 | S7_15538705 | 5.3 | 12.4 | -20.9 | -24.9 | 23.1 | -7.1 |
| SY | 1 | 15 | S1_15951980 | S1_15951983 | 8 | 10 | S8_4870225 | S8_17923633 | 5.2 | 12.0 | -13.9 | -19.3 | 38.5 | 10.4 |
| DFF | 2 | 105 | S2_20786266 | S2_3909322 | 3 | 95 | S3_1820861 | S3_18837767 | 5.9 | 15.5 | 2.9 | 0.8 | 11.2 | 5.1 |
| DFF | 2 | 170 | S2_31369072 | S2_2636840 | 6 | 100 | S6_11368993 | S6_16630543 | 5.6 | 19.8 | 0.3 | 5.0 | -8.1 | 9.0 |
| DFF | 2 | 0 | S2_19392681 | S2_31090530 | 7 | 170 | S7_7547477 | S7_2556783 | 5.7 | 19.1 | 0.5 | 6.1 | 3.9 | 4.6 |
| SPC | 2 | 5 | S2_31090530 | S2_11172947 | 6 | 120 | S6_8998640 | S6_22745176 | 5.3 | 17.0 | 0.1 | 0.4 | -1.2 | 0.7 |
| SW | 2 | 40 | S2_10335056 | S2_2989918 | 11 | 175 | S11_41966756 | S11_2739522 | 6.2 | 24.4 | 0.2 | 0.1 | -1.4 | -0.7 |
| SW | 2 | 10 | S2_11172947 | S2_11585386 | 4 | 100 | S4_3982439 | S4_10981441 | 5.1 | 25.4 | 0.4 | 0.5 | -0.9 | 1.0 |
| SW | 2 | 45 | S2_2989945 | S2_28067338 | 6 | 95 | S6_21912913 | S6_11368997 | 5.6 | 21.0 | -0.1 | 0.2 | 0.7 | -1.8 |
| SW | 2 | 125 | S2_12561939 | S2_16904395 | 8 | 90 | S8_4088164 | S8_11725020 | 5.6 | 25.0 | -0.1 | -0.3 | -1.1 | 1.0 |
| SY | 2 | 20 | S2_5465513 | S2_27251002 | 6 | 75 | S6_12492736 | S6_19839881 | 5.1 | 14.1 | 3.8 | 11.6 | -6.9 | -48.9 |
| SY | 2 | 105 | S2_20786266 | S2_3909322 | 8 | 100 | S8_12763827 | S8_2545645 | 6.1 | 19.6 | 3.8 | 4.0 | -25.2 | -55.6 |
| DFF | 3 | 110 | S3_517899 | S3_5034170 | 4 | 60 | S4_3978352 | S4_3978307 | 6.2 | 16.7 | 5.3 | 7.1 | -2.0 | 6.2 |
| DFF | 3 | 0 | S3_17585835 | S3_6422190 | 5 | 75 | S5_1033048 | S5_2154363 | 5.2 | 14.7 | 0.6 | 9.8 | -5.7 | -3.9 |
| DFF | 3 | 95 | S3_1820861 | S3_18837767 | 10 | 80 | S10_14607250 | S10_15235469 | 5.7 | 16.2 | -2.3 | 7.2 | -6.1 | 0.2 |
| SW | 3 | 130 | S3_3207601 | S3_28801734 | 7 | 40 | S7_5257435 | S7_19515938 | 5.5 | 23.7 | -0.5 | 0.0 | -0.2 | -1.7 |
| SW | 4 | 55 | S4_3978352 | S4_3978307 | 4 | 95 | S4_3982439 | S4_10981441 | 5.5 | 25.6 | -0.1 | 0.7 | -1.0 | 1.7 |
| SW | 4 | 45 | S4_3978352 | S4_3978307 | 7 | 145 | S7_4934324 | S7_16759426 | 7.0 | 14.2 | 0.3 | -0.8 | 0.8 | 0.1 |
| SW | 4 | 50 | S4_3978352 | S4_3978307 | 10 | 55 | S10_7592635 | S10_16594094 | 5.2 | 17.5 | 0.1 | -0.8 | 0.1 | -1.2 |
| SW | 4 | 30 | S4_3978304 | S4_11052197 | 11 | 195 | S11_10379800 | S11_39387203 | 5.6 | 19.5 | -0.5 | -0.6 | -0.6 | -0.3 |
| SY | 4 | 60 | S4_3978352 | S4_3978307 | 7 | 50 | S7_17391305 | S7_629308 | 5.2 | 15.1 | -6.9 | -19.4 | -39.9 | -53.8 |
| SW | 5 | 55 | S5_4439127 | S5_1033048 | 6 | 165 | S6_19397317 | S6_22274548 | 5.2 | 14.6 | -0.4 | -0.9 | 0.0 | 0.1 |

| Trait | Chr1 | Pos1 | LM1 | RM1 | Chr2 | Pos2 | LM2 | RM2 | LOD | PVE (%) | [aa] | [ad] | [da] | [dd] |
|-----------------------------|------|------|--------------|--------------|------|------|--------------|--------------|-----|---------|-------|-------|-------|-------|
| SY | 5 | 5 | S5_2134834 | S5_2133997 | 8 | 100 | S8_12763827 | S8_2545645 | 7.2 | 21.1 | -5.2 | 8.6 | -47.6 | -29.4 |
| DFF | 6 | 100 | S6_11368993 | S6_16630543 | 6 | 135 | S6_18650949 | S6_10118855 | 5.1 | 23.1 | 0.8 | -4.7 | 6.6 | 11.6 |
| DFF | 6 | 100 | S6_11368993 | S6_16630543 | 7 | 165 | S7_7547426 | S7_7547477 | 5.4 | 12.0 | -3.6 | 1.1 | 6.5 | 3.3 |
| DFF | 6 | 185 | S6_9119076 | S6_1641600 | 11 | 155 | S11_26961748 | S11_11799678 | 5.5 | 19.5 | -6.6 | 4.4 | 2.8 | 5.7 |
| SPC | 6 | 95 | S6_21912913 | S6_11368997 | 7 | 40 | S7_5257435 | S7_19515938 | 6.3 | 30.5 | 0.0 | 1.2 | -0.2 | 1.5 |
| SPC | 6 | 120 | S6_8998640 | S6_22745176 | 8 | 75 | S8_4817492 | S8_18097152 | 5.5 | 18.6 | 0.3 | -0.8 | -0.2 | 1.5 |
| SPC | 6 | 145 | S6_4528744 | S6_11344426 | 10 | 25 | S10_8682310 | S10_22432012 | 5.0 | 19.1 | 0.4 | -0.7 | -0.7 | 0.7 |
| SW | 6 | 95 | S6_21912913 | S6_11368997 | 7 | 40 | S7_5257435 | S7_19515938 | 6.1 | 18.6 | 0.4 | 0.6 | -0.8 | -1.1 |
| SW | 6 | 10 | S6_5168768 | S6_21993984 | 6 | 95 | S6_21912913 | S6_11368997 | 5.3 | 22.1 | 0.1 | -0.1 | 0.8 | -1.8 |
| SW | 6 | 95 | S6_21912913 | S6_11368997 | 10 | 150 | S10_11797843 | S10_17661180 | 5.3 | 21.7 | 0.1 | 1.1 | -0.1 | -1.4 |
| SW | 6 | 95 | S6_21912913 | S6_11368997 | 11 | 190 | S11_10379800 | S11_39387203 | 5.1 | 19.6 | 0.1 | -0.5 | 0.6 | 1.2 |
| SW | 7 | 40 | S7_5257435 | S7_19515938 | 8 | 5 | S8_4870225 | S8_17923633 | 5.5 | 25.3 | 0.0 | 1.1 | 0.2 | 1.4 |
| SY | 8 | 100 | S8_12763827 | S8_2545645 | 8 | 140 | S8_19001637 | S8_19307650 | 5.4 | 16.4 | 0.5 | -31.6 | 18.2 | -28.0 |
| SY | 8 | 100 | S8_12763827 | S8_2545645 | 10 | 125 | S10_21275558 | S10_8446246 | 6.1 | 16.0 | 1.1 | -38.8 | 13.8 | -55.8 |
| SY | 8 | 115 | S8_12196669 | S8_8905244 | 11 | 200 | S11_10379800 | S11_39387203 | 5.5 | 23.1 | 1.3 | -1.5 | 21.3 | -68.0 |
| SPC | 10 | 130 | S10_12572056 | S10_11360684 | 11 | 175 | S11_41966756 | S11_2739522 | 5.2 | 21.4 | -0.3 | 0.6 | -1.2 | 1.7 |
| SPC | 10 | 115 | S10_16591318 | S10_19313155 | 10 | 165 | S10_11797822 | S10_22177616 | 5.5 | 12.8 | -0.1 | 0.0 | 1.1 | 0.7 |
| SY | 10 | 140 | S10_11129172 | S10_22177741 | 11 | 35 | S11_29910199 | S11_1427973 | 6.1 | 14.3 | -26.5 | -16.0 | 4.6 | 30.7 |
| DFF | 11 | 30 | S11_6866243 | S11_22800082 | 11 | 185 | S11_27825781 | S11_27703059 | 5.1 | 30.1 | -0.6 | -4.0 | 2.3 | 14.1 |
| SPC | 11 | 10 | S11_9655513 | S11_11782549 | 11 | 25 | S11_39259070 | S11_5870873 | 5.2 | 28.9 | -0.3 | 0.2 | 0.7 | 2.4 |
| SW | 11 | 175 | S11_41966756 | S11_2739522 | 11 | 190 | S11_10379800 | S11_39387203 | 5.7 | 24.8 | 0.6 | 0.9 | -0.5 | 1.0 |
| Pop5 (ICP 5529 × ICP 11605) | | | | | | | | | | | | | | |
| GH | 1 | 80 | S1_17462230 | s1_16873606 | 5 | 45 | S5_4199096 | S5_3228176 | 5.1 | 10.6 | 0.2 | 0.3 | 0.3 | 0.1 |
| SW | 1 | 90 | S1_16910575 | S1_17478283 | 2 | 15 | S2_4089442 | S2_36164833 | 5.1 | 13.6 | 1.0 | -1.4 | 1.2 | -0.9 |
| SW | 1 | 90 | S1_16910575 | S1_17478283 | 7 | 175 | S7_14683829 | S7_14588865 | 5.2 | 14.6 | 1.1 | -1.6 | 0.9 | -1.2 |
| SW | 1 | 90 | S1_16910575 | S1_17478283 | 11 | 95 | S11_42473528 | S11_40289708 | 6.9 | 13.5 | -1.3 | -1.2 | -1.3 | -0.9 |
| SW | 1 | 95 | S1_17486758 | S1_17365797 | 3 | 125 | S3_5052534 | S3_8600411 | 5.5 | 14.7 | 1.0 | -1.5 | 1.4 | -1.4 |
| SW | 1 | 35 | s1_4415753 | S1_4839845 | 1 | 90 | S1_16910575 | S1_17478283 | 6.2 | 11.5 | 0.0 | 1.1 | -0.6 | -0.5 |

| Trait | Chr1 | Pos1 | LM1 | RM1 | Chr2 | Pos2 | LM2 | RM2 | LOD | PVE (%) | [aa] | [ad] | [da] | [dd] |
|-------|------|------|-------------|-------------|------|------|--------------|--------------|------|---------|-------|-------|-------|-------|
| SY | 1 | 50 | S1_1575466 | S1_12652912 | 3 | 85 | S3_23698867 | S3_8011694 | 5.5 | 17.4 | 22.1 | -18.8 | -21.4 | 41.8 |
| SY | 1 | 80 | S1_17462230 | s1_16873606 | 2 | 5 | S2_6500923 | S2_36141669 | 5.6 | 22.9 | 2.5 | -38.8 | 5.3 | -35.3 |
| SY | 1 | 75 | S1_3905217 | S1_17462230 | 5 | 85 | S5_2154598 | S5_3299149 | 7.2 | 32.7 | -33.8 | 2.8 | 1.3 | 57.2 |
| SY | 1 | 75 | S1_3905217 | S1_17462230 | 8 | 160 | S8_17090863 | S8_5491195 | 7.2 | 33.3 | 4.4 | -44.5 | -12.6 | -46.8 |
| SY | 1 | 75 | S1_3905217 | S1_17462230 | 9 | 30 | S9_7304246 | S9_5330124 | 5.6 | 27.2 | -0.2 | -29.3 | 0.6 | -55.8 |
| SY | 1 | 75 | S1_3905217 | S1_17462230 | 11 | 150 | S11_772476 | S11_17940886 | 5.9 | 31.5 | 23.6 | 15.4 | 30.5 | -20.0 |
| SY | 1 | 55 | S1_435014 | S1_14036692 | 1 | 60 | S1_435014 | S1_14036692 | 6.8 | 29.6 | -11.8 | -24.6 | 71.9 | -18.8 |
| SY | 1 | 20 | S1_5944791 | S1_5173345 | 6 | 55 | S6_6094182 | S6_3312026 | 6.7 | 40.0 | -10.5 | -11.0 | 45.6 | -34.4 |
| DFF | 2 | 10 | S2_16974864 | S2_6623704 | 7 | 175 | S7_14683829 | S7_14588865 | 5.1 | 21.2 | -3.3 | -3.4 | 8.7 | 1.8 |
| GH | 2 | 140 | S2_13395941 | S2_13388912 | 4 | 50 | S4_5573457 | S4_7149747 | 5.4 | 16.6 | 0.1 | 0.5 | 0.1 | -0.3 |
| GH | 2 | 130 | s2_16726731 | S2_16216536 | 2 | 165 | S2_36104004 | S2_7680557 | 5.5 | 26.7 | 0.1 | 0.3 | 0.3 | -0.6 |
| GH | 2 | 170 | S2_36104004 | S2_7680557 | 3 | 65 | S3_14618126 | S3_22872410 | 6.7 | 22.6 | 0.2 | -0.1 | -0.5 | -0.3 |
| GH | 2 | 160 | S2_36104004 | S2_7680557 | 6 | 95 | S6_14282225 | S6_14311546 | 5.7 | 13.1 | -0.2 | 0.6 | 0.0 | -0.3 |
| GH | 2 | 160 | S2_36104004 | S2_7680557 | 8 | 70 | S8_16623818 | S8_8700231 | 5.2 | 22.3 | -0.2 | 0.6 | -0.2 | -0.2 |
| GH | 2 | 50 | S2_9110747 | S2_12221357 | 5 | 40 | S5_2081547 | S5_4199096 | 5.9 | 14.9 | -0.1 | 0.1 | -0.4 | -0.7 |
| GH | 2 | 50 | S2_9110747 | S2_12221357 | 7 | 110 | S7_6037064 | S7_2639387 | 8.9 | 22.0 | -0.2 | -0.1 | 0.3 | 0.2 |
| GH | 2 | 50 | S2_9110747 | S2_12221357 | 11 | 70 | S11_43548291 | S11_32240905 | 6.9 | 21.7 | 0.3 | -0.1 | 0.0 | 0.4 |
| SW | 2 | 10 | S2_16974864 | S2_6623704 | 11 | 25 | S11_6210775 | S11_39507811 | 5.3 | 24.4 | 0.3 | -1.2 | 1.0 | -1.3 |
| SY | 2 | 10 | S2_16974864 | S2_6623704 | 3 | 115 | S3_14754306 | S3_8040710 | 5.3 | 19.0 | 0.7 | 31.2 | -19.7 | -46.9 |
| SY | 2 | 10 | S2_16974864 | S2_6623704 | 7 | 175 | S7_14683829 | S7_14588865 | 5.7 | 27.9 | 17.8 | -47.8 | -14.1 | 56.9 |
| SY | 2 | 25 | S2_30868559 | S2_3713697 | 6 | 70 | S6_14548839 | S6_12512558 | 7.0 | 28.3 | -1.0 | 13.9 | 46.7 | -68.2 |
| SY | 2 | 40 | S2_31385744 | s2_1201138_ | 11 | 160 | S11_38144723 | S11_27887800 | 6.6 | 25.7 | 3.2 | -0.9 | -60.1 | 40.4 |
| SY | 2 | 5 | S2_6500923 | S2_36141669 | 8 | 105 | S8_9267520 | S8_9779781 | 6.9 | 31.4 | -2.5 | -9.8 | 66.5 | -41.5 |
| DFF | 3 | 80 | S3_8195933 | S3_3563061 | 11 | 70 | S11_43548291 | S11_32240905 | 5.5 | 23.6 | -4.4 | -4.5 | -3.7 | 12.3 |
| GH | 3 | 35 | s3_20698771 | S3_18430894 | 3 | 65 | S3_14618126 | S3_22872410 | 16.6 | 74.8 | -0.1 | -0.1 | -0.6 | -0.6 |
| GH | 3 | 35 | s3_20698771 | S3_18430894 | 4 | 25 | S4_1710877 | s4_496463 | 15.3 | 73.8 | 0.1 | -0.1 | 0.7 | -0.6 |
| GH | 3 | 35 | s3_20698771 | S3_18430894 | 5 | 135 | S5_4199522 | S5_3988054 | 8.7 | 74.3 | -0.1 | -0.2 | 0.2 | -0.6 |
| GH | 3 | 35 | s3_20698771 | S3_18430894 | 6 | 65 | S6_16310378 | S6_14551548 | 15.6 | 74.2 | 0.2 | -0.2 | 0.5 | -0.6 |

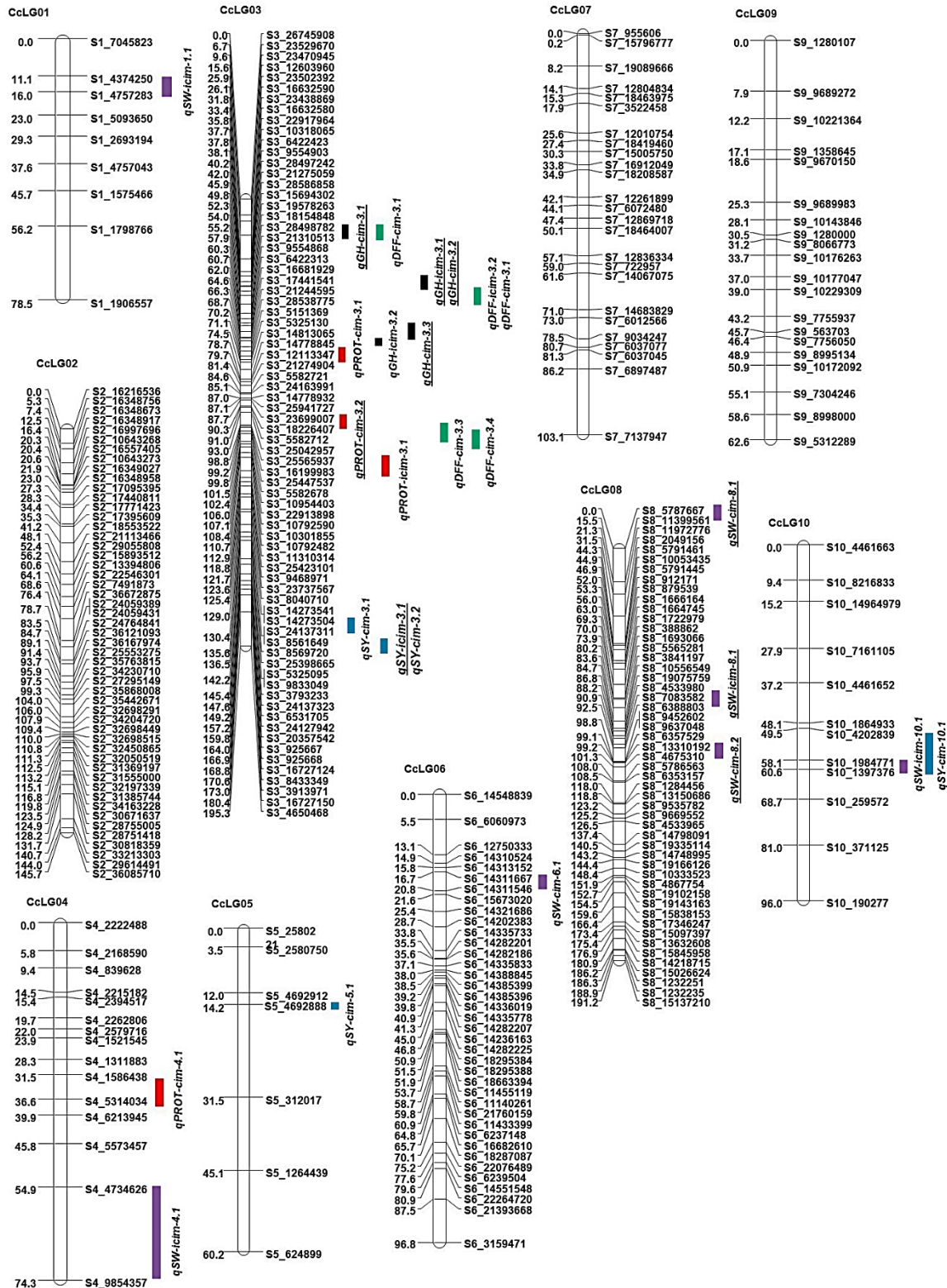
| Trait | Chr1 | Pos1 | LM1 | RM1 | Chr2 | Pos2 | LM2 | RM2 | LOD | PVE (%) | [aa] | [ad] | [da] | [dd] |
|-------|------|------|-------------|-------------|------|------|--------------|--------------|------|---------|-------|-------|-------|-------|
| GH | 3 | 35 | s3_20698771 | S3_18430894 | 8 | 90 | S8_7083922 | S8_8700211 | 12.5 | 74.1 | 0.4 | -0.4 | 0.0 | 0.1 |
| GH | 3 | 35 | s3_20698771 | S3_18430894 | 9 | 65 | S9_1280107 | S9_7212593 | 5.8 | 69.4 | -0.1 | -0.1 | 0.0 | -0.3 |
| GH | 3 | 35 | s3_20698771 | S3_18430894 | 11 | 165 | S11_35533615 | S11_24152330 | 10.2 | 73.0 | 0.2 | -0.2 | 0.5 | -0.6 |
| GH | 3 | 25 | S3_22234078 | S3_16681929 | 7 | 20 | S7_19090687 | S7_13036645 | 8.8 | 33.7 | -0.2 | 0.1 | 0.6 | -0.6 |
| GH | 3 | 90 | S3_8011694 | S3_22090943 | 10 | 45 | S10_5310960 | S10_4472034 | 5.3 | 16.4 | 0.2 | 0.0 | -0.1 | 0.5 |
| SW | 3 | 20 | S3_24127385 | S3_21274904 | 3 | 100 | S3_10301855 | S3_7318897 | 5.2 | 16.4 | 1.3 | 1.8 | -0.4 | -1.3 |
| SW | 3 | 20 | S3_24127385 | S3_21274904 | 10 | 60 | S10_4472034 | S10_234727 | 5.6 | 19.6 | 1.1 | 0.3 | -0.5 | 0.5 |
| SW | 3 | 15 | S3_28538775 | S3_21244595 | 11 | 95 | S11_42473528 | S11_40289708 | 5.8 | 15.8 | 1.0 | 1.7 | -1.2 | -0.3 |
| SY | 3 | 100 | S3_10301855 | S3_7318897 | 11 | 140 | S11_31114457 | S11_28353104 | 8.7 | 26.8 | -15.8 | -61.7 | 37.2 | -5.3 |
| SY | 3 | 40 | S3_18430894 | S3_18154848 | 8 | 155 | S8_9779799 | S8_17090863 | 5.4 | 31.8 | -13.3 | 52.3 | -20.5 | -45.5 |
| SY | 3 | 130 | S3_2106166 | S3_6531705 | 6 | 125 | S6_18245488 | S6_18663445 | 5.6 | 26.1 | 2.3 | -34.0 | 13.6 | -79.5 |
| SY | 3 | 85 | S3_23698867 | S3_8011694 | 3 | 105 | S3_925660 | S3_8994380 | 6.8 | 22.4 | -31.1 | -26.1 | 27.4 | 35.3 |
| SY | 3 | 155 | S3_29089318 | S3_517761 | 7 | 115 | S7_16759426 | S7_18208587 | 5.8 | 17.4 | -33.9 | -18.7 | 42.7 | 20.3 |
| DFF | 4 | 40 | S4_3887219 | S4_3355054 | 11 | 80 | S11_18575052 | S11_38654219 | 7.0 | 22.2 | 4.8 | 4.3 | -2.7 | 10.8 |
| GH | 4 | 25 | S4_1710877 | s4_496463 | 8 | 5 | S8_18016282 | S8_879539 | 5.6 | 18.2 | 0.0 | 0.5 | 0.0 | -0.4 |
| GH | 4 | 25 | S4_1710877 | s4_496463 | 11 | 10 | S11_36998432 | S11_26636997 | 5.5 | 17.3 | -0.2 | -0.1 | 0.3 | 0.2 |
| GH | 4 | 30 | s4_428893 | S4_2900796 | 6 | 65 | S6_16310378 | S6_14551548 | 5.2 | 10.9 | 0.3 | -0.2 | -0.2 | 0.1 |
| SPC | 4 | 10 | S4_1867372 | S4_2222488 | 5 | 90 | S5_2154598 | S5_3299149 | 6.9 | 15.4 | -0.2 | -0.5 | 1.0 | 0.7 |
| SPC | 4 | 40 | S4_3887219 | S4_3355054 | 7 | 175 | S7_14683829 | S7_14588865 | 5.2 | 15.0 | 0.2 | -0.2 | 0.4 | -1.7 |
| SW | 4 | 25 | S4_1710877 | s4_496463 | 7 | 70 | S7_7974084 | S7_2627909 | 5.1 | 19.9 | -0.9 | -0.3 | -0.6 | -2.3 |
| SW | 4 | 25 | S4_1710877 | s4_496463 | 11 | 120 | S11_2412606 | S11_5977933 | 5.1 | 19.5 | -0.7 | -2.1 | -1.6 | 0.3 |
| SY | 4 | 5 | S4_2313990 | S4_1867372 | 11 | 165 | S11_35533615 | S11_24152330 | 5.3 | 20.8 | -22.7 | -6.4 | 20.4 | 39.9 |
| SY | 4 | 30 | s4_428893 | S4_2900796 | 7 | 20 | S7_19090687 | S7_13036645 | 5.1 | 17.4 | 30.5 | 33.6 | 35.3 | 10.2 |
| DFF | 5 | 120 | S5_703897 | S5_4199522 | 11 | 135 | S11_13945965 | S11_24152343 | 5.4 | 23.1 | -1.3 | -0.4 | 1.2 | -15.9 |
| GH | 5 | 115 | S5_2827511 | S5_703897 | 11 | 25 | S11_6210775 | S11_39507811 | 8.5 | 25.5 | -0.4 | 0.2 | 0.1 | 0.1 |
| GH | 5 | 30 | S5_3908353 | S5_2511713 | 6 | 140 | S6_22076489 | S6_15818390 | 7.4 | 19.2 | -0.3 | 0.1 | -0.1 | 0.6 |
| GH | 5 | 45 | S5_4199096 | S5_3228176 | 5 | 70 | S5_2154719 | S5_3512197 | 6.4 | 18.1 | -0.1 | 0.2 | -0.5 | -0.2 |
| GH | 5 | 45 | S5_4199096 | S5_3228176 | 10 | 15 | S10_7783201 | S10_7567880 | 5.6 | 11.1 | -0.2 | 0.3 | -0.1 | 0.4 |

| Trait | Chr1 | Pos1 | LM1 | RM1 | Chr2 | Pos2 | LM2 | RM2 | LOD | PVE (%) | [aa] | [ad] | [da] | [dd] |
|-------|------|------|-------------|-------------|------|------|--------------|--------------|-----|---------|-------|-------|-------|-------|
| GH | 5 | 130 | S5_4199522 | S5_3988054 | 7 | 100 | S7_10731962 | S7_15294781 | 8.6 | 26.8 | 0.0 | 0.3 | -0.1 | -0.6 |
| GH | 5 | 130 | S5_4199522 | S5_3988054 | 8 | 10 | S8_18016282 | S8_879539 | 8.4 | 28.0 | 0.0 | 0.4 | 0.1 | -0.6 |
| SPC | 5 | 105 | S5_3512215 | S5_3512203 | 7 | 65 | S7_19133038 | S7_19133012 | 5.8 | 9.5 | 0.2 | -0.2 | -0.1 | -1.2 |
| SPC | 5 | 85 | S5_2154598 | S5_3299149 | 11 | 55 | S11_4453854 | S11_4725362 | 5.2 | 21.2 | 0.3 | 0.7 | 0.4 | 1.9 |
| SW | 5 | 115 | S5_2827511 | S5_703897 | 11 | 95 | S11_42473528 | S11_40289708 | 6.0 | 19.6 | 0.1 | 0.2 | 1.3 | 3.0 |
| SY | 5 | 105 | S5_3512215 | S5_3512203 | 11 | 160 | S11_38144723 | S11_27887800 | 5.5 | 16.9 | -6.0 | 0.8 | 46.6 | -31.5 |
| SY | 5 | 65 | S5_2154419 | S5_3511745 | 6 | 70 | S6_14548839 | S6_12512558 | 5.9 | 35.1 | 30.5 | 4.8 | -11.4 | 79.8 |
| SY | 5 | 65 | S5_2154419 | S5_3511745 | 9 | 25 | S9_7304246 | S9_5330124 | 5.0 | 22.0 | -5.5 | -39.6 | -26.0 | -55.6 |
| SY | 5 | 75 | S5_2154719 | S5_3512197 | 5 | 95 | S5_3299149 | S5_5120324 | 5.0 | 18.0 | -35.5 | -0.1 | -12.3 | 44.8 |
| SY | 5 | 125 | S5_4199522 | S5_3988054 | 7 | 170 | S7_14130607 | S7_14683829 | 6.2 | 25.3 | -20.9 | 26.7 | -27.0 | 68.5 |
| DFP | 6 | 45 | S6_60533 | S6_3186747 | 6 | 110 | S6_18663394 | S6_17420283 | 5.1 | 14.7 | 1.5 | 2.8 | -7.1 | -3.9 |
| GH | 6 | 80 | S6_12512558 | S6_3630897 | 8 | 10 | S8_18016282 | S8_879539 | 6.8 | 28.5 | -0.1 | 0.7 | -0.2 | -0.2 |
| GH | 6 | 70 | S6_14548839 | S6_12512558 | 6 | 80 | S6_12512558 | S6_3630897 | 6.8 | 19.3 | -0.4 | 0.1 | 0.0 | 0.5 |
| GH | 6 | 70 | S6_14548839 | S6_12512558 | 7 | 145 | S7_4126324 | S7_4191819 | 5.9 | 19.9 | 0.1 | 0.4 | 0.1 | -0.1 |
| GH | 6 | 15 | S6_3630463 | S6_6794468 | 11 | 85 | S11_23930022 | S11_45876012 | 6.4 | 27.6 | 0.0 | -0.6 | 0.3 | -0.7 |
| SW | 6 | 95 | S6_14282225 | S6_14311546 | 10 | 65 | S10_4472034 | S10_234727 | 5.1 | 21.8 | -0.9 | 1.0 | 0.2 | 0.4 |
| SW | 6 | 15 | S6_3630463 | S6_6794468 | 11 | 25 | S11_6210775 | S11_39507811 | 7.3 | 30.0 | 1.2 | -1.6 | 0.4 | -1.3 |
| SY | 6 | 125 | S6_18245488 | S6_18663445 | 8 | 105 | S8_9267520 | S8_9779781 | 6.8 | 32.6 | -3.9 | 7.2 | 56.5 | -80.4 |
| SY | 6 | 125 | S6_18245488 | S6_18663445 | 10 | 75 | S10_4472034 | S10_234727 | 5.5 | 17.5 | -4.1 | -5.9 | 23.3 | 50.6 |
| SY | 6 | 120 | S6_18322873 | S6_18322737 | 7 | 25 | S7_360074 | S7_396455 | 5.2 | 12.4 | 16.9 | -27.3 | -13.0 | 13.9 |
| SY | 6 | 50 | S6_3186747 | S6_6094182 | 11 | 160 | S11_38144723 | S11_27887800 | 8.6 | 32.3 | -9.0 | 1.9 | 45.3 | -76.8 |
| SY | 6 | 55 | S6_6094182 | S6_3312026 | 6 | 60 | S6_3312026 | S6_16310378 | 5.9 | 33.3 | 7.5 | 36.8 | -4.9 | -73.3 |
| GH | 7 | 15 | S7_19090687 | S7_13036645 | 9 | 10 | S9_10172092 | S9_7756050 | 5.7 | 13.3 | 0.3 | 0.1 | 0.0 | 0.2 |
| GH | 7 | 55 | S7_4753261 | S7_16343301 | 8 | 10 | S8_18016282 | S8_879539 | 6.4 | 21.2 | 0.1 | -0.6 | -0.2 | -0.3 |
| GH | 7 | 75 | S7_566440 | S7_5435193 | 10 | 30 | S10_16425032 | S10_5310960 | 7.3 | 18.8 | -0.1 | 0.3 | 0.1 | 0.6 |
| GH | 7 | 130 | S7_5677691 | S7_2549635 | 11 | 195 | S11_33160406 | S11_23457576 | 7.1 | 16.7 | -0.3 | 0.0 | 0.0 | 0.4 |
| GH | 7 | 110 | S7_6037064 | S7_2639387 | 7 | 160 | S7_6897487 | S7_6219852 | 7.2 | 20.7 | -0.3 | 0.1 | 0.0 | 0.4 |
| SW | 7 | 155 | S7_10971518 | S7_6897487 | 9 | 65 | S9_1280107 | S9_7212593 | 5.6 | 23.0 | -0.8 | 0.6 | 0.6 | -2.5 |

| Trait | Chr1 | Pos1 | LM1 | RM1 | Chr2 | Pos2 | LM2 | RM2 | LOD | PVE (%) | [aa] | [ad] | [da] | [dd] |
|-------|------|------|--------------|--------------|------|------|--------------|--------------|-----|---------|-------|-------|-------|-------|
| SW | 7 | 115 | S7_16759426 | S7_18208587 | 11 | 190 | S11_33160406 | S11_23457576 | 6.1 | 23.4 | -1.1 | -1.5 | -1.2 | -0.6 |
| SY | 7 | 155 | S7_10971518 | S7_6897487 | 8 | 130 | S8_14208514 | s8_14254343 | 6.6 | 23.9 | -22.5 | -38.5 | 43.9 | 34.7 |
| SY | 7 | 170 | S7_14130607 | S7_14683829 | 9 | 45 | S9_7212583 | S9_1662492 | 7.6 | 15.9 | -12.3 | -26.3 | -13.5 | 35.8 |
| SY | 7 | 20 | S7_19090687 | S7_13036645 | 11 | 160 | S11_38144723 | S11_27887800 | 7.9 | 25.7 | -39.9 | 12.2 | -12.4 | 62.6 |
| SY | 7 | 110 | S7_6037064 | S7_2639387 | 7 | 175 | S7_14683829 | S7_14588865 | 6.9 | 31.4 | 6.7 | 22.7 | 55.1 | -51.9 |
| GH | 8 | 90 | S8_7083922 | S8_8700211 | 10 | 70 | S10_4472034 | S10_234727 | 7.1 | 24.2 | 0.2 | -0.5 | -0.2 | -0.3 |
| GH | 8 | 85 | S8_7083922 | S8_8700211 | 11 | 80 | S11_18575052 | S11_38654219 | 7.0 | 24.3 | 0.3 | 0.0 | 0.0 | 0.6 |
| GH | 8 | 60 | S8_8700222 | S8_5616255 | 8 | 85 | S8_7083922 | S8_8700211 | 5.8 | 19.0 | -0.4 | 0.0 | 0.0 | 0.5 |
| SW | 8 | 5 | S8_18016282 | S8_879539 | 11 | 25 | S11_6210775 | S11_39507811 | 5.9 | 26.8 | 1.1 | -0.8 | 0.8 | 0.0 |
| SY | 8 | 130 | S8_14208514 | s8_14254343 | 11 | 160 | S11_38144723 | S11_27887800 | 6.8 | 30.2 | 6.6 | -1.9 | -58.8 | 79.1 |
| SY | 8 | 105 | S8_9267520 | S8_9779781 | 8 | 120 | S8_10333523 | S8_14208514 | 5.5 | 28.6 | -22.6 | -37.6 | 30.2 | 47.9 |
| GH | 9 | 50 | S9_7212583 | S9_1662492 | 11 | 70 | S11_43548291 | S11_32240905 | 5.6 | 17.7 | 0.3 | -0.1 | 0.0 | 0.2 |
| SW | 9 | 40 | S9_5330124 | S9_5329954 | 11 | 25 | S11_6210775 | S11_39507811 | 6.1 | 23.0 | -0.2 | 0.2 | -2.0 | 2.1 |
| SY | 9 | 40 | S9_5330124 | S9_5329954 | 11 | 160 | S11_38144723 | S11_27887800 | 8.1 | 24.5 | 13.2 | 7.5 | 64.5 | -49.5 |
| GH | 10 | 30 | S10_16425032 | S10_5310960 | 11 | 80 | S11_18575052 | S11_38654219 | 5.7 | 19.3 | 0.3 | -0.1 | -0.1 | 0.4 |
| SW | 10 | 65 | S10_4472034 | S10_234727 | 11 | 25 | S11_6210775 | S11_39507811 | 5.4 | 29.0 | 1.2 | -1.2 | 0.6 | 0.2 |
| SY | 10 | 65 | S10_4472034 | S10_234727 | 11 | 160 | S11_38144723 | S11_27887800 | 6.8 | 32.6 | 39.5 | -26.1 | -13.3 | 68.7 |
| GH | 11 | 10 | S11_36998432 | S11_26636997 | 11 | 80 | S11_18575052 | S11_38654219 | 7.4 | 20.9 | 0.1 | 0.2 | 0.5 | 0.0 |
| SW | 11 | 50 | S11_42065843 | S11_12498183 | 11 | 95 | S11_42473528 | S11_40289708 | 6.3 | 17.0 | -1.5 | -0.3 | -1.4 | -0.7 |
| SY | 11 | 25 | S11_6210775 | S11_39507811 | 11 | 135 | S11_13945965 | S11_24152343 | 6.5 | 22.8 | -21.4 | -48.1 | 23.3 | 35.3 |

Supplementary Figure S1. Genetic and QTL maps for Pop1 (ICP 11605 × ICP 14209).

Markers are shown on right side of the linkage group while map distances are indicated on left side. QTLs for the different traits are indicated by different colored bars with red, purple, blue, black and green showing QTLs for seed protein content, seed weight, seed yield, growth habit and days to first flowering, respectively.

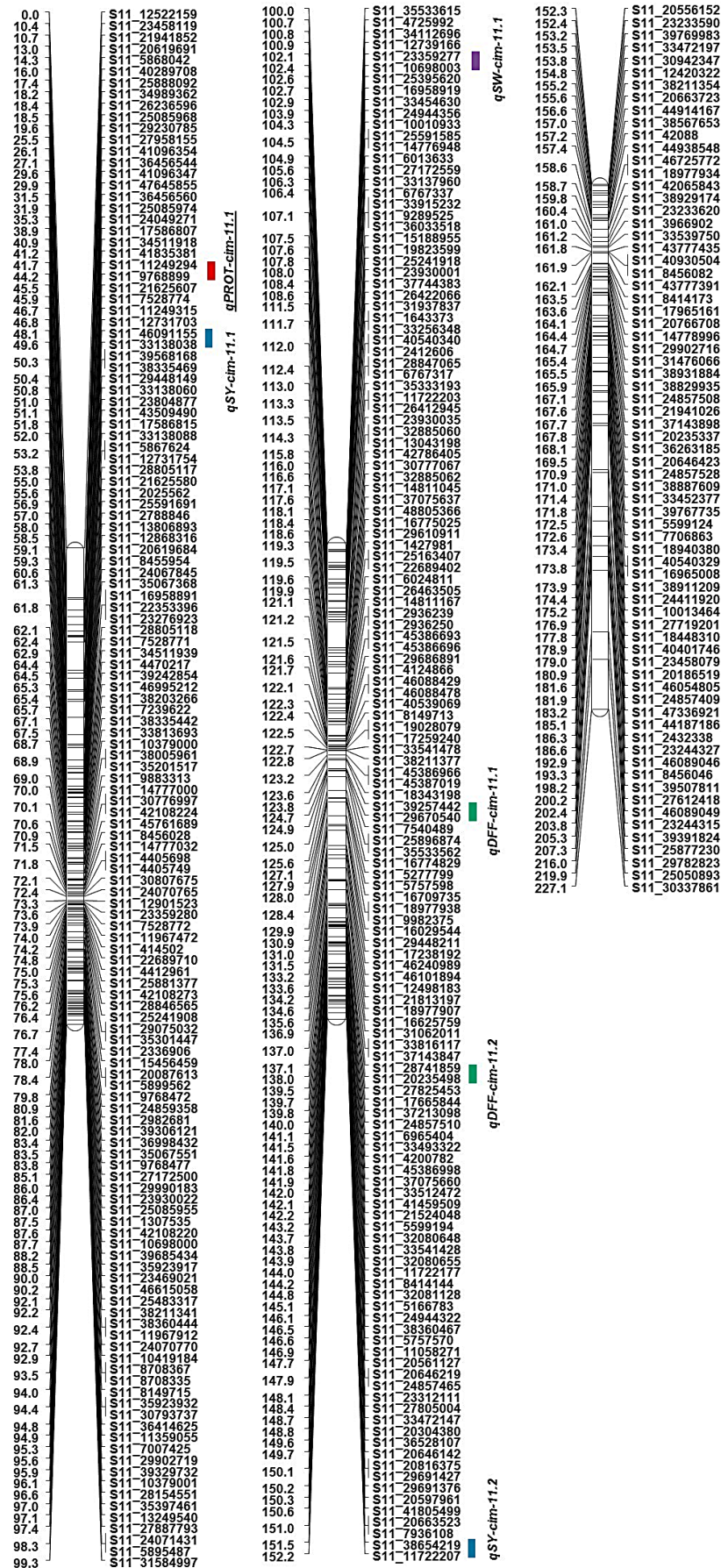


Supplementary Figure S1 (continued)

CcLG011-a

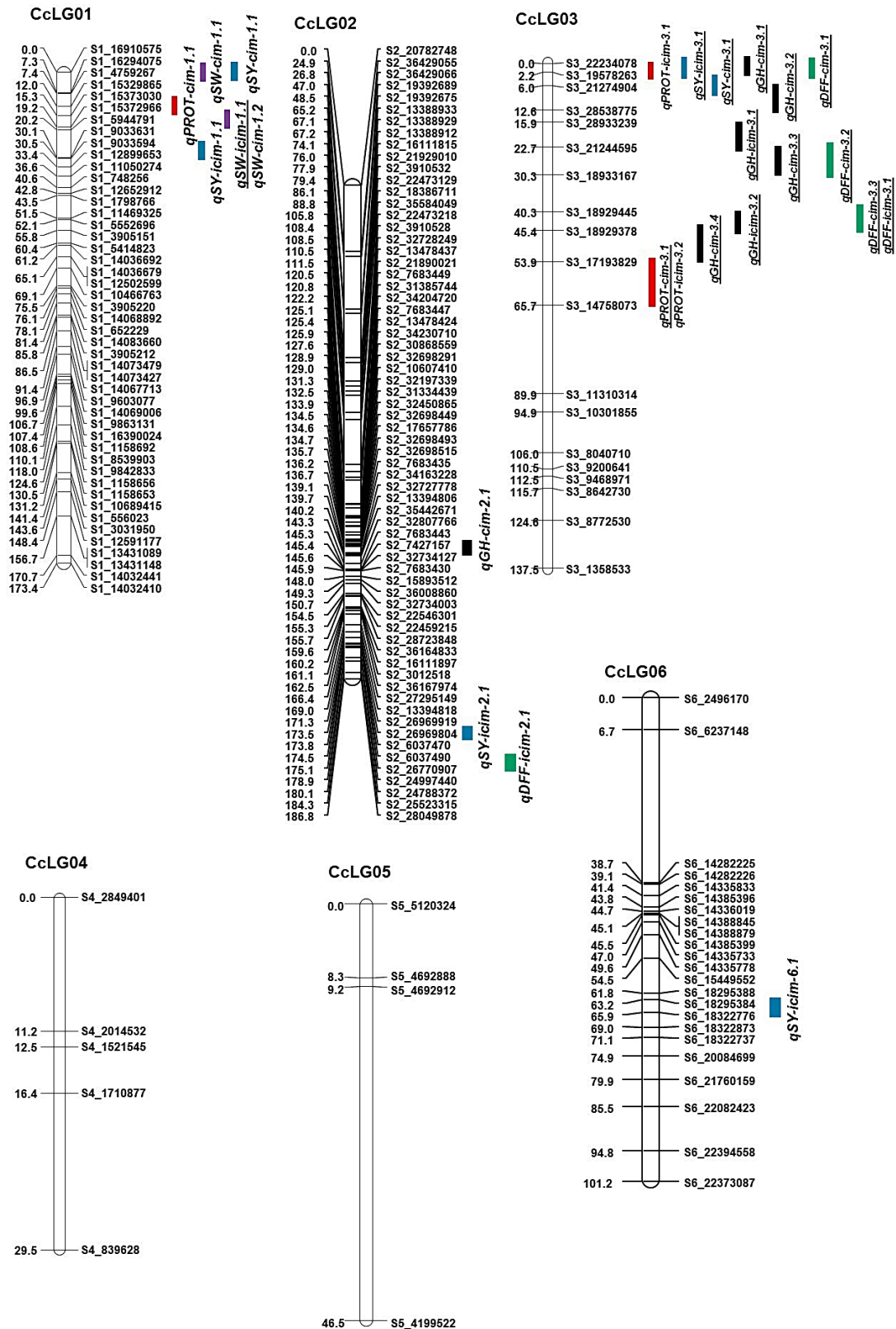
CcLG11-b

CcLG11-c

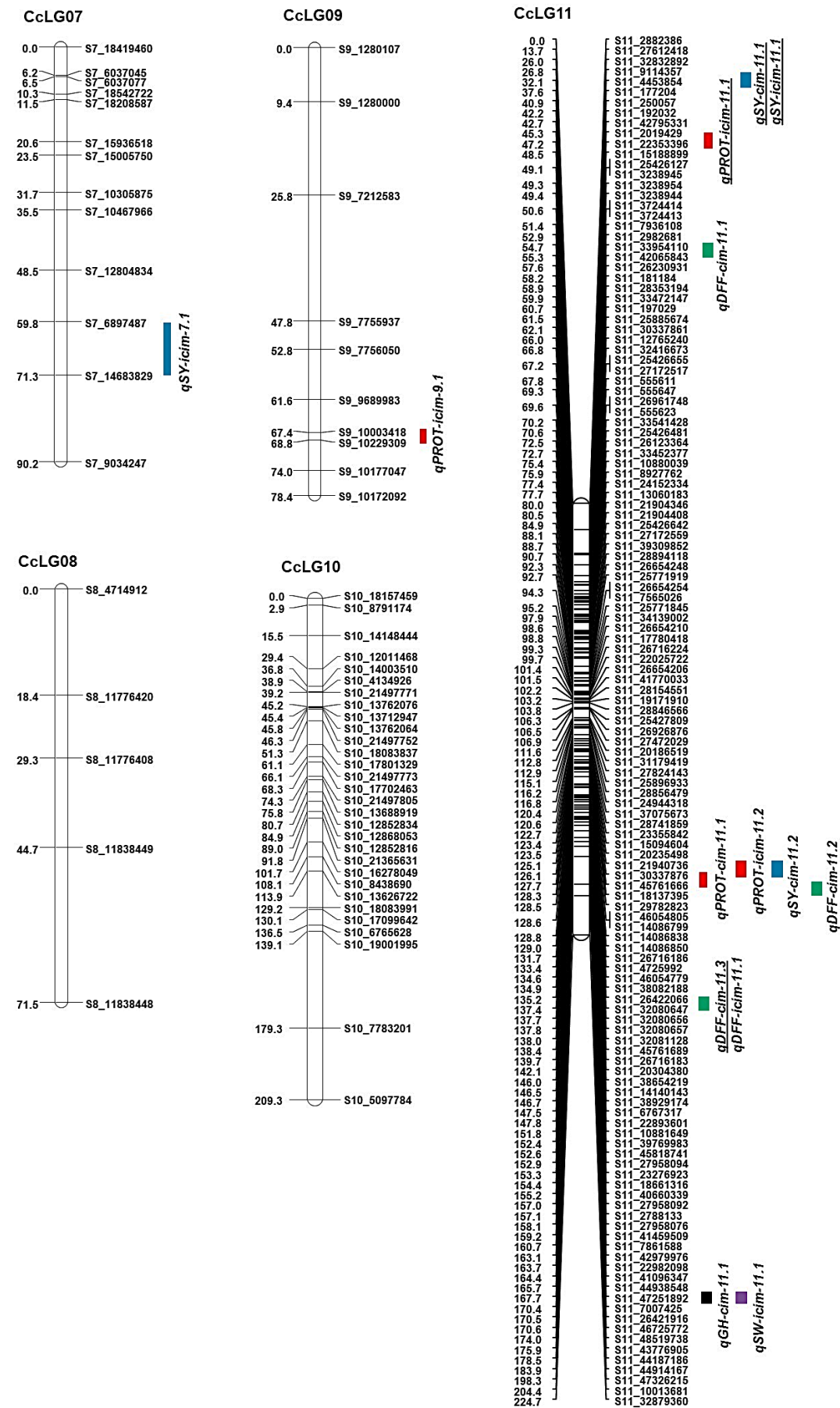


Supplementary Figure S2. Genetic and QTL maps for Pop2 (ICP 8863 × ICP 11605).

Markers are shown on right side of the linkage group while map distances are indicated on left side. QTLs for the different traits are indicated by different colored bars with red, purple, blue, black and green showing QTLs for seed protein content, seed weight, seed yield, growth habit and days to first flowering, respectively.

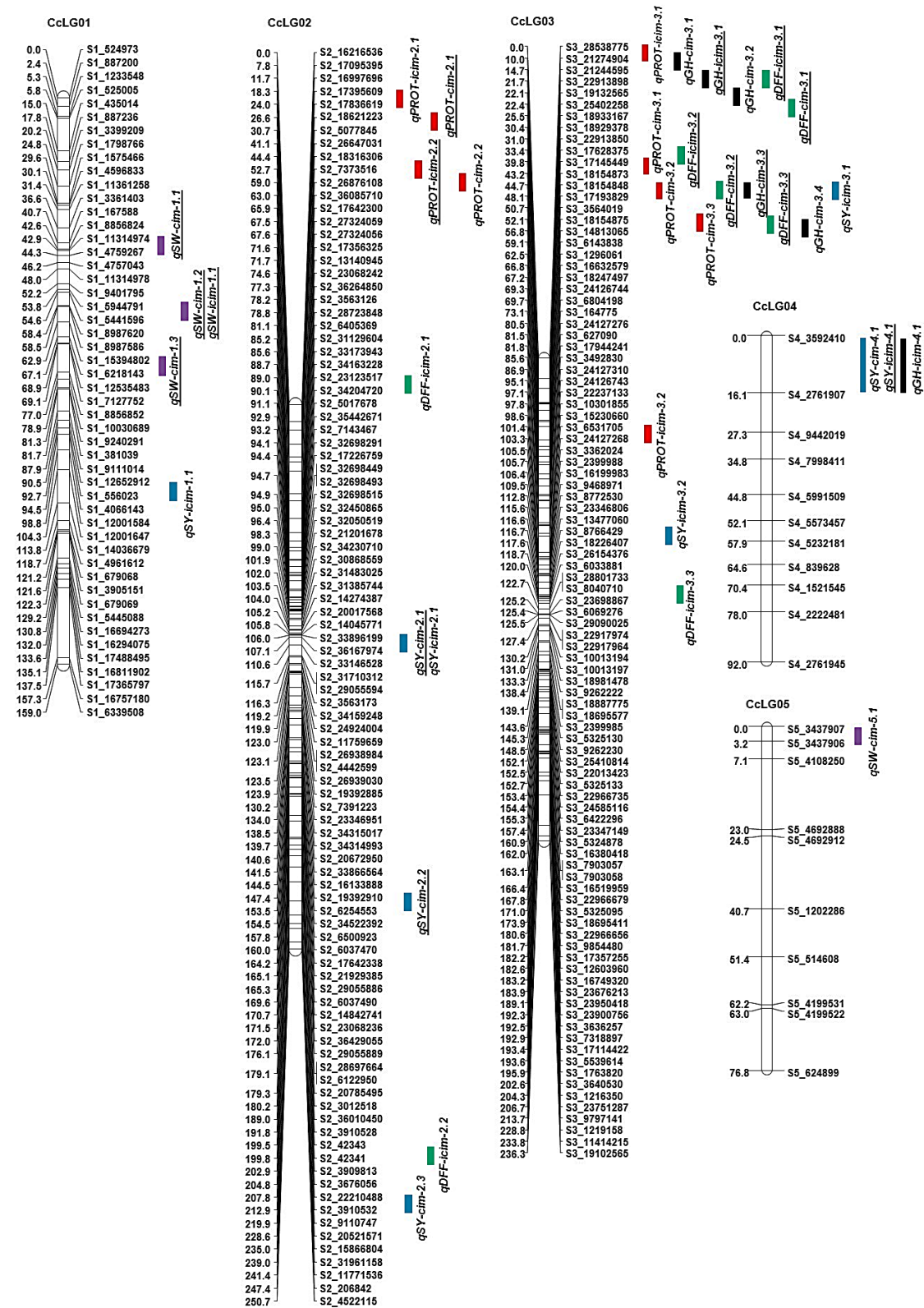


Supplementary Figure S2 (continued)

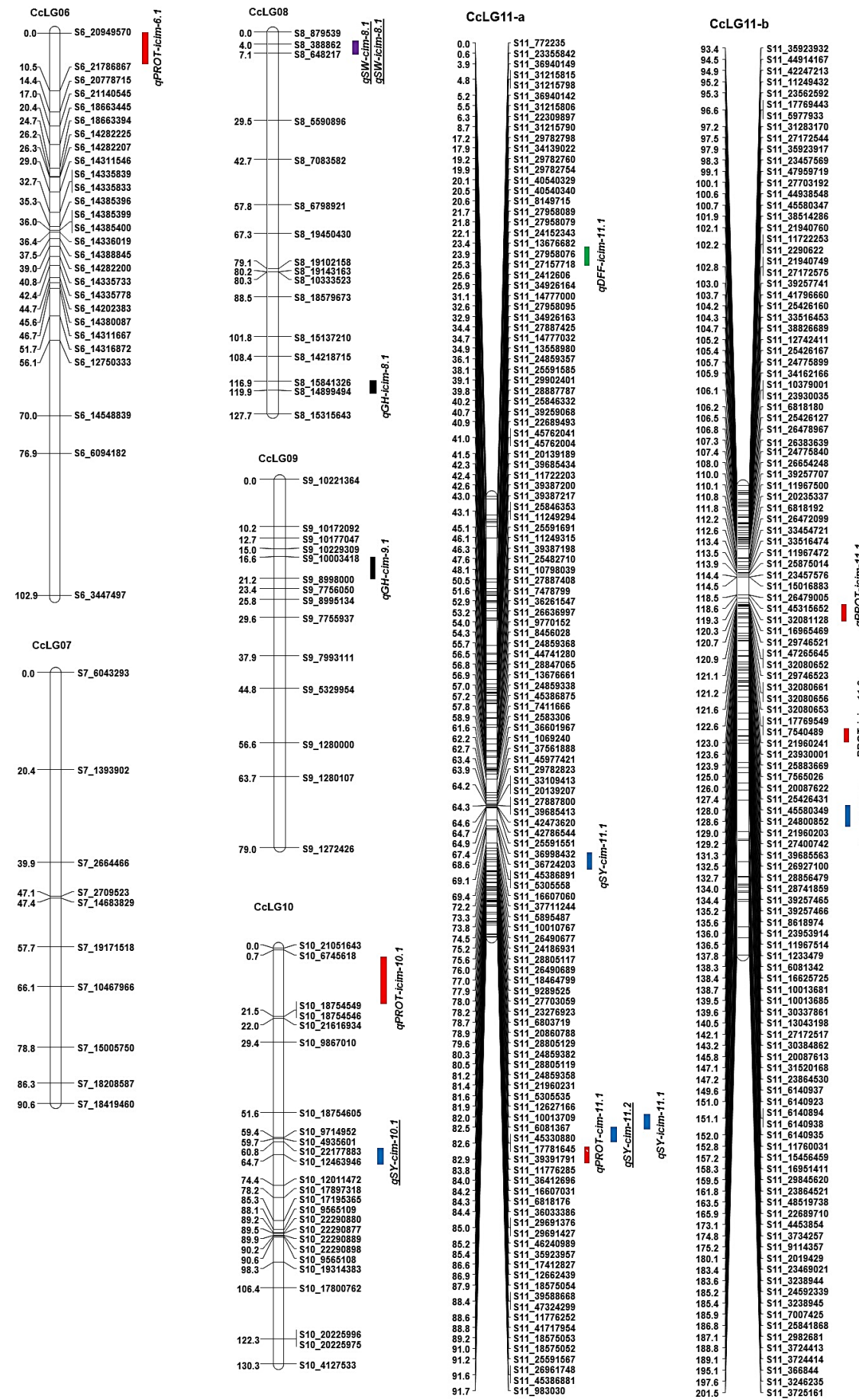


Supplementary Figure S3. Genetic and QTL maps for Pop3 (HPL 24 × ICP 11605).

Markers are shown on right side of the linkage group while map distances are indicated on left side. QTLs for the different traits are indicated by different colored bars with red, purple, blue, black and green showing QTLs for seed protein content, seed weight, seed yield, growth habit and days to first flowering, respectively.

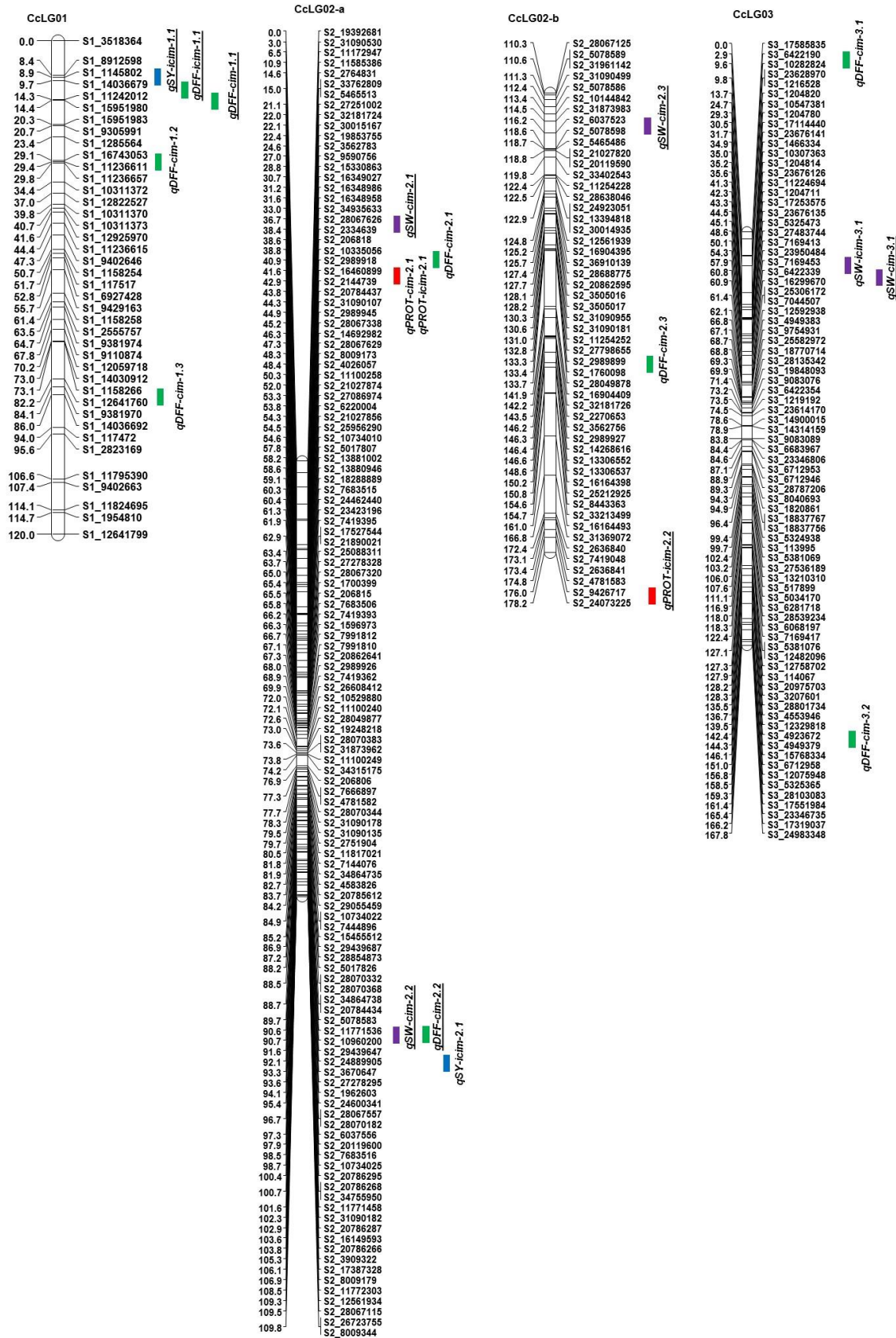


Supplementary Figure S3 (continued)

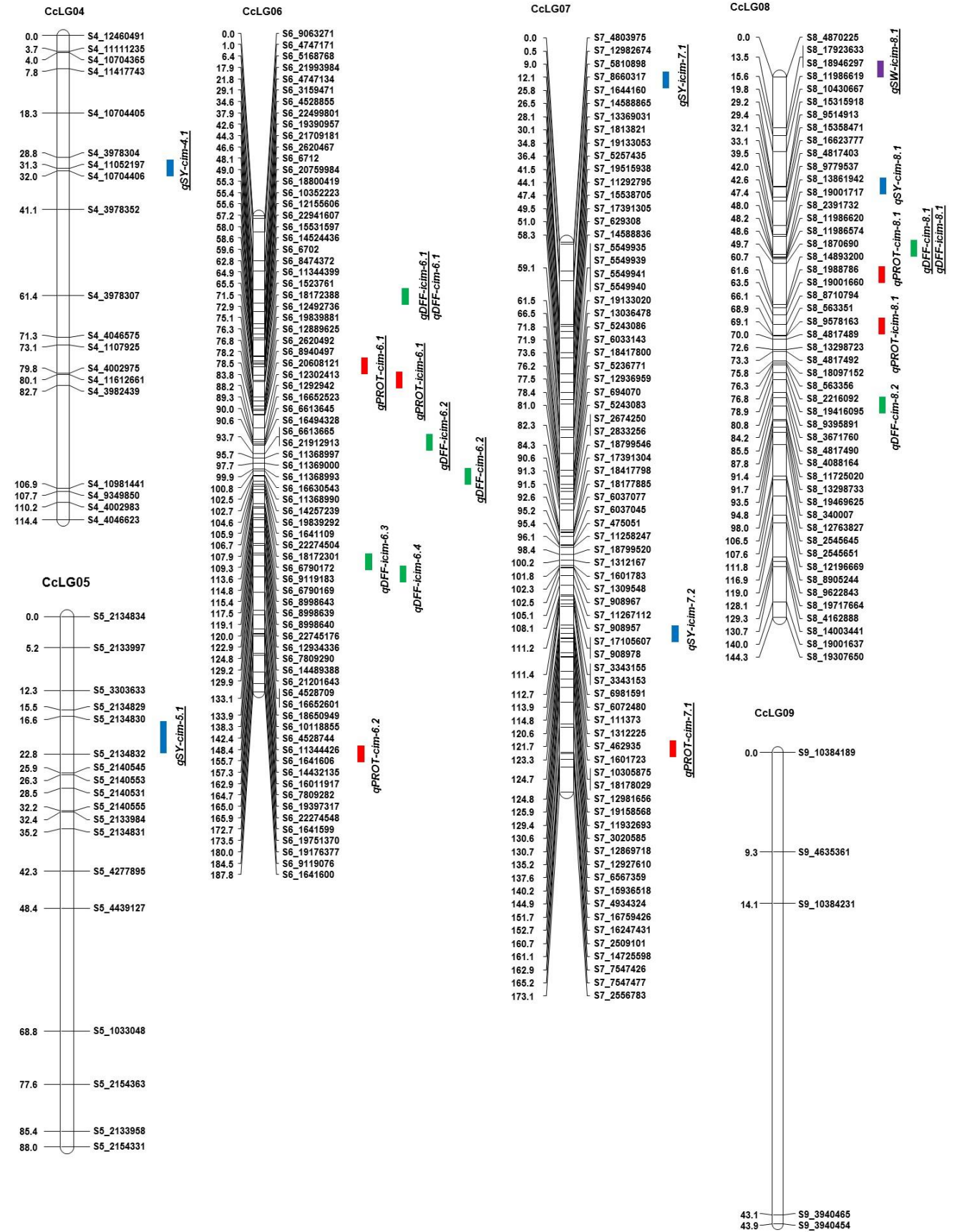


Supplementary Figure S4. Genetic and QTL maps for Pop4 (HPL 24 × ICP 11605).

Markers are shown on right side of the linkage group while map distances are indicated on left side. QTLs for the different traits are indicated by different colored bars with red, purple, blue, black and green showing QTLs for seed protein content, seed weight, seed yield, growth habit and days to first flowering, respectively

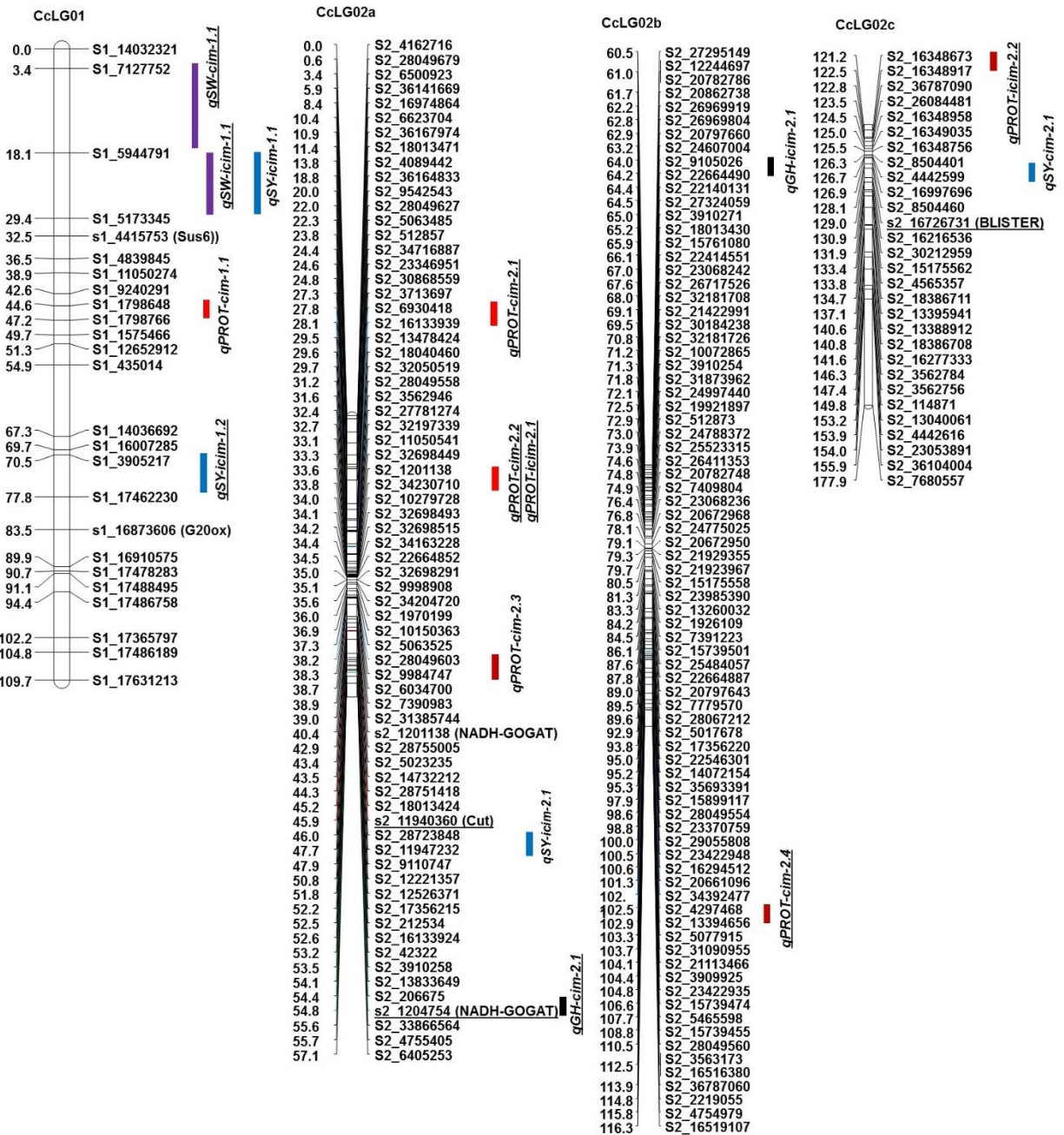


Supplementary Figure S4 (continued)

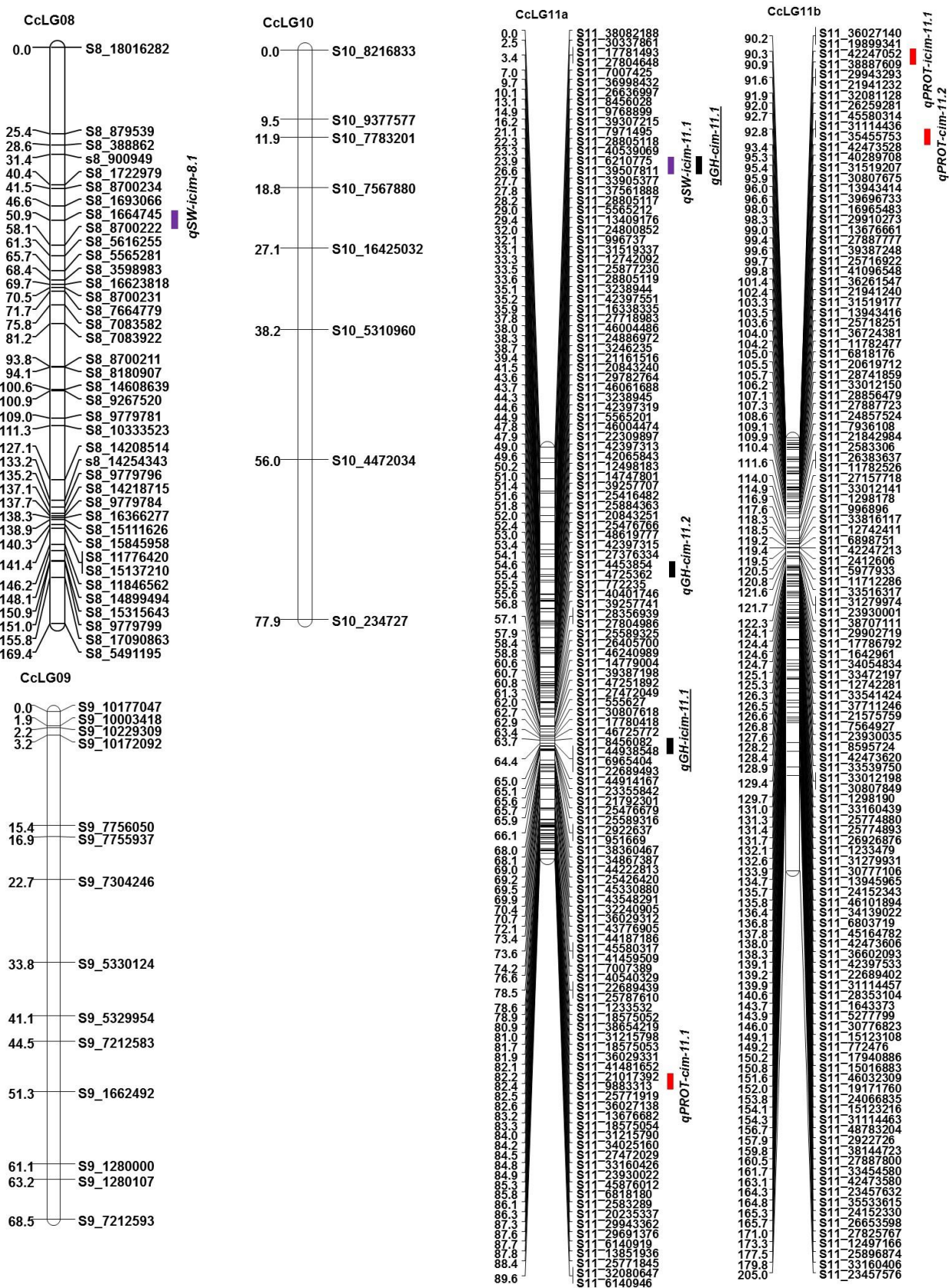


Supplementary Figure S5. Genetic and QTL maps for Pop5 (ICP 5529 × ICP 11605).

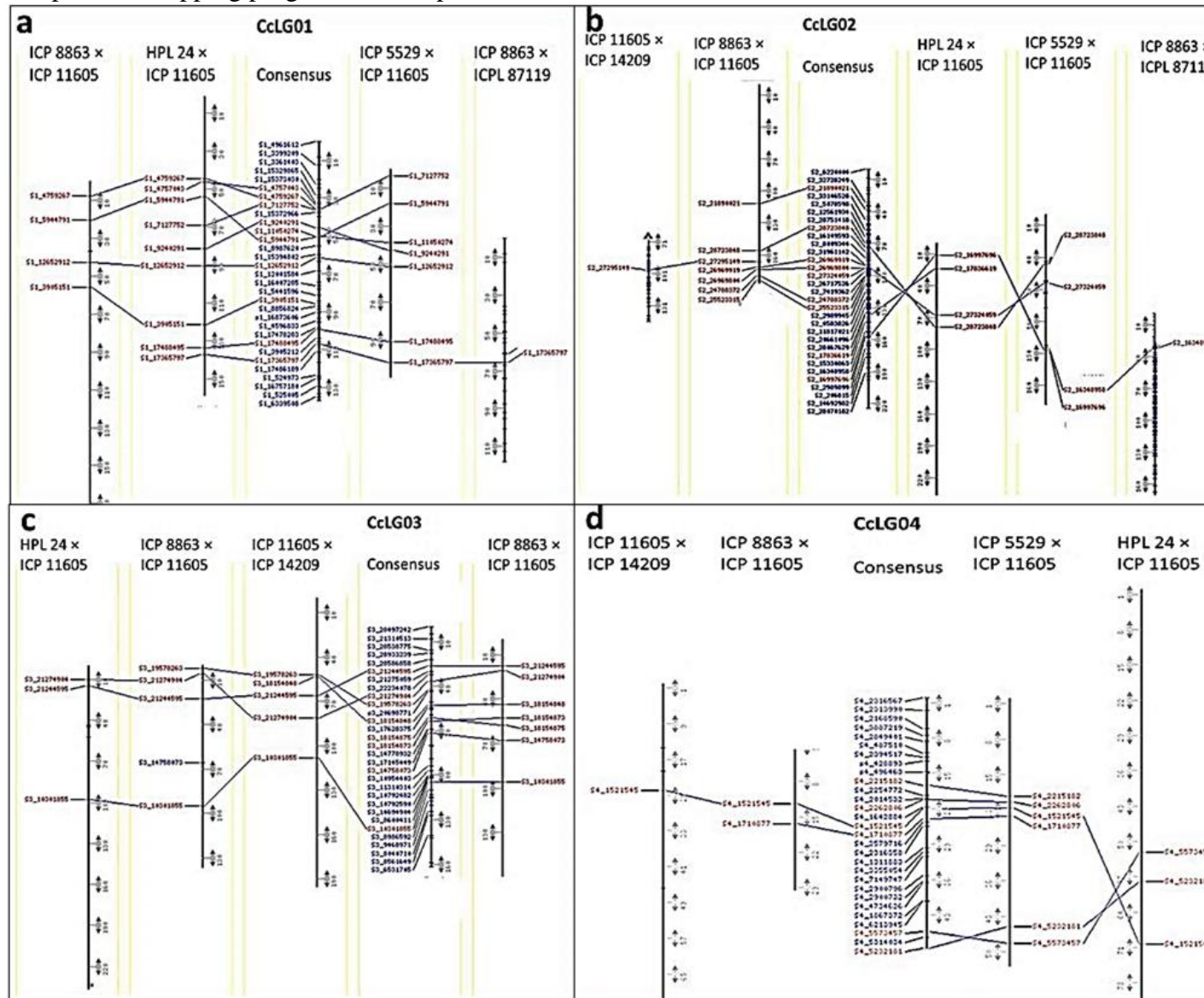
Markers are shown on right side of the linkage group while map distances are indicated on left side. QTLs for the different traits are indicated by different colored bars with red, purple, blue, black and green showing QTLs for seed protein content, seed weight, seed yield, growth habit and days to first flowering, respectively. Gene names are in parentheses;



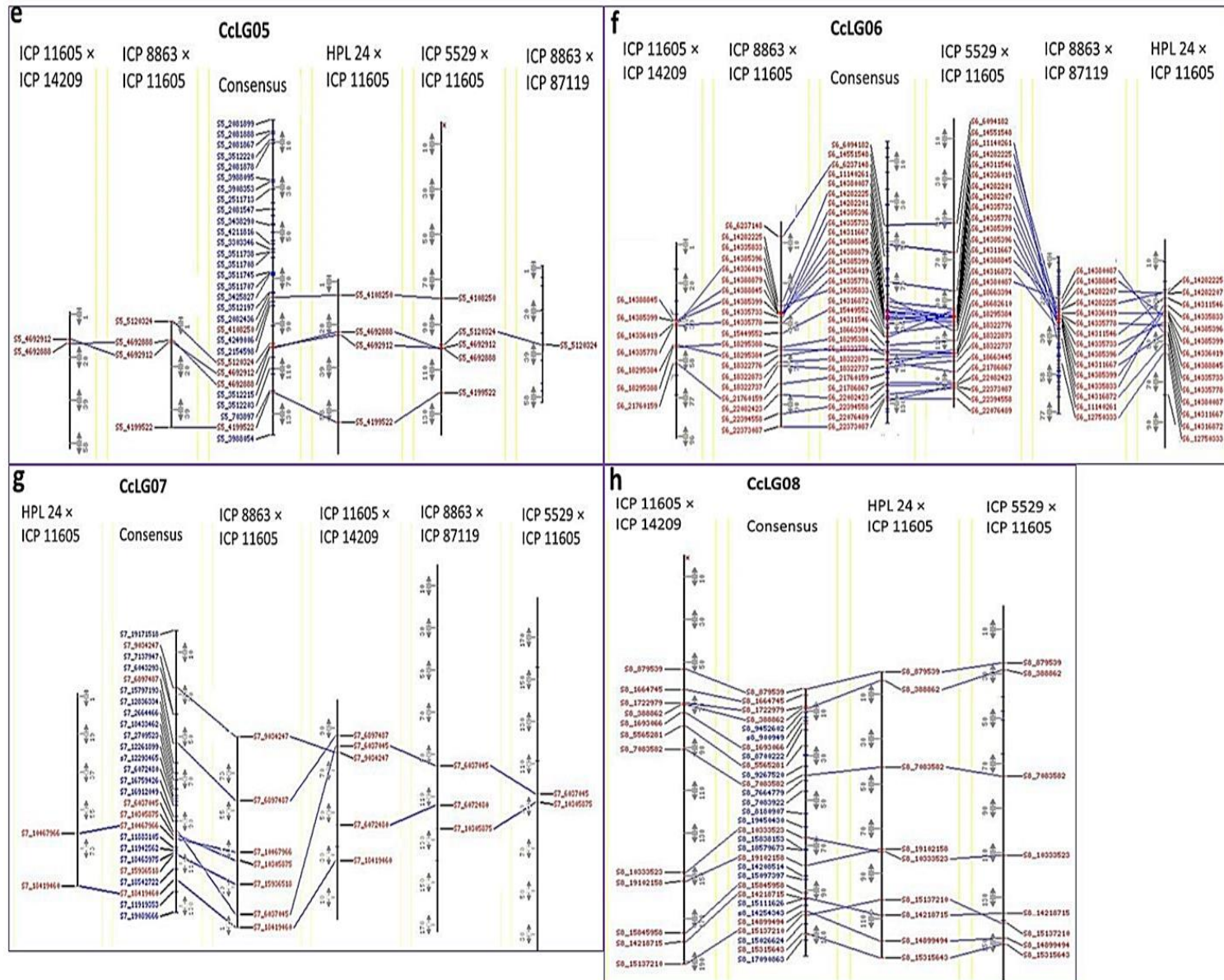
Supplementary Figure S5 (continued)



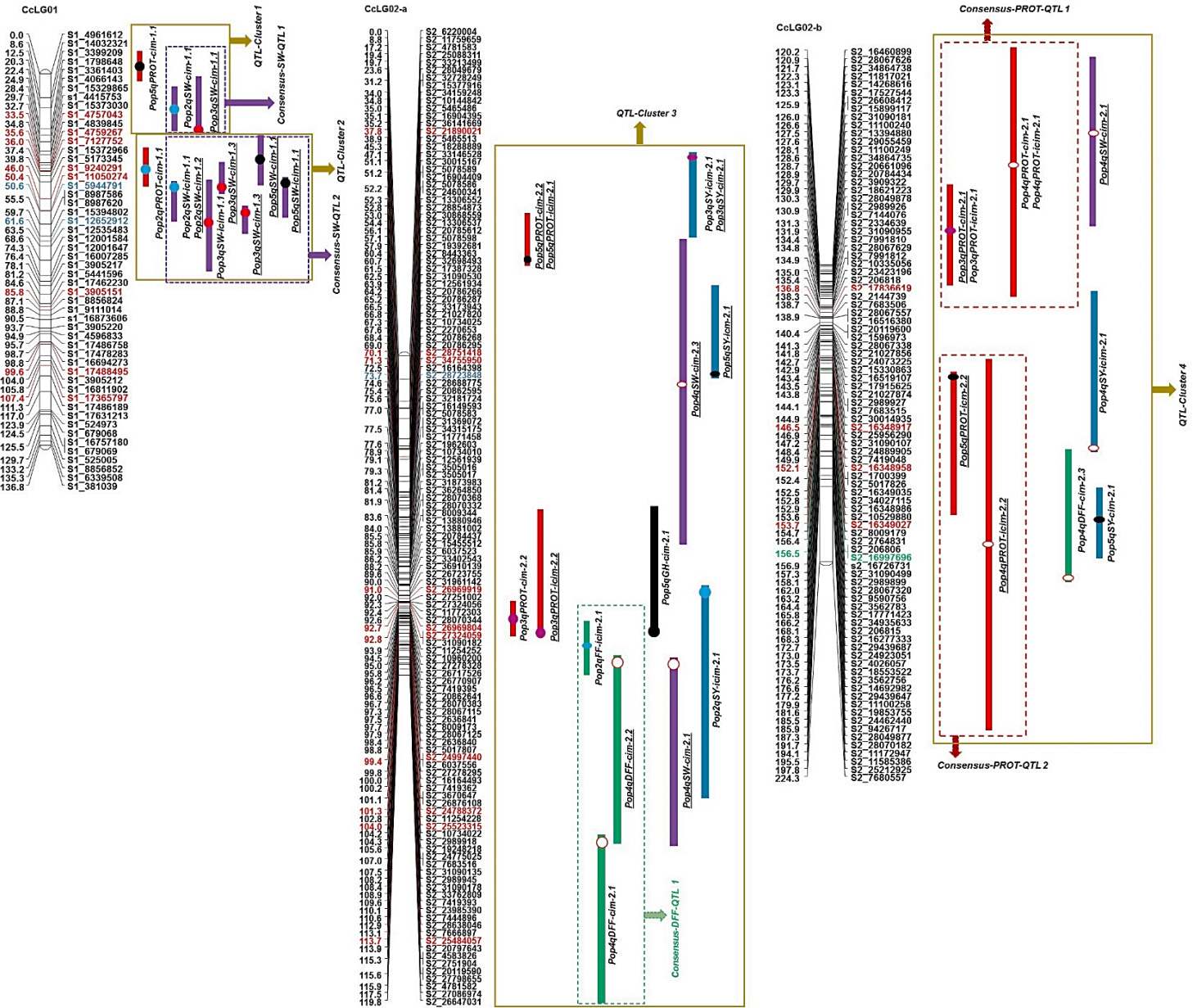
Supplementary Figure S6. Charts depicting marker-based correspondences of consensus with individual genetic maps. a, b, c, d, e, f, g, h, i, j and k are CcLG01, CcLG02, CcLG03, CcLG04, CcLG05, CcLG06, CcLG07, CcLG08, CcL09, CcLG10 and CcLG11, respectively. Only common markers are included to visually assess the collinearity of marker orders and marker positions. Linkage groups were aligned together using comparative mapping programme CMap version 1.01



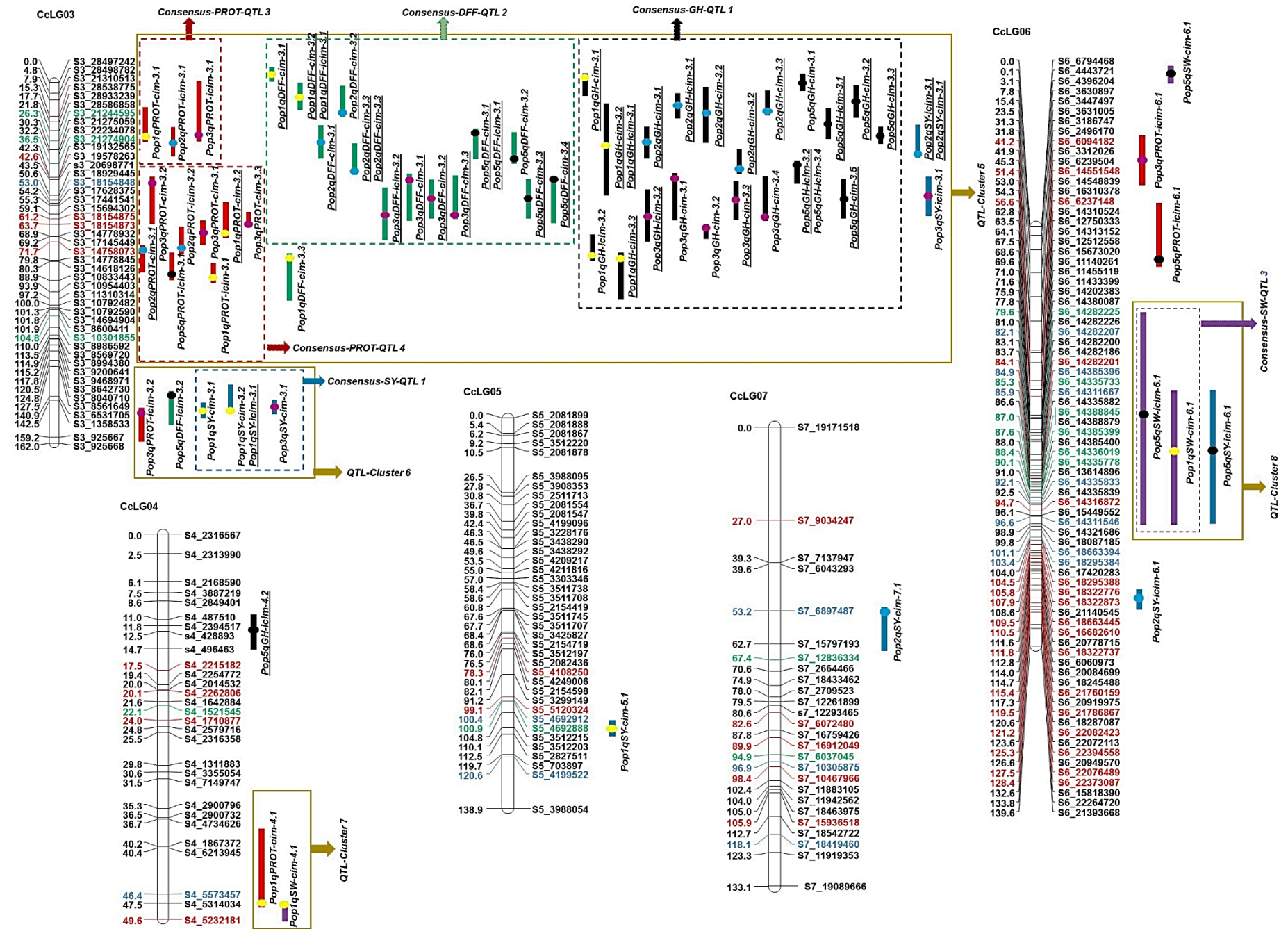
Supplementary Figure S6 (continued)



Supplementary Figure S7. Consensus genetic and QTL maps. Markers are shown on right side of the linkage group while map distances are indicated on left side. Markers unique to mapping populations, common between two, three and four mapping populations, have been shown by black, red, blue and green colours, respectively. QTLs for the different traits are indicated by colored bars with brown, green, grey, purple and red showing QTLs for GH, SY, DTFF, HSW and SPC, respectively. Source populations of projected QTLs are indicated by dots of different colours where yellow, blue, green, purple and black represent Pop1, Pop2, Pop3, Pop4 and Pop5, respectively. The position of the dot on the QTL bar indicates whether both or only one of the flanking markers were projected onto the consensus map. Where the dot lies at the center of the QTL bar it indicates that both flanking markers of the QTL are present, while if the dot lies either on the upper or lower part of the QTL bar it shows that only one marker closest to the dot was projected.

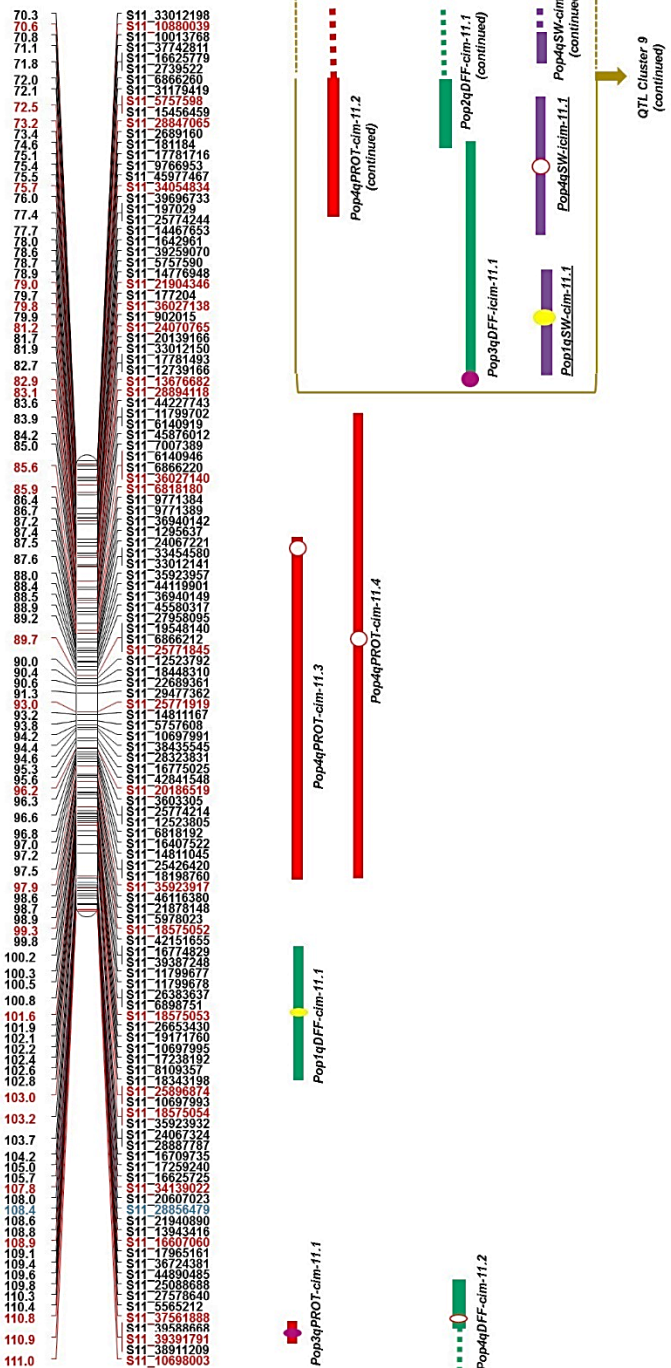


Supplementary Figure S7 (continued)



Supplementary Figure S7 (continued)

CcLG11-b



CcLG11-c

