

Recombination frequency variation in maize as revealed by genome-wide single-nucleotide polymorphisms

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With 2 tables

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Supporting Information

Table S1: Information for three SNP linkage maps. Phy = Number of SNPs that have physical position; DT = SNPs from DT (drought tolerance) chip; RA = SNPs from RA (random) chip; § Total = Monomorphic + polymorphic SNPs.

Table S2: Information of genetic linkage maps constructed using three RIL populations. Try SNPs, SNP markers that were added to the integrated map using “try” command of Mapmaker to determine the linkage status without exact positions provided on the linkage maps.

Table S3: Relationship between physical and genetic distances for maps derived from three RIL populations. The relationship between physical and genetic distances is shown by cM/Mbp. The bins shown in brackets belong to centromeric regions based on Davis et al. (1999). The bins underlined have the most severe recombination suppression and thus identified as the centromere locations in this study. Dashes indicate no data available.

Figure S1: Integrated maize linkage map constructed using three RIL populations and physical map. Cosegregation and SSR markers are designated by vertical line and bold font, respectively. The markers with different orders from the physical map are indicated with *Italic font*. The markers underlined were determined using ‘XB’ RIL population. Core markers are indicated in bold with their corresponding bin numbers in brackets.

Figure S2: Relationship between physical and genetic distance in the map derived from ‘XB’ population. Centromeric bin and pericentromeric regions are indicated by black and gray horizontal arrows, respectively. A non-centromeric recombination suppression region on chromosome 4 is indicated by a non-filled arrow. Numbers in horizontal axis represent the sizes of chromosome regions in cM. The vertical axis shows the cM/Mbp ratio. Some bin regions are indicated by the bin numbers. For chromosomes 1 and 3, two centromere bins are indicated, one as reported by Davis et al. (1999) and the other as identified in this study.

Table S1: Information for three SNP linkage maps. Phy = Number of SNPs that have physical position; DT = SNPs from DT (drought tolerance) chip; RA = SNPs from RA (random) chip; § Total = Monomorphic + polymorphic SNPs.

| Populations | 'XB' | | | | 'C5' | | | | 'C6' | | | |
|-------------|------|------|-------|------|------|------|-------|------|------|------|-------|------|
| | DT | RA | Total | Phy. | DT | RA | Total | Phy. | DT | RA | Total | Phy. |
| Polymorphic | 337 | 645 | 982 | 881 | 361 | 369 | 730 | 626 | 330 | 354 | 684 | 578 |
| Monomorphic | 753 | 404 | 1258 | 915 | 729 | 680 | 1409 | 1143 | 760 | 695 | 1455 | 1191 |
| Total § | 1090 | 1049 | 2139 | 1796 | 1090 | 1049 | 2139 | 1796 | 1090 | 1049 | 2139 | 1796 |
| Mapped | 142 | 291 | 433 | 391 | 59 | 75 | 134 | 117 | 147 | 147 | 294 | 254 |

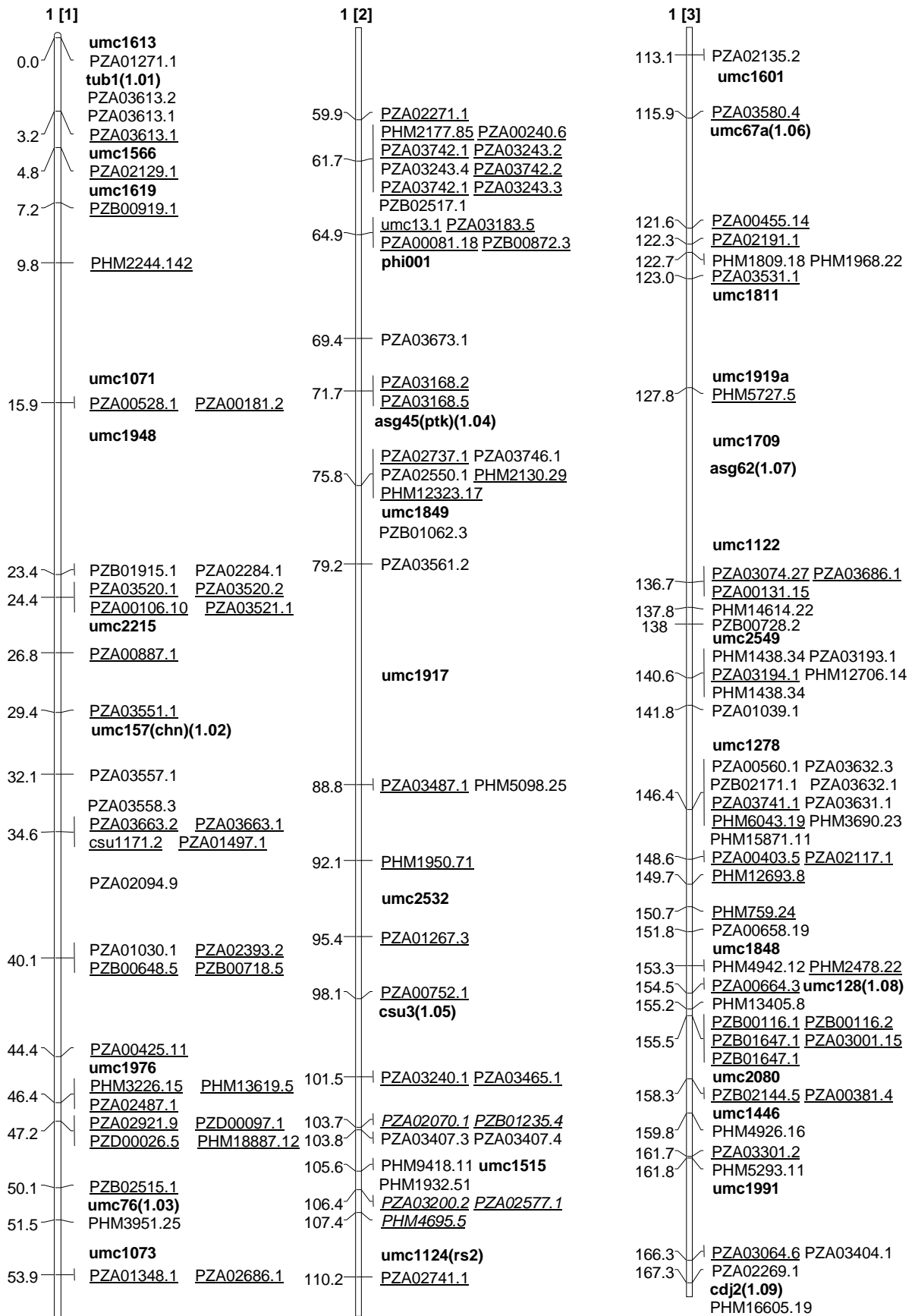
Table S2: Information of genetic linkage maps constructed using three RIL populations. Try SNPs, SNP markers that were added to the integrated map using “try” command of Mapmaker to determine the linkage status without exact positions provided on the linkage maps.

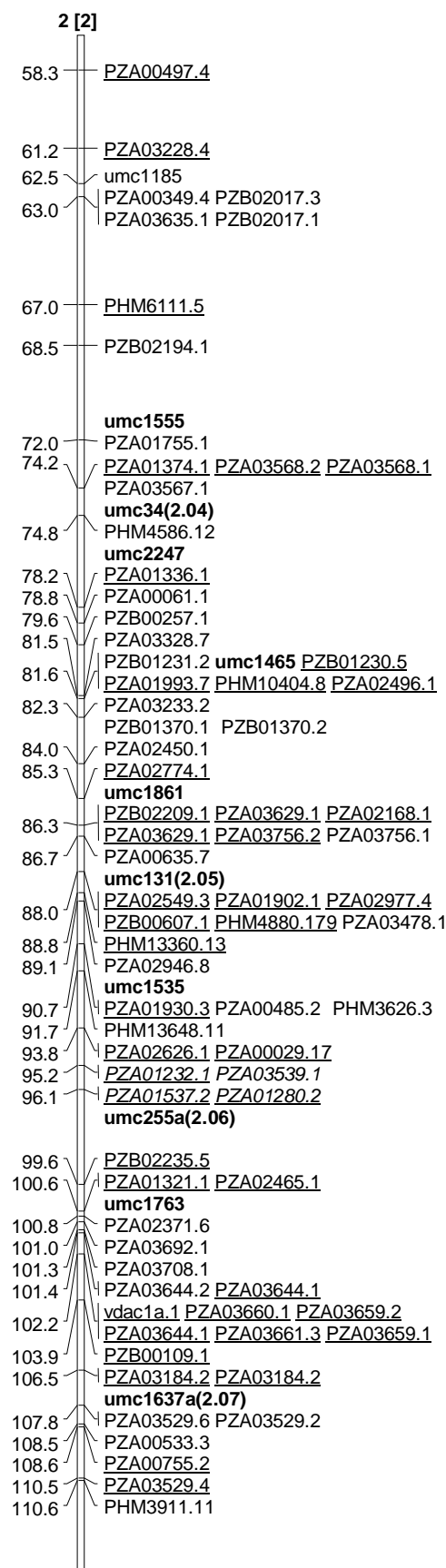
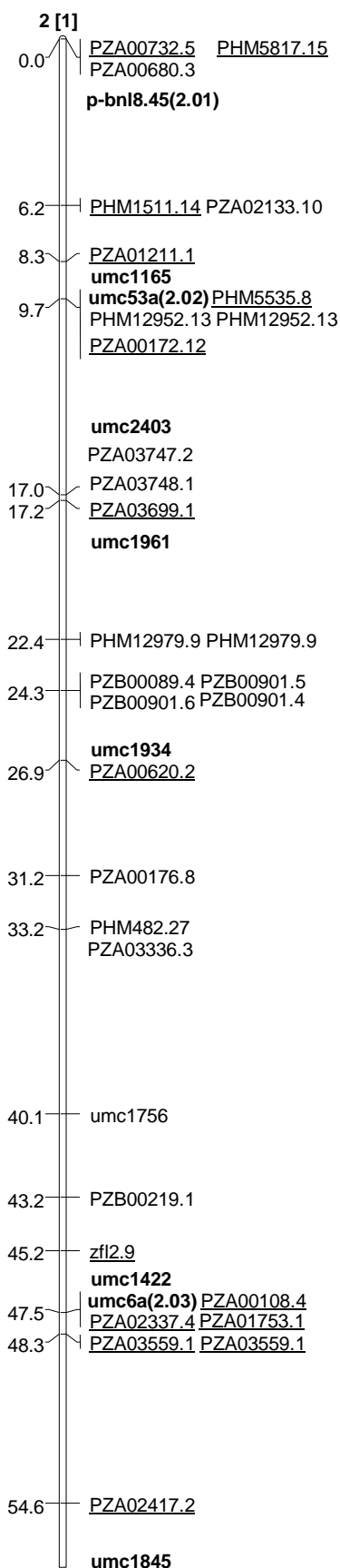
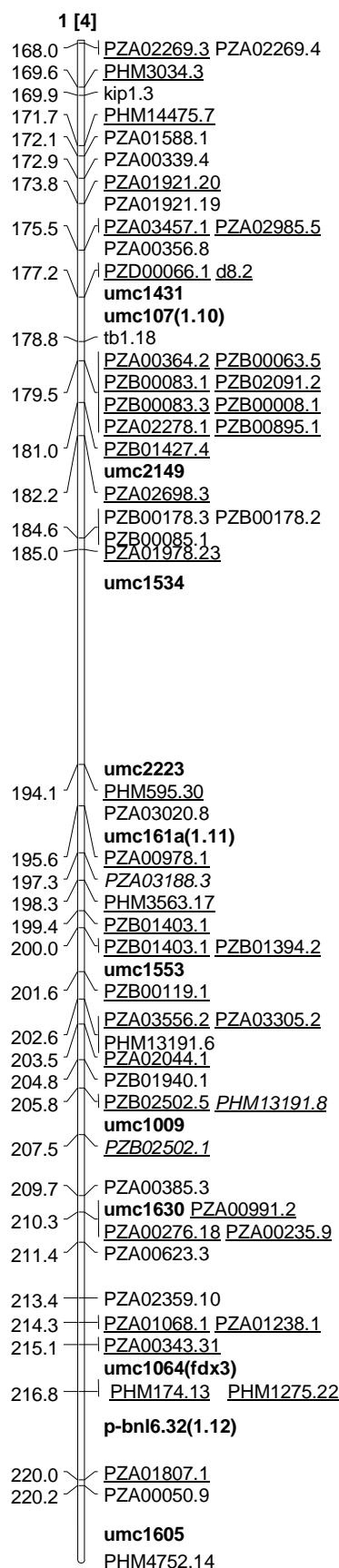
| Population | #Framework | #Cosegregation | #Try | #Total | Map | SNP/cM |
|------------|------------|----------------|------|--------|---------|--------|
| ‘XB’ | 391 | 328 | 181 | 900 | 1345.97 | 0.67 |
| ‘C5’ | 185 | 55 | 126 | 366 | 889.50 | 0.41 |
| ‘C6’ | 286 | 185 | 123 | 594 | 1426.20 | 0.42 |

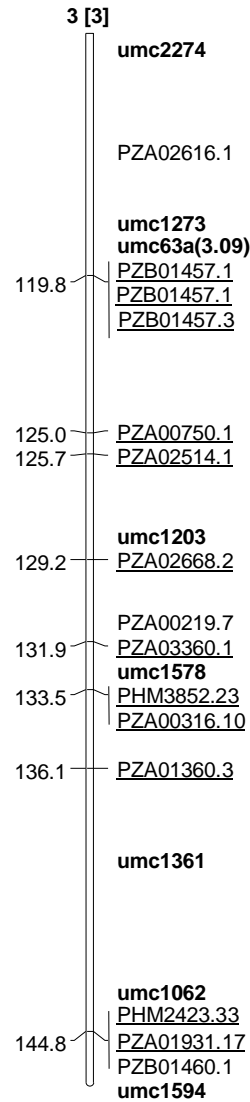
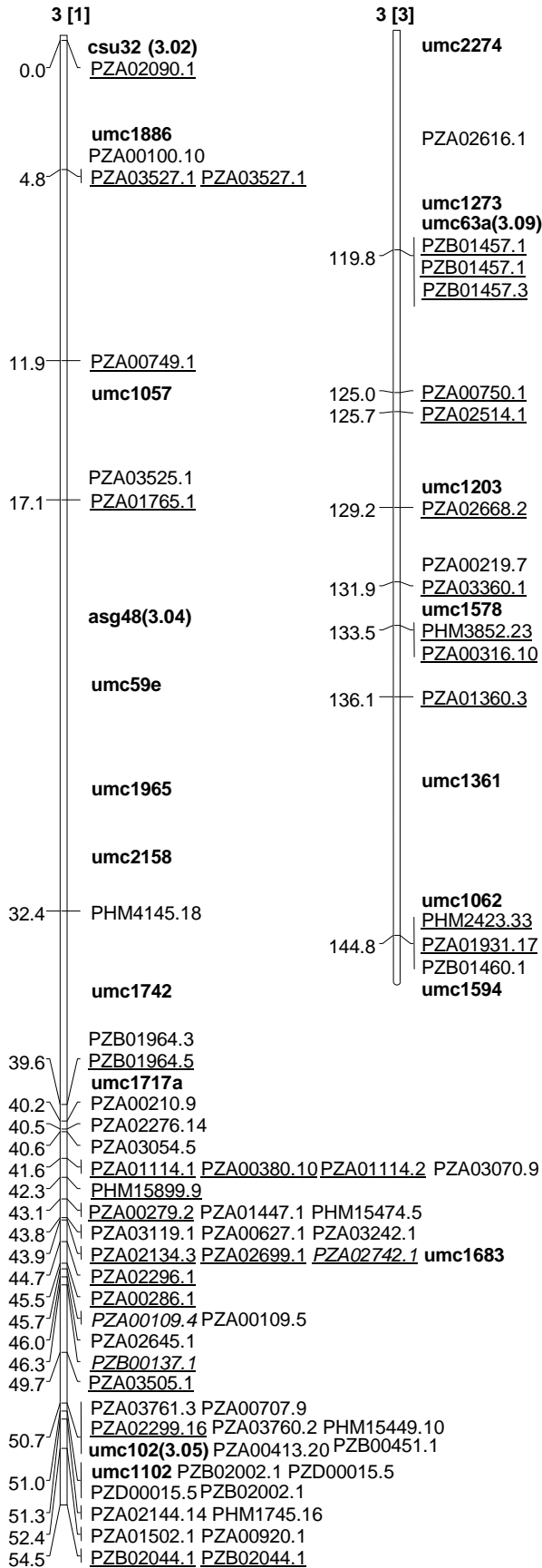
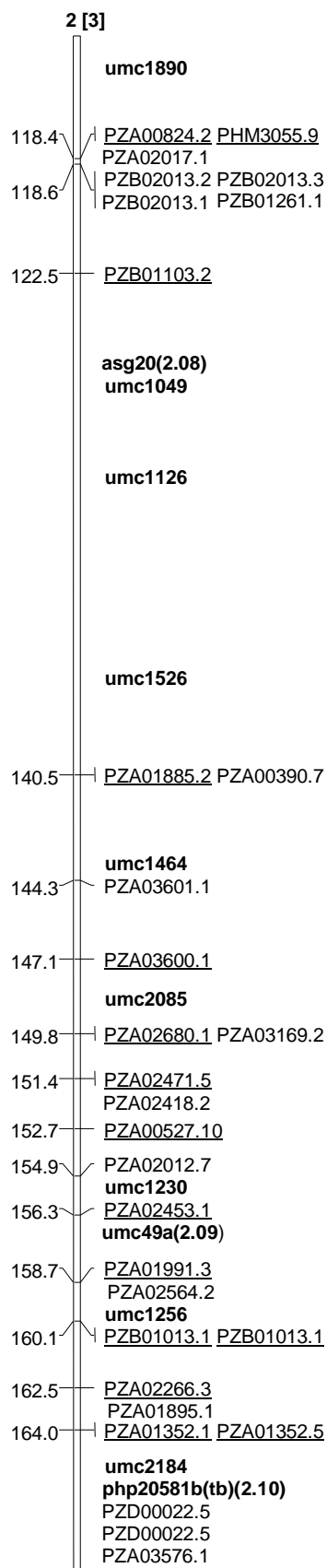
Table S3: Relationship between physical and genetic distances for maps derived from three RIL populations. The relationship between physical and genetic distances is shown by cM/Mbp. The bins shown in brackets belong to centromeric regions based on Davis et al. (1999). The bins underlined have the most severe recombination suppression and thus identified as the

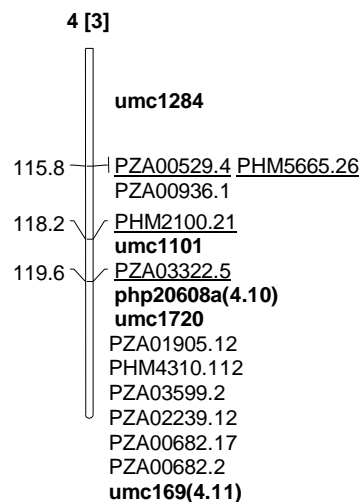
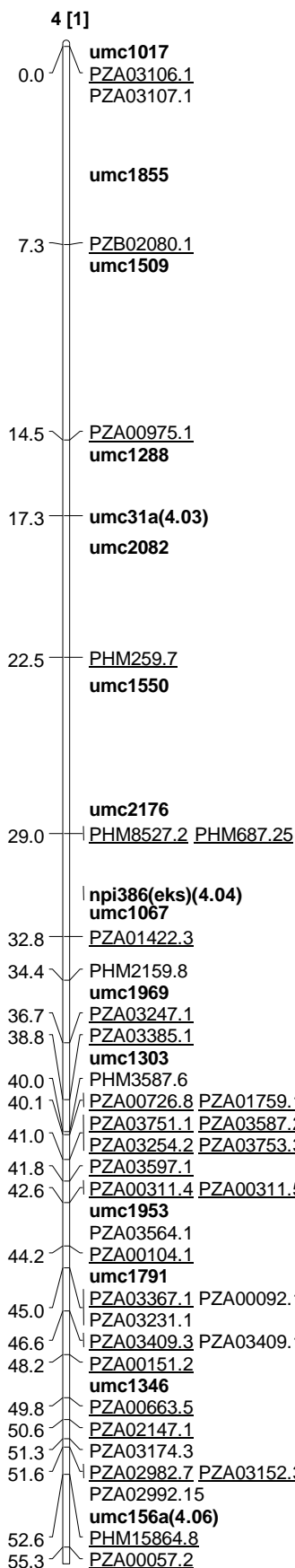
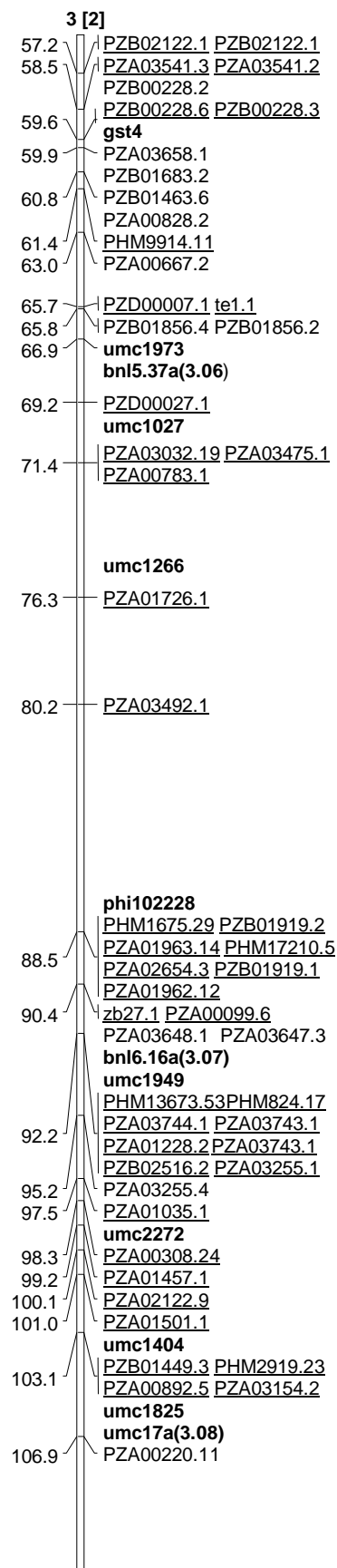
| Bin | cM/Mbp | | | Phy. Position (Mbp) | | | Combined | |
|--------------------|--------|------|------|---------------------|-----------|-----------|----------|------|
| | XB | C5 | C6 | XB | C5 | C6 | Average | C.V. |
| 1.01 | 2.82 | --- | 2.35 | (3,12) | --- | (4,12) | 2.59 | 0.13 |
| 1.02 | 1.15 | --- | 1.59 | (15,28) | --- | (13,28) | 1.37 | 0.23 |
| 1.03 | 1.06 | --- | 1.49 | (35,52) | --- | (45,52) | 1.28 | 0.24 |
| 1.04 | 0.83 | --- | 0.93 | (54,81) | --- | (53,76) | 0.88 | 0.08 |
| <u>1.05</u> | 0.17 | --- | 0.12 | (91,175) | --- | (91,167) | 0.15 | 0.26 |
| (1.06) | 0.5 | --- | --- | (180,192) | --- | --- | 0.5 | --- |
| 1.07 | 0.69 | --- | 0.76 | (202,228) | --- | (206,217) | 0.73 | 0.07 |
| 1.08 | 0.62 | 0.7 | 0.97 | (231,249) | (212,249) | (233,249) | 0.76 | 0.24 |
| 1.09 | 0.75 | --- | 2.32 | (253,263) | --- | (253,260) | 1.54 | 0.72 |
| 1.10 | 1.24 | 1.88 | --- | (270,282) | (276,281) | --- | 1.56 | 0.29 |
| 1.11 | 2.56 | 3.73 | --- | (283,295) | (284,287) | --- | 3.15 | 0.26 |
| 2.00-2.01 | 3.44 | --- | 6.85 | (1,4) | --- | (1,2) | 5.15 | 0.47 |
| 2.02 | 3.94 | 2.1 | 3.1 | (4,14) | (7,10) | (4,14) | 3.05 | 0.30 |
| 2.03 | 3.01 | 2.2 | 2.68 | (16,22) | (18,25) | (23,25) | 2.63 | 0.16 |
| 2.04 | 0.4 | 0.74 | 1.03 | (28,58) | (36,58) | (28,60) | 0.72 | 0.44 |
| <u>(2.05)</u> | 0.18 | 0.21 | --- | (103,149) | (126,145) | (126,145) | 0.2 | 0.11 |
| 2.06 | 0.73 | --- | 0.67 | (169,180) | --- | (162,174) | 0.7 | 0.06 |
| 2.07 | 0.89 | 1.5 | 2.58 | (187,200) | (187,196) | (199,200) | 1.66 | 0.52 |
| 2.08 | 1.25 | --- | 0.74 | (207,220) | --- | (207,220) | 1 | 0.36 |
| 2.09 | 0.88 | --- | 1.52 | (220,226) | --- | (220,226) | 1.2 | --- |
| 3.01 | --- | --- | --- | --- | --- | --- | --- | --- |
| 3.02-3.03 | 3.13 | --- | --- | (4,10) | --- | --- | 3.13 | --- |
| <u>3.04</u> | 0.15 | 0.32 | 0.17 | (27,103) | (21,103) | (27,121) | 0.21 | 0.45 |
| (3.05) | 0.44 | 0.73 | 0.62 | (144,160) | (133,162) | (125,162) | 0.6 | 0.24 |
| 3.06 | 1.36 | --- | --- | (170,185) | --- | --- | 1.36 | --- |
| 3.07 | 1.08 | --- | 2.63 | (192,202) | --- | (194,200) | 1.86 | 0.59 |
| 3.08-3.09-3.10 | 1.67 | --- | 2.83 | (213,228) | --- | (214,220) | 2.25 | 0.36 |
| 4.01-4.02 | 2.11 | --- | 3.01 | (3,10) | --- | (2,7) | 2.56 | 0.25 |
| 4.03 | 2.06 | --- | --- | (14,17) | --- | --- | 2.06 | --- |
| <u>(4.04-4.05)</u> | 0.14 | --- | 0.09 | (24,148) | --- | (29,147) | 0.12 | 0.33 |
| 4.06 | 0.74 | --- | --- | (151,166) | --- | --- | 0.74 | --- |
| 4.07 | 1.52 | --- | --- | (172,178) | --- | --- | 1.52 | --- |
| 4.08 | 0.55 | 1.07 | 0.47 | (180,205) | (194,210) | (180,210) | 0.7 | 0.47 |
| 4.09 | 1.12 | 0.57 | 2.4 | (218,242) | (215,241) | (236,241) | 1.36 | 0.69 |
| 4.10 | --- | --- | --- | --- | --- | --- | --- | --- |
| 4.11 | --- | --- | --- | --- | --- | --- | --- | --- |
| 5.00 | 2.52 | --- | --- | (1,3) | --- | --- | 2.52 | --- |
| 5.01 | 6.08 | --- | --- | (4,8) | --- | --- | 6.08 | --- |
| 5.02 | 2.69 | --- | --- | (12,14) | --- | --- | 2.69 | --- |
| 5.03 | 0.32 | 0.56 | 0.47 | (16,71) | (32,84) | (20,83) | 0.45 | 0.47 |
| <u>(5.04)</u> | 0.12 | 0.17 | 0.22 | (78,170) | (108,170) | (91,169) | 0.17 | 0.42 |
| 5.05 | 0.62 | 2.84 | 1.09 | (173,190) | (172,180) | (173,189) | 1.52 | 0.88 |
| 5.06 | 1.46 | --- | 1.92 | (192,207) | --- | (191,207) | 1.69 | 0.20 |
| 5.07 | 2.3 | --- | 3.16 | (208,210) | --- | (210,212) | 2.73 | 0.22 |
| 5.08-5.09 | 2.9 | --- | 3.97 | (212,216) | --- | (212,215) | 3.44 | 0.22 |
| <u>(6.01-6.02)</u> | 0.19 | 0.31 | 0.31 | (21,92) | (22,92) | (22,92) | 0.27 | 0.26 |
| 6.03 | --- | --- | --- | --- | --- | --- | --- | --- |
| 6.04 | 1.23 | --- | --- | (108,119) | --- | --- | 1.23 | --- |
| 6.05 | 0.8 | --- | 1.13 | (124,153) | --- | (124,149) | 0.97 | 0.24 |
| 6.06 | 1.61 | --- | --- | (157,161) | --- | (149,161) | 1.61 | --- |
| 6.07 | 4.9 | 5.25 | --- | (163,165) | (162,165) | --- | 5.08 | 0.05 |
| 6.08 | 1.95 | 4.28 | --- | (165,167) | (165,167) | --- | 3.12 | 0.53 |
| 7.00 | --- | --- | 2.5 | --- | --- | (2,6) | 2.5 | --- |
| 7.01 | --- | --- | 1.79 | --- | --- | (6,11) | 1.79 | --- |
| <u>(7.02)</u> | 0.19 | 0.18 | 0.24 | (14,120) | (72,86) | (14,103) | 0.2 | 0.17 |

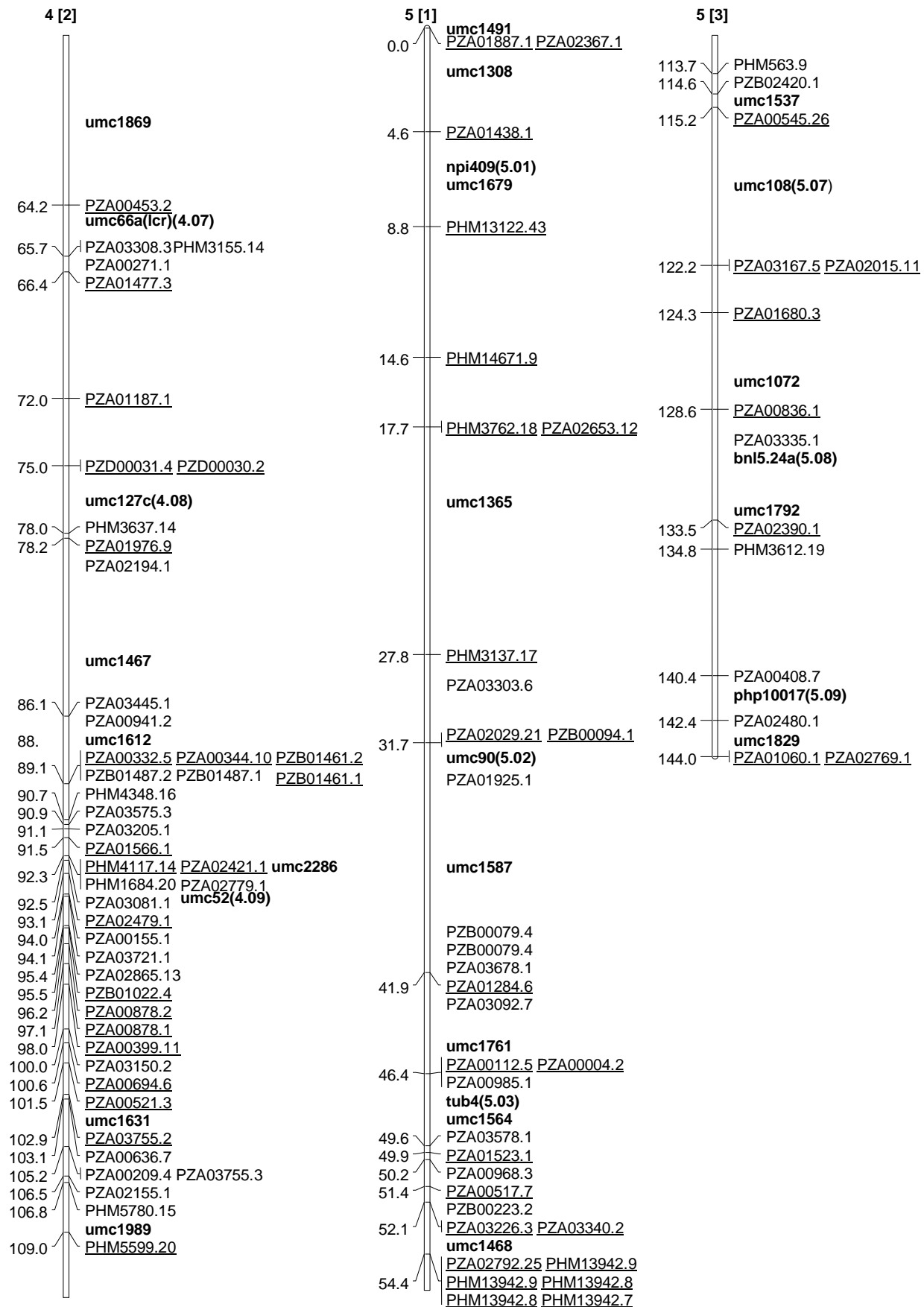
| | | | | | | | | |
|---------|------|------|------|-----------|-----------|-----------|------|------|
| 7.03 | 0.81 | 1.84 | 0.31 | (124,152) | (128,141) | (131,138) | 0.99 | 0.79 |
| 7.04 | 3.51 | --- | 1.75 | (162,163) | --- | (156,162) | 2.63 | 0.47 |
| 7.05 | 2.87 | --- | --- | (163,166) | --- | (165,166) | --- | --- |
| 7.06 | 6.31 | --- | 4.79 | (166,169) | --- | (166,169) | 5.55 | 0.19 |
| (8.01) | 2.39 | --- | --- | (4,8) | --- | --- | 2.39 | --- |
| (8.02) | 1.24 | --- | --- | (14,18) | --- | --- | 1.24 | --- |
| (8.03) | 0.19 | --- | 0.23 | (18,106) | --- | (45,115) | 0.21 | 0.13 |
| 8.04 | 0.29 | 0.73 | 0.79 | (118,132) | (123,129) | (123,129) | 0.6 | 0.45 |
| 8.05 | 0.84 | 1.93 | 0.8 | (135,156) | (134,135) | (134,146) | 1.19 | 0.54 |
| 8.06 | 1.34 | 2.32 | 0.36 | (160,161) | (162,163) | (151,163) | 1.34 | 0.73 |
| 8.07 | 1.08 | 2.91 | --- | (165,166) | (163,165) | --- | 2 | 0.65 |
| 8.08 | 4.49 | 7.59 | --- | (169,172) | (171,172) | --- | 6.04 | 0.36 |
| 9.01 | 1.87 | 1.85 | --- | (10,19) | (11,19) | --- | 1.86 | 0.01 |
| 9.02 | 6.81 | 1.96 | --- | (23,24) | (21,22) | --- | 4.39 | 0.78 |
| (9.03) | 0.06 | --- | 0.11 | (24,80) | --- | (30,90) | 0.09 | 0.42 |
| 9.04 | 0.79 | 1 | 1.21 | (99,117) | (99,105) | (99,112) | 1 | 0.21 |
| 9.05 | 1.17 | --- | 1.28 | (124,133) | --- | (127,131) | 1.23 | 0.06 |
| 9.06 | 4.25 | --- | --- | (141,143) | --- | --- | 4.25 | --- |
| 9.07 | 8.47 | --- | 5.69 | (144,145) | --- | (147,150) | 7.08 | 0.28 |
| 9.08 | --- | --- | --- | --- | --- | --- | --- | --- |
| 10.01 | --- | --- | --- | --- | --- | --- | --- | --- |
| 10.02 | 3.83 | --- | 3.64 | (6,10) | --- | --- | 3.74 | 0.04 |
| (10.03) | 0.11 | 0.28 | 0.17 | (15,112) | (15,86) | (18,110) | 0.19 | 0.44 |
| 10.04 | 1.25 | 0.89 | 0.63 | (118,121) | (111,127) | (121,127) | 0.92 | 0.34 |
| 10.05 | 1.19 | --- | 1.3 | (134,137) | --- | (130,134) | 1.25 | 0.06 |
| 10.06 | 1.81 | 2.45 | 4.61 | (142,137) | (138,142) | (137,139) | 2.96 | 0.50 |
| 10.07 | 5.38 | 5.77 | 5.49 | (144,148) | (144,147) | (144,147) | 5.55 | 0.04 |

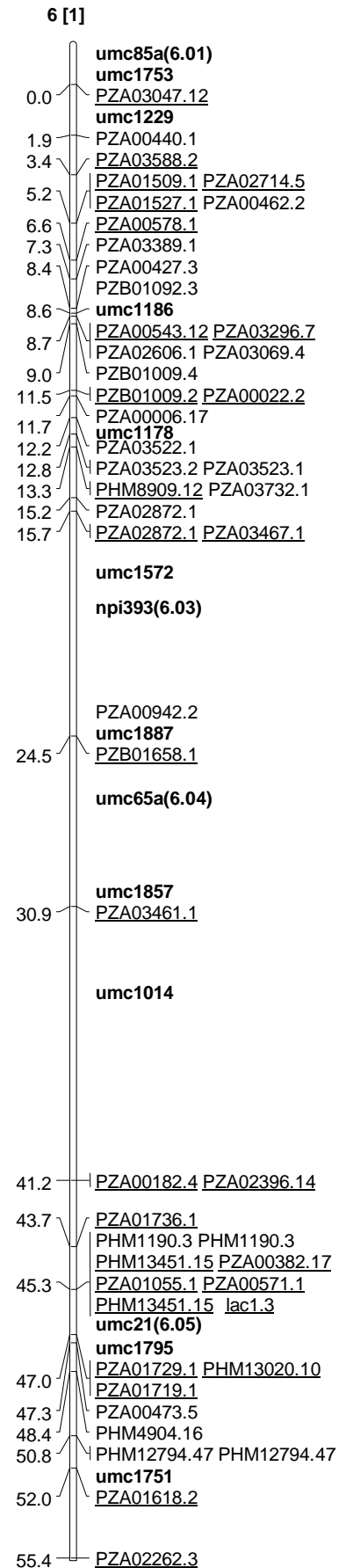
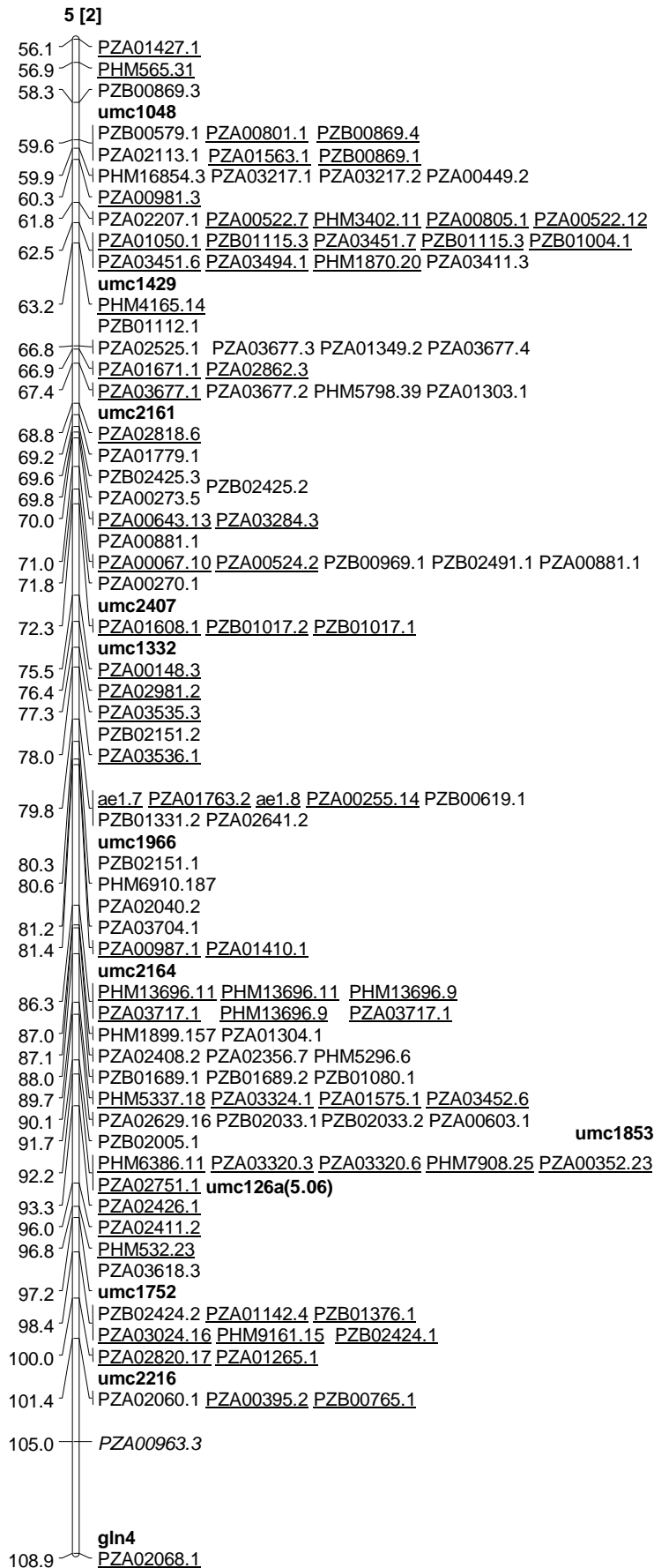


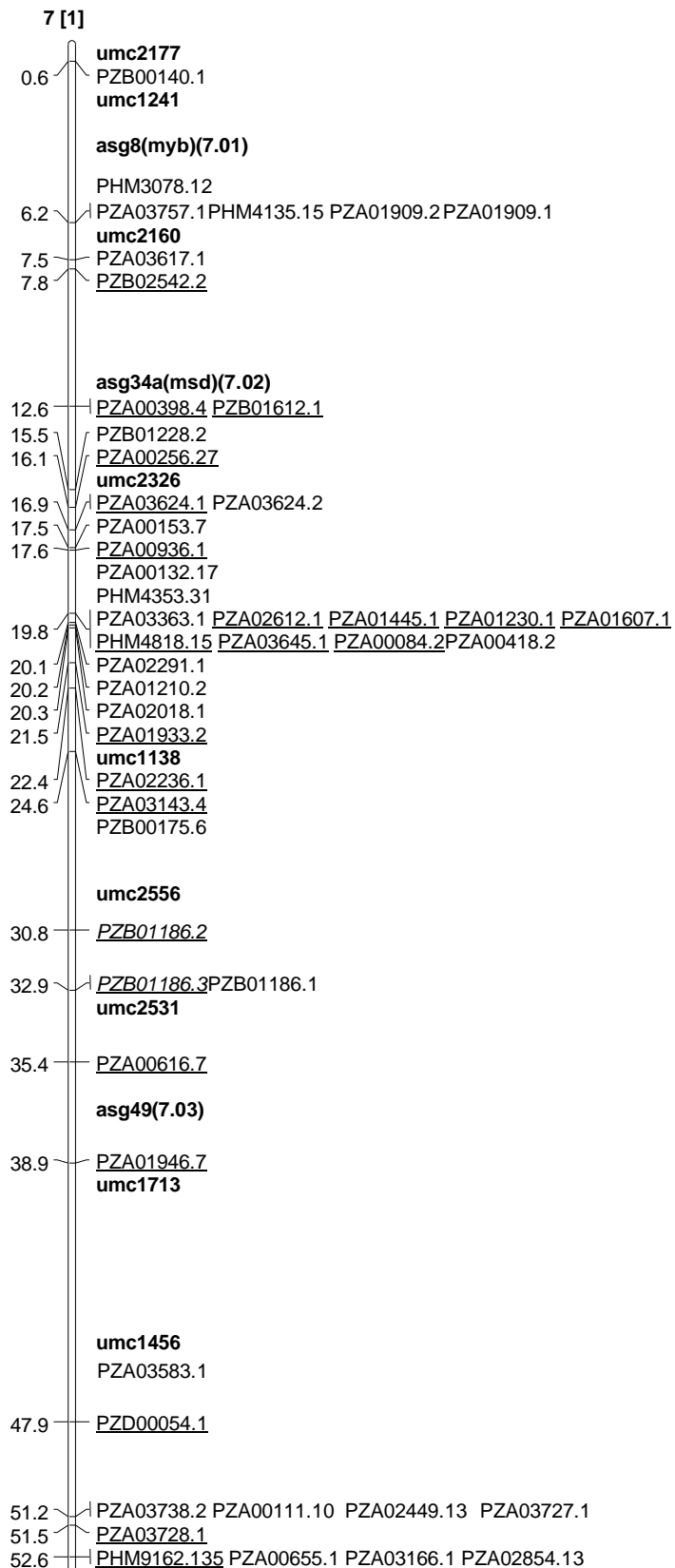
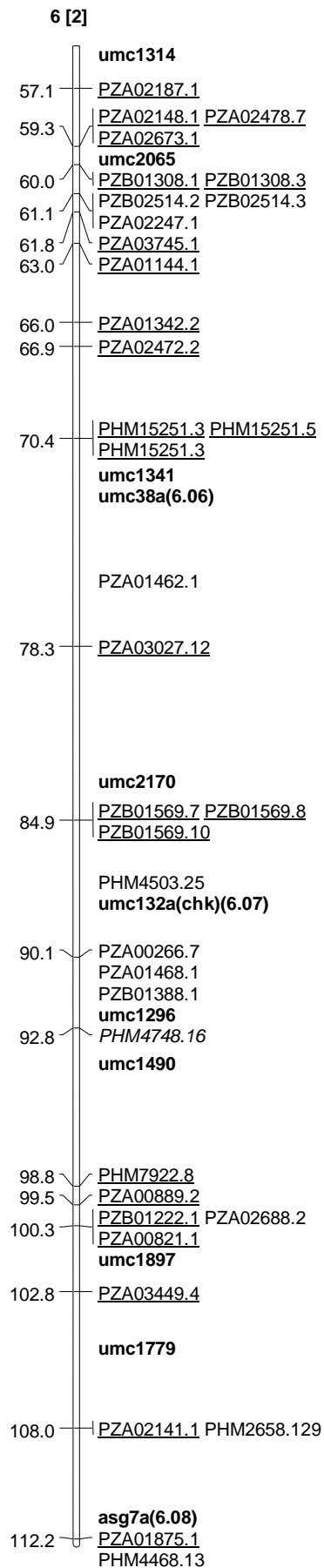


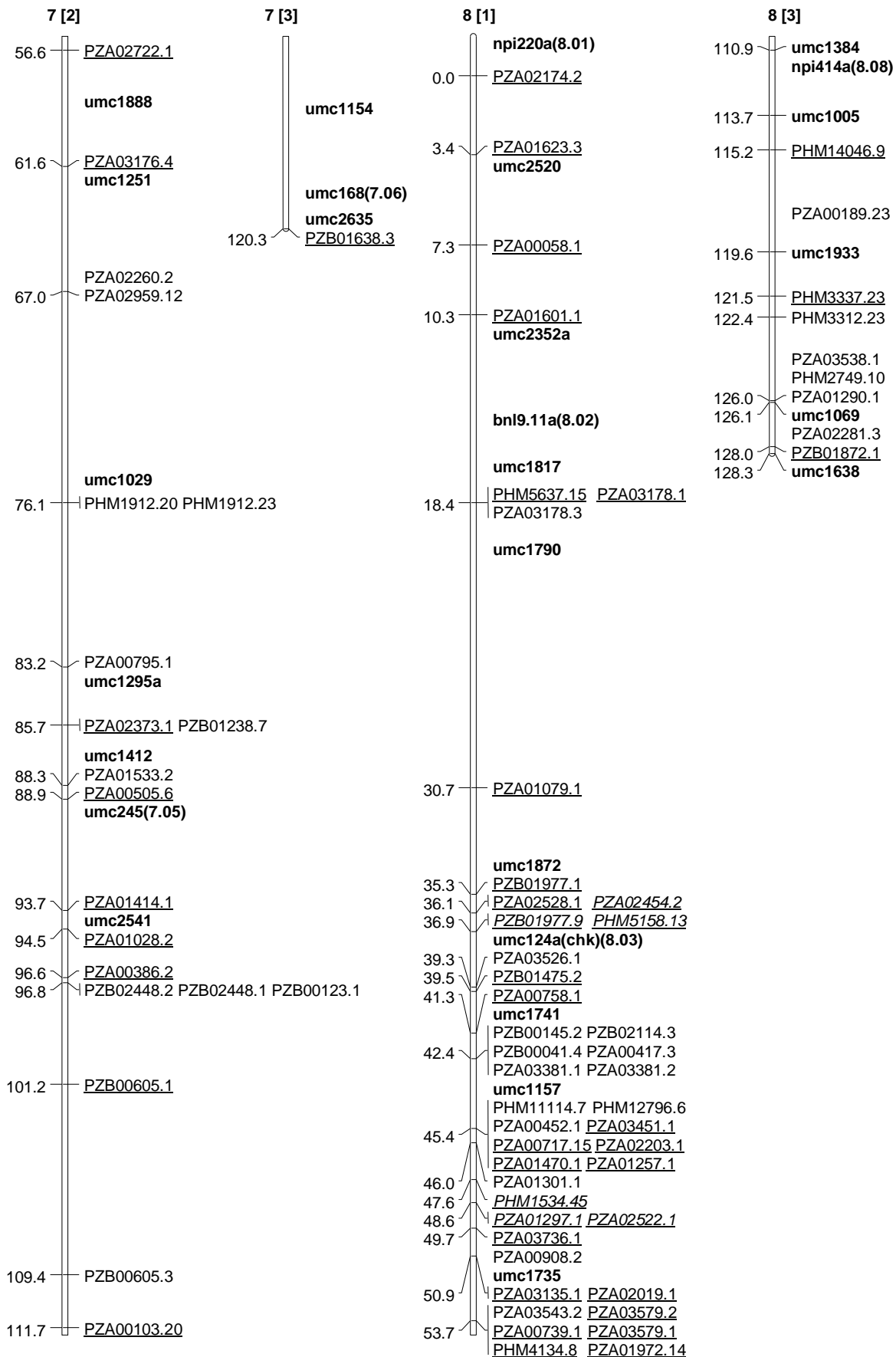


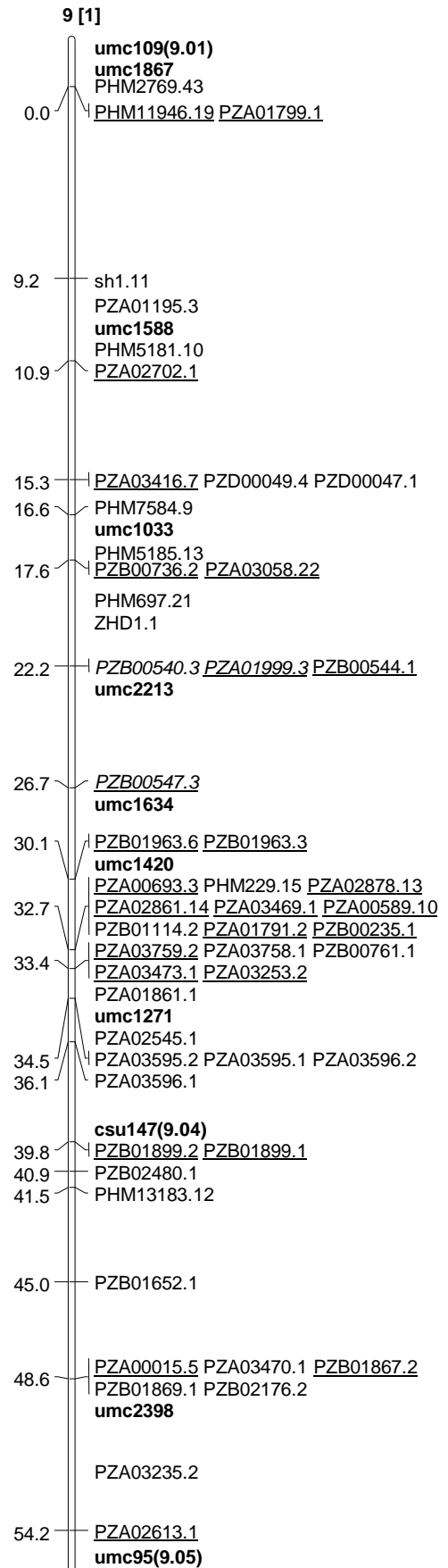
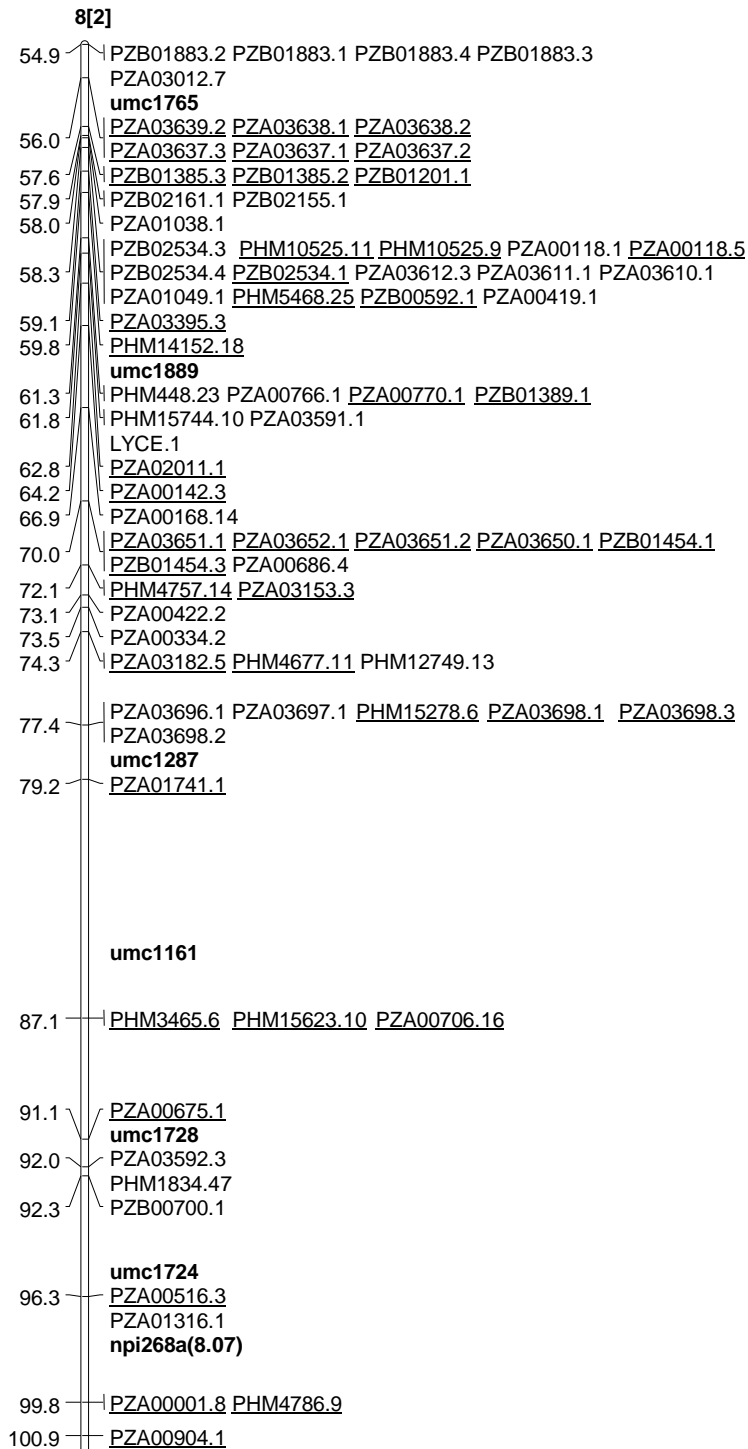


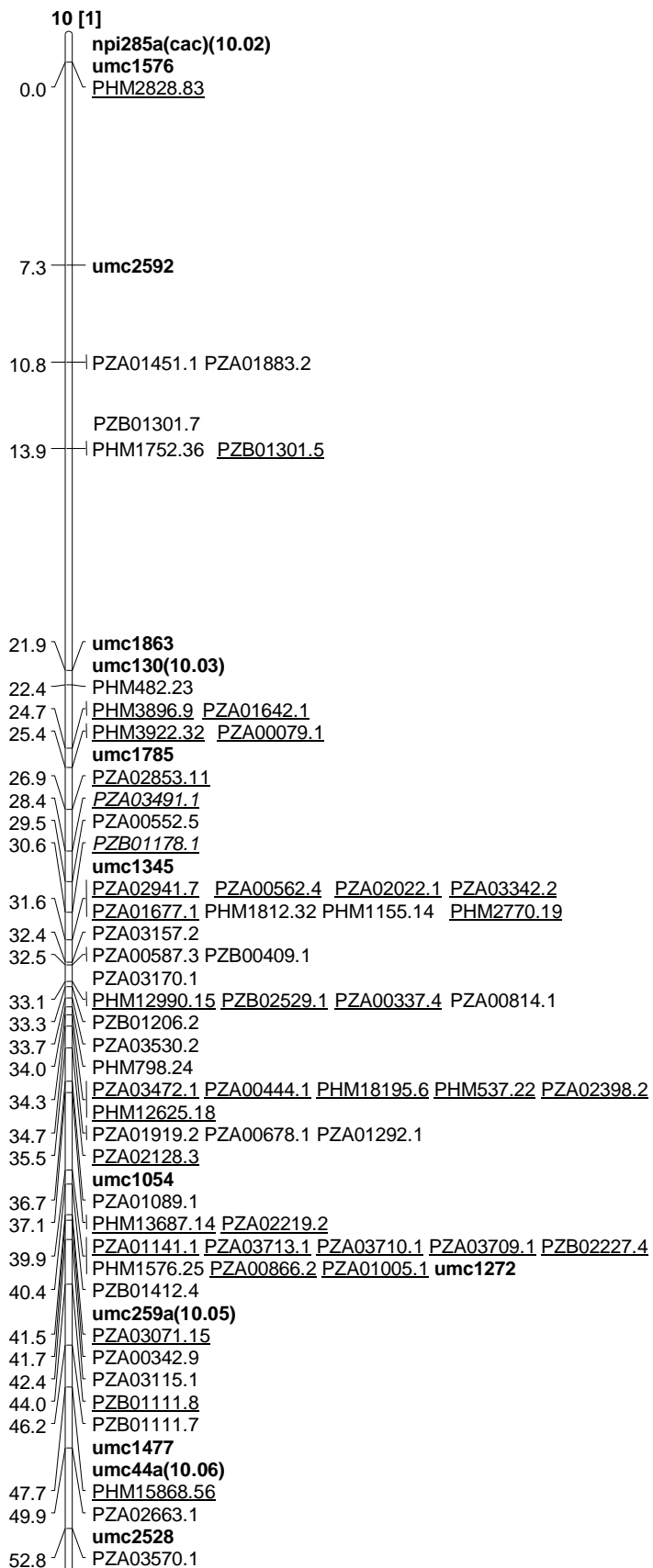
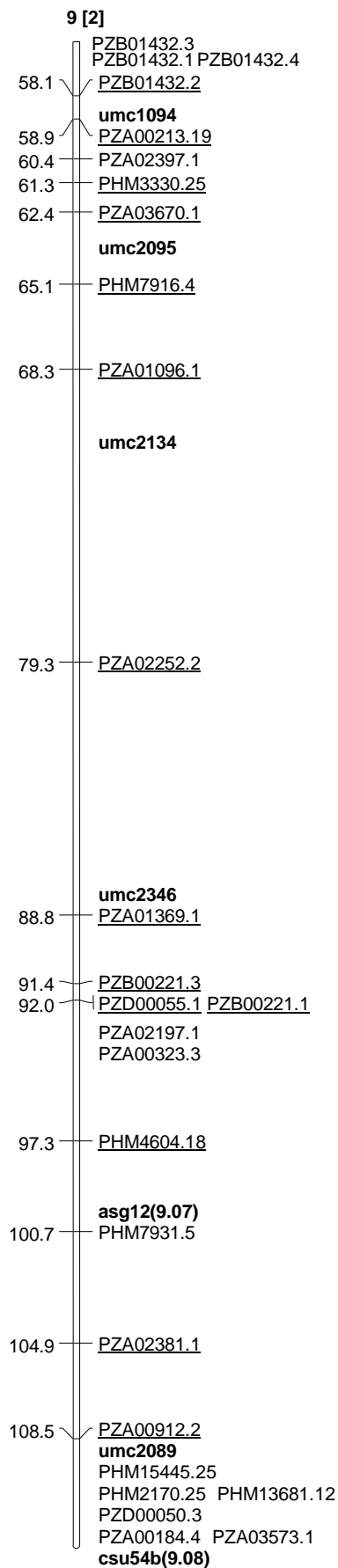












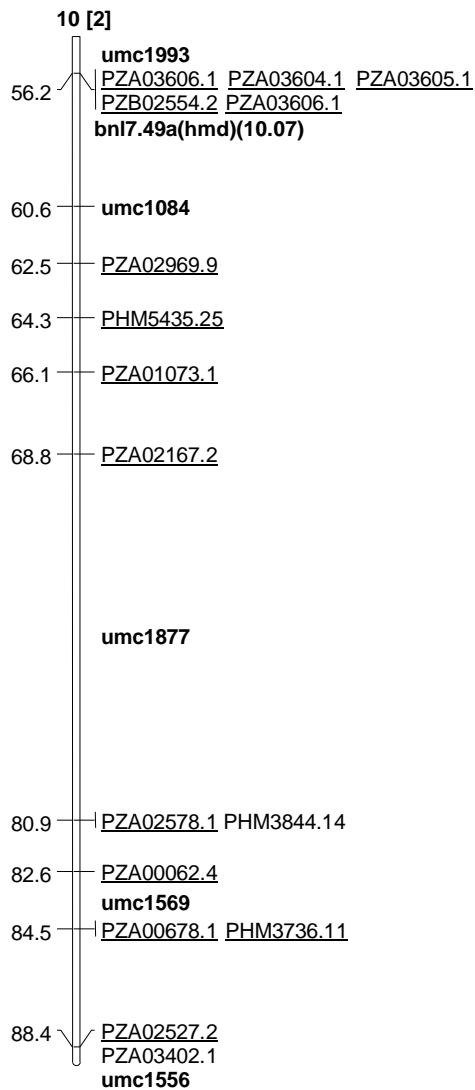


Figure S1: Integrated maize linkage map constructed using three RIL populations and physical map. Cosegregation and SSR markers are designated by vertical line and bold font, respectively. The markers with different orders from the physical map are indicated with italic font. The markers underlined were determined using 'XB' RIL population. Core markers are indicated in bold with their corresponding bin numbers in brackets.

Genetic distance versus physical distance (cM/Mbp)

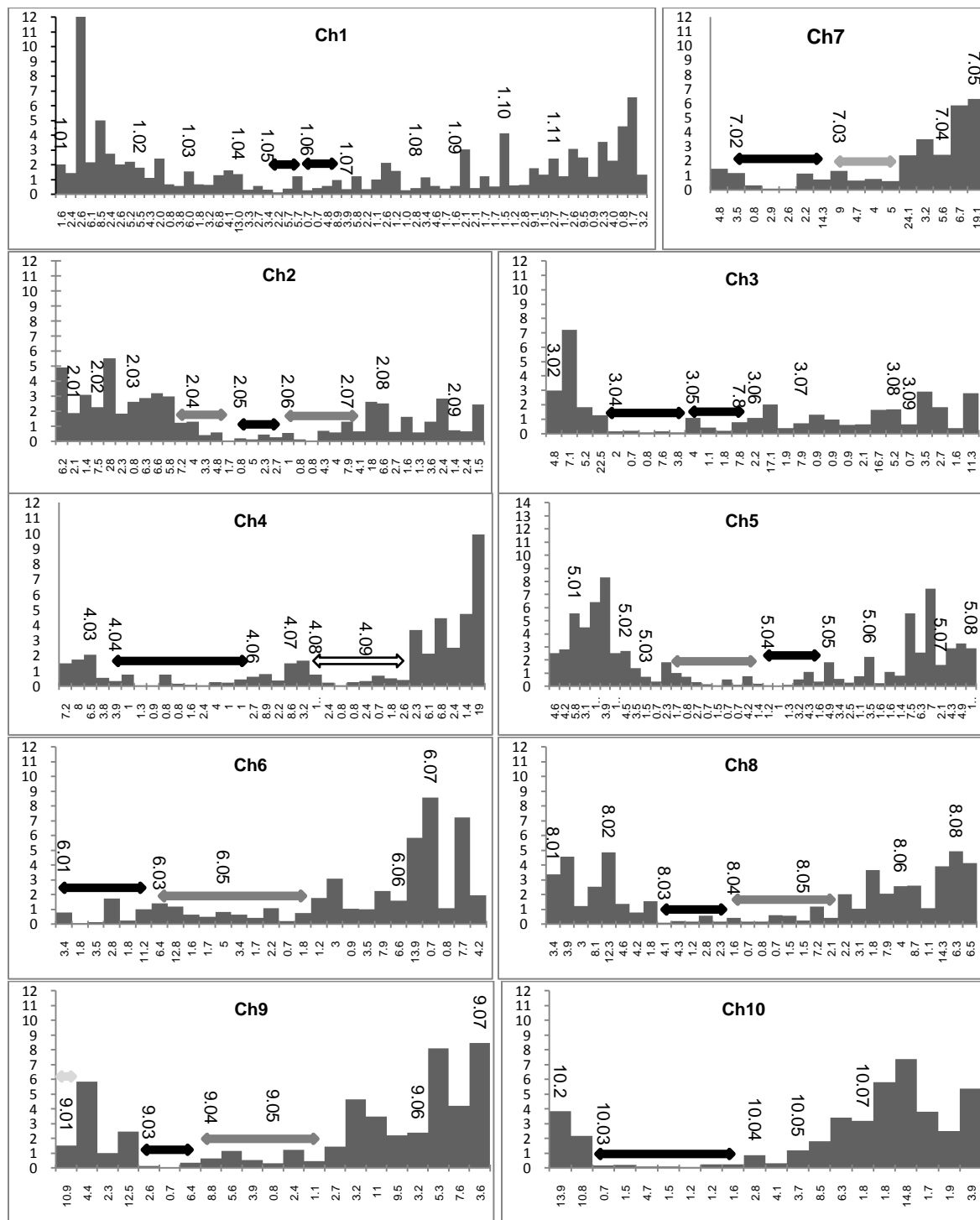


Figure S2: Relationship between physical and genetic distance in the map derived from 'XB' population. Centromeric bin and pericentromeric regions are indicated by black and gray horizontal arrows, respectively. A non-centromeric recombination suppression region on chromosome 4 is indicated by a non-filled arrow. Numbers in horizontal axis represent the sizes of chromosome regions in cM. The vertical axis shows the cM/Mbp ratio. Some bin regions are indicated by the bin numbers. For chromosomes 1 and 3, two centromere bins are indicated, one as reported by Davis et al. (1999) and the other as identified in this study.