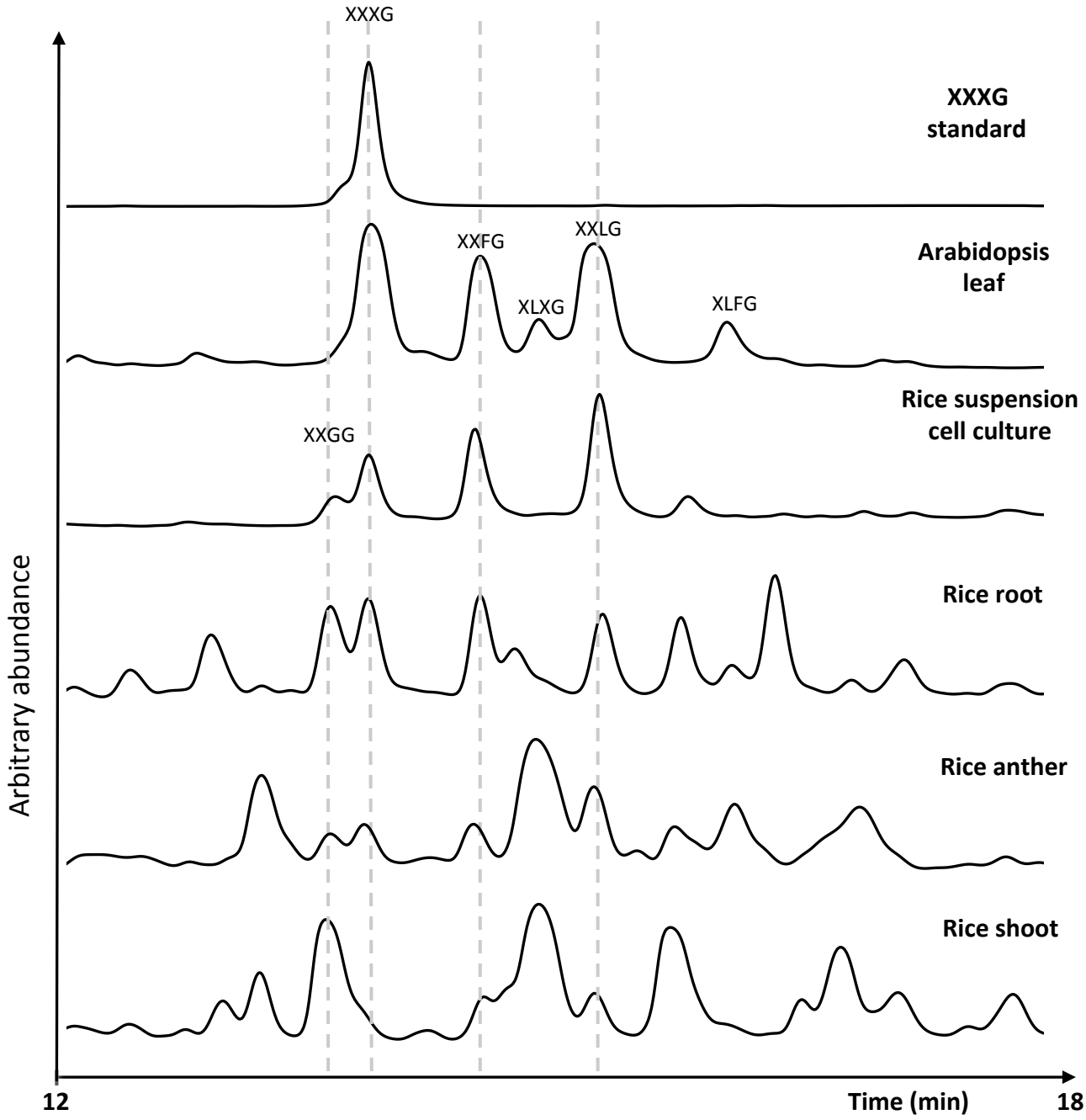
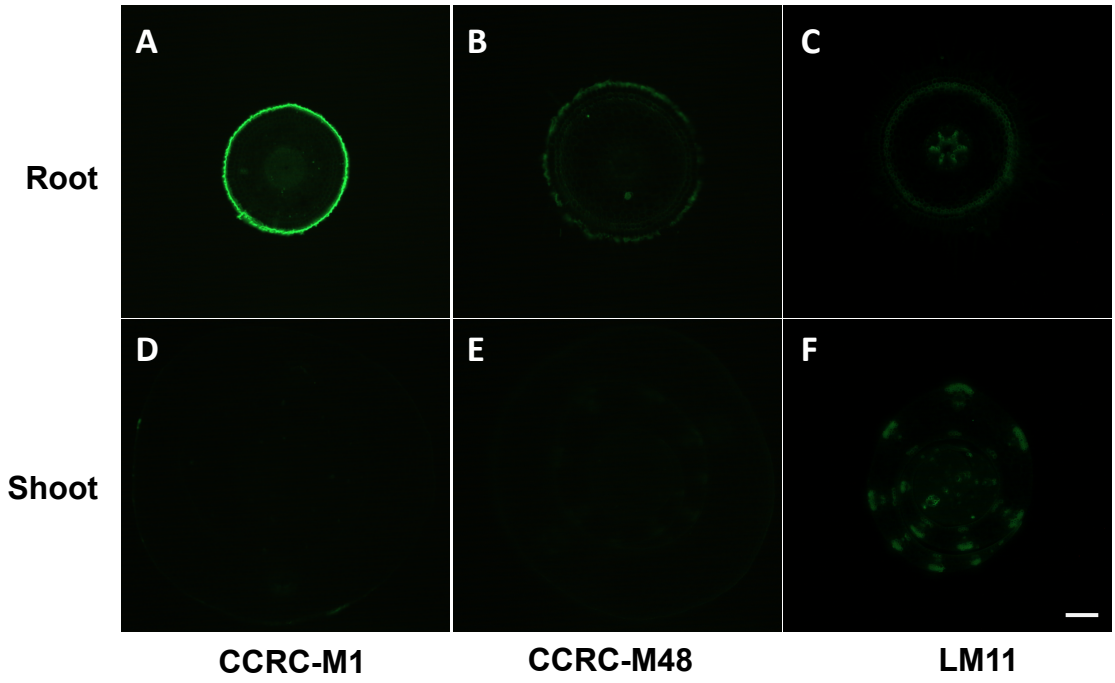
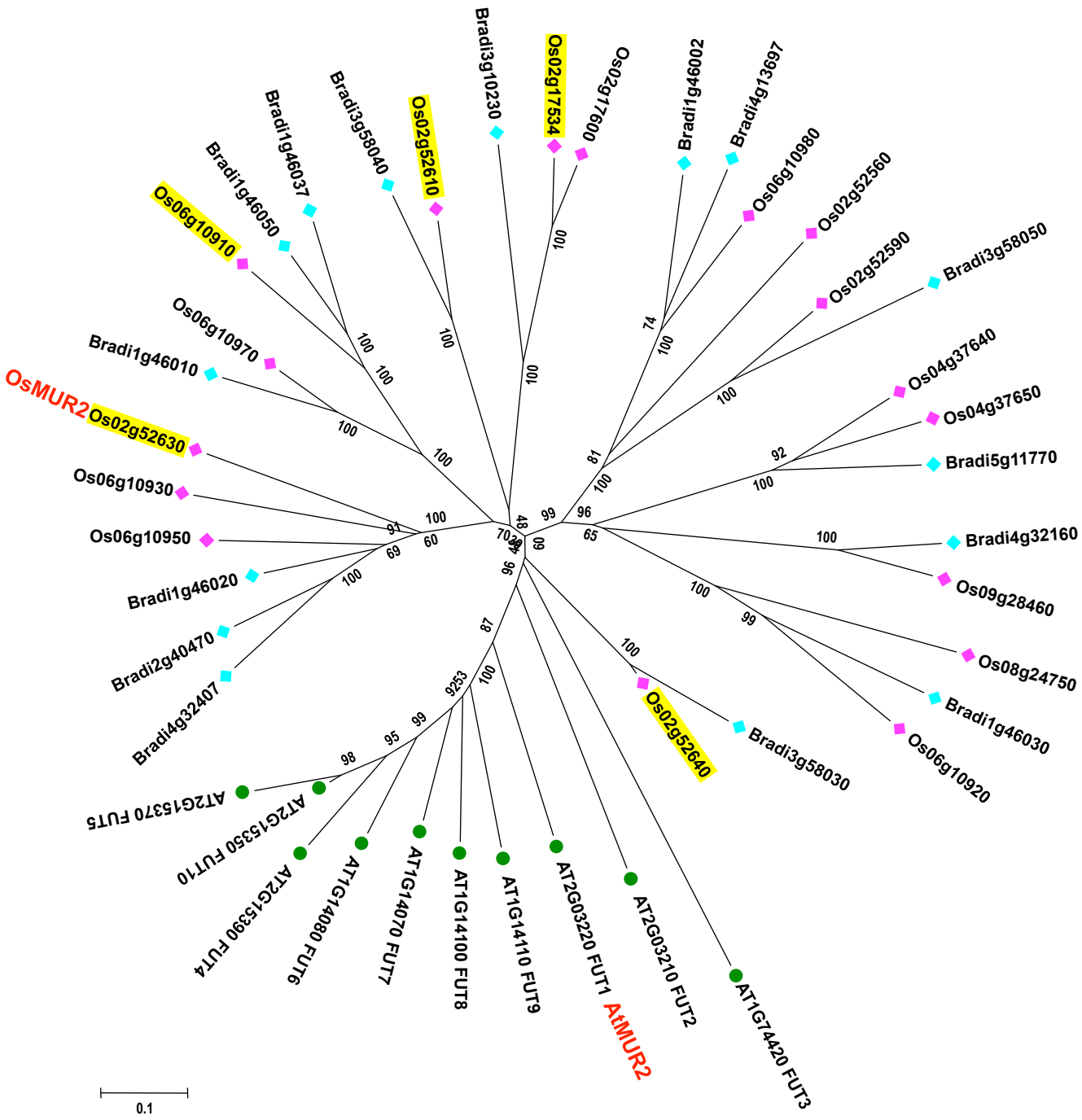


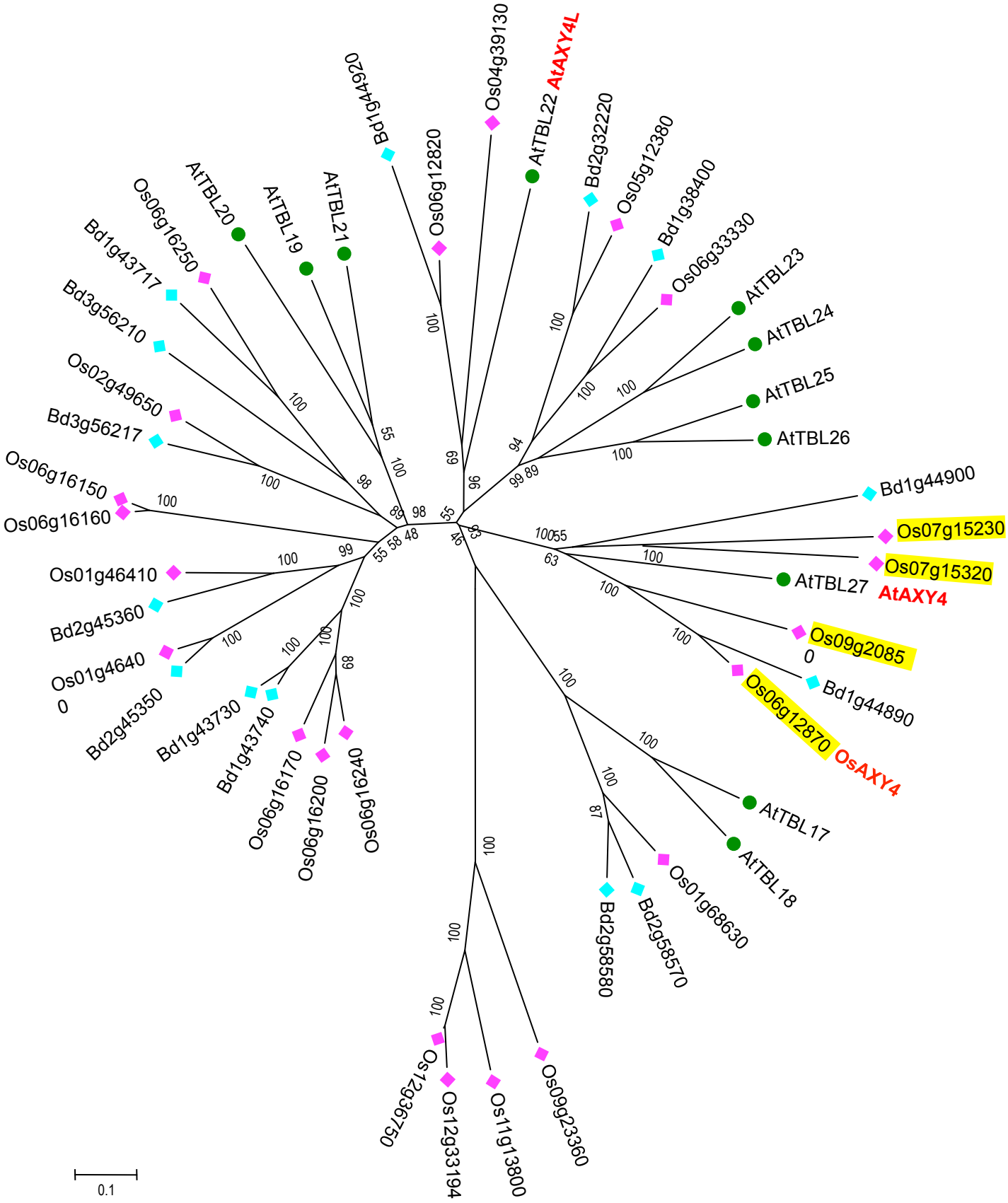

**Supplementary Figure S1.** HPAEC-PAD analysis of XyG oligosaccharides derived from various tissues. XXXG heptasaccharide and XEG digest oligosaccharides from Arabidopsis are used as controls. XyG oligosaccharides are annotated using the one-letter code nomenclature described by Fry et al., 1993.



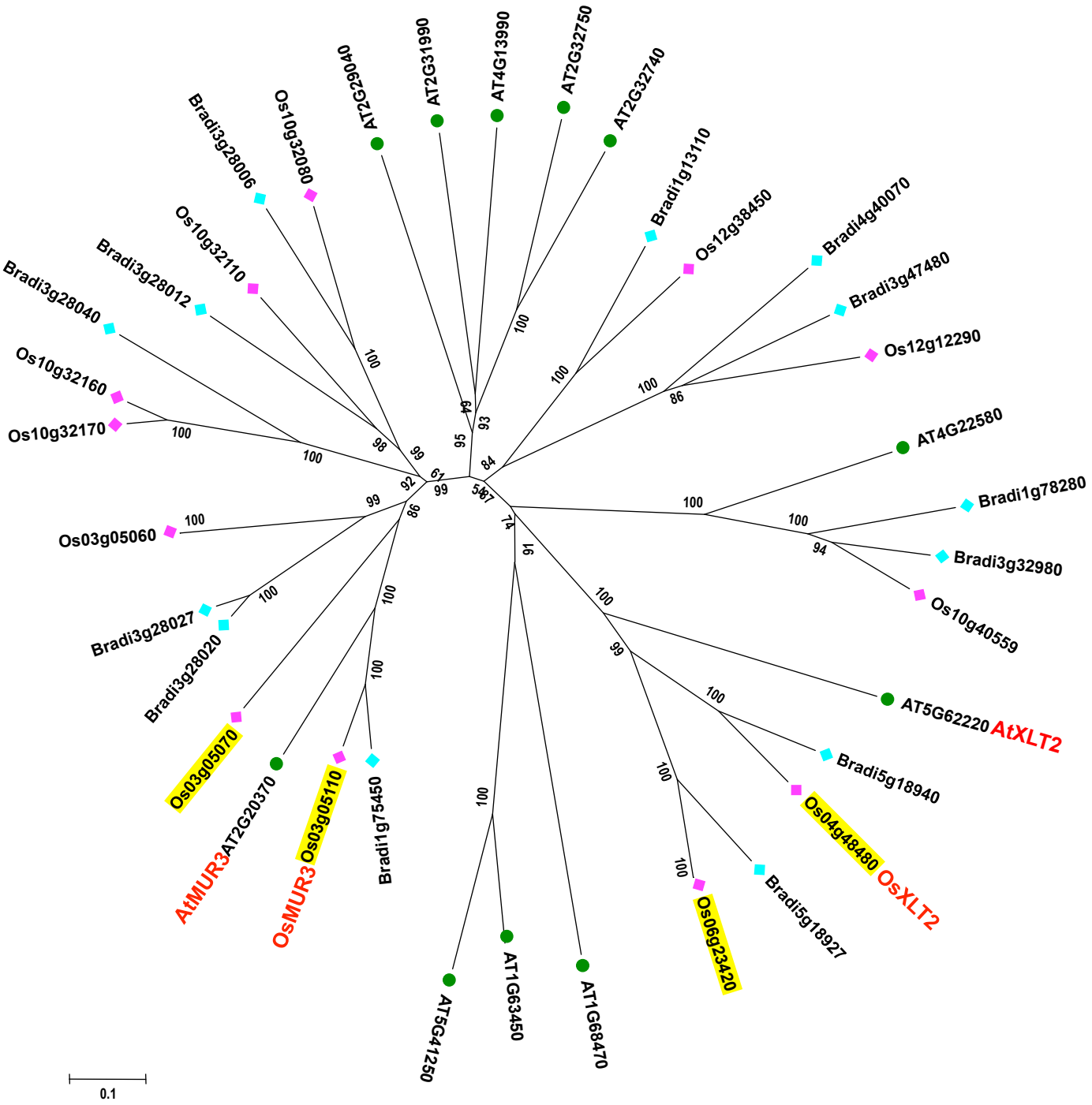

**Supplementary Figure S2.** Immunofluorescent labeling of 3-day-old rice root and shoot transverse sections with different antibodies. (A) to (C) Rice root cross-sections labeled with CCRC-M1 (A), CCRC-M48 (B), LM11 (C). (D) to (F) Rice shoot cross-sections labeled with CCRC-M1 (D), CCRC-M48 (E), LM11 (F). CCRC-M1 recognizes fucosylated xyloglucan; CCRC-M48 recognizes non-fucosylated xyloglucan; LM11 recognizes xylan. Bar=50 μm.



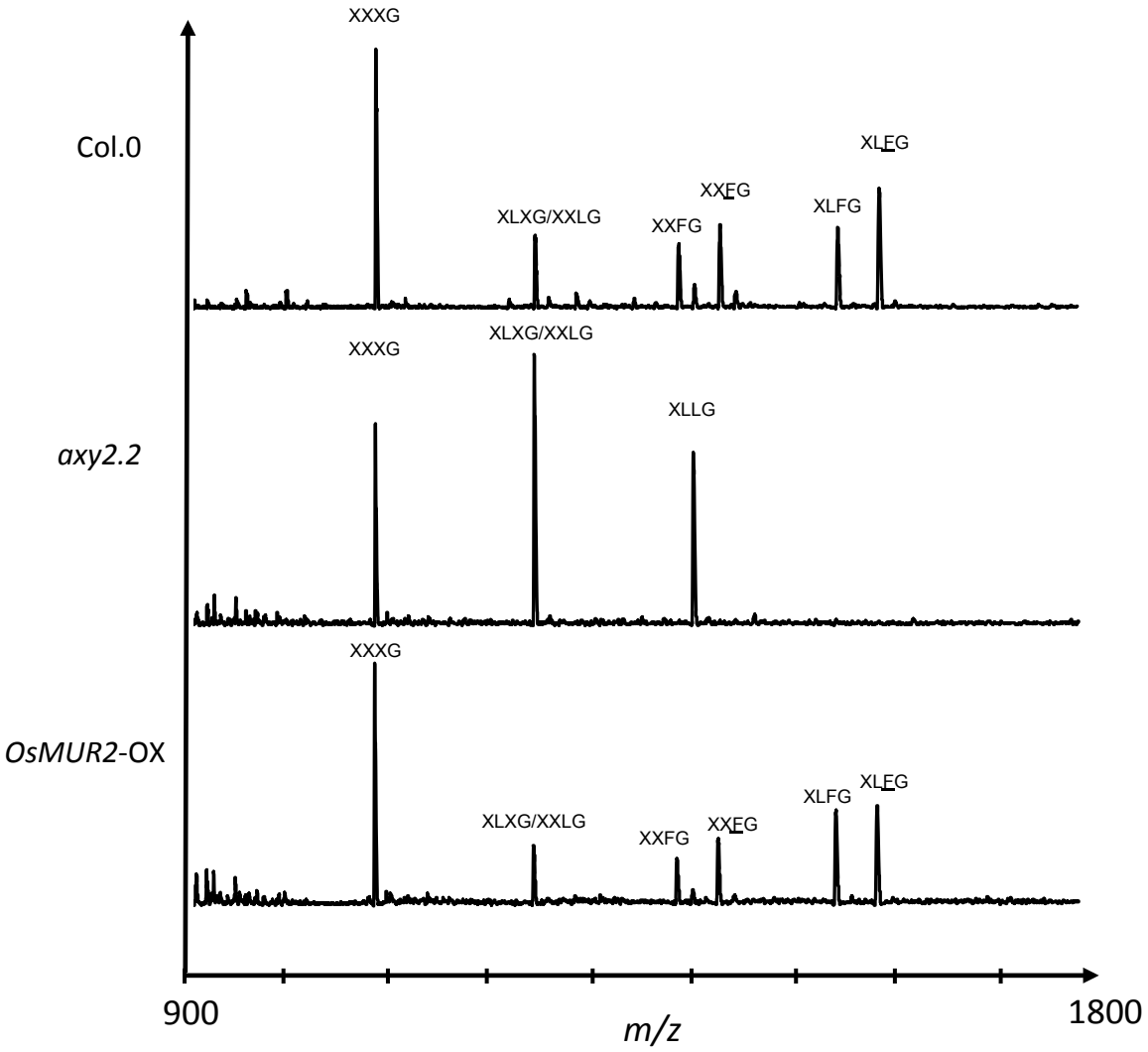

**Supplementary Figure S3**. Phylogenic tree of MUR2 homologs in Arabidopsis, rice and Brachypodium. Genes shown in Table 1 are highlighted in yellow. Homologs were identified from Phytozome (http://www.phytozome.net). Bootstrap values are shown.



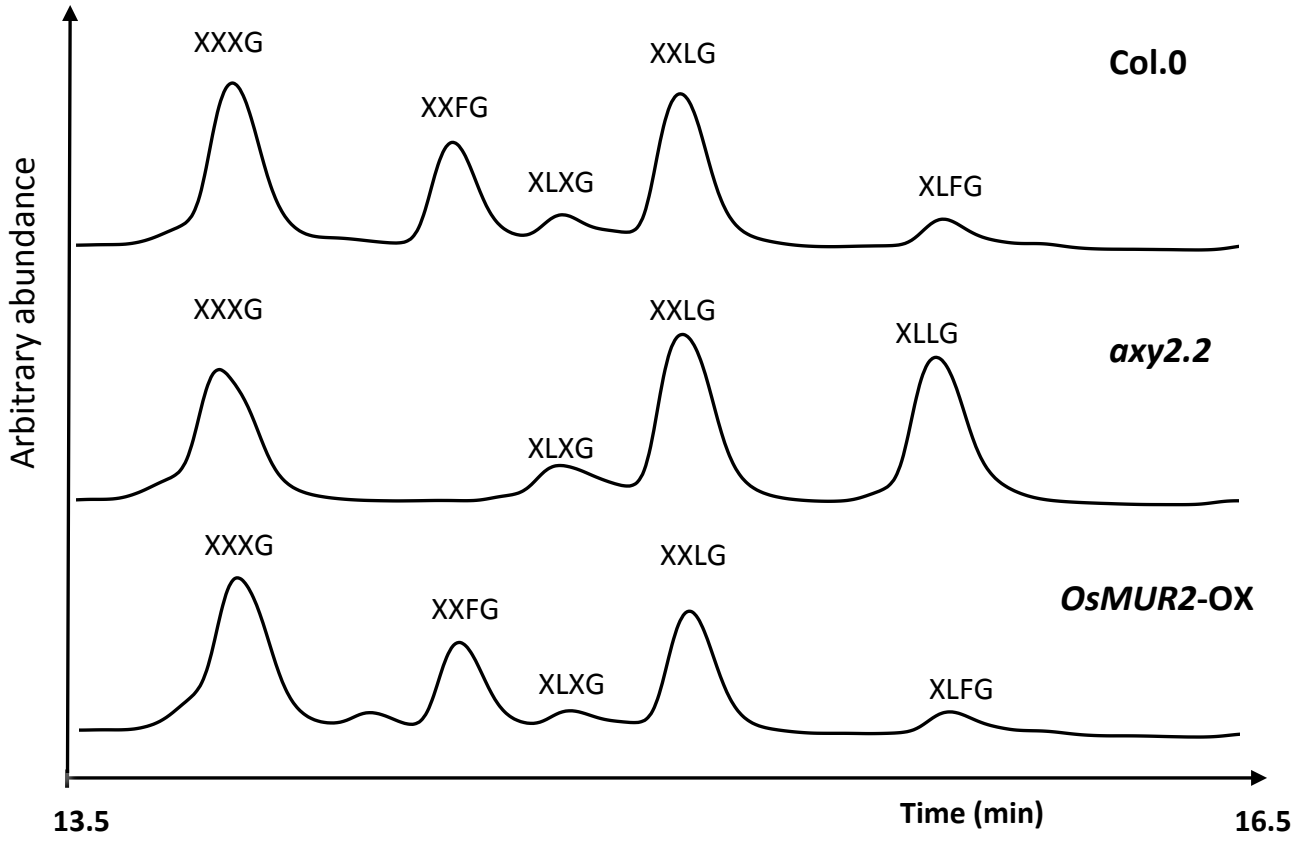

**Supplementary Figure S4**. Phylogenic tree of AXY4 homologs in Arabidopsis, rice and Brachypodium. Homologs were identified from Phytozome (http://www.phytozome.net) and only protein sequences from TBL17-TBL27 subclade were shown here. Genes listed in Table 1 are marked in yellow. Bootstrap values are shown.



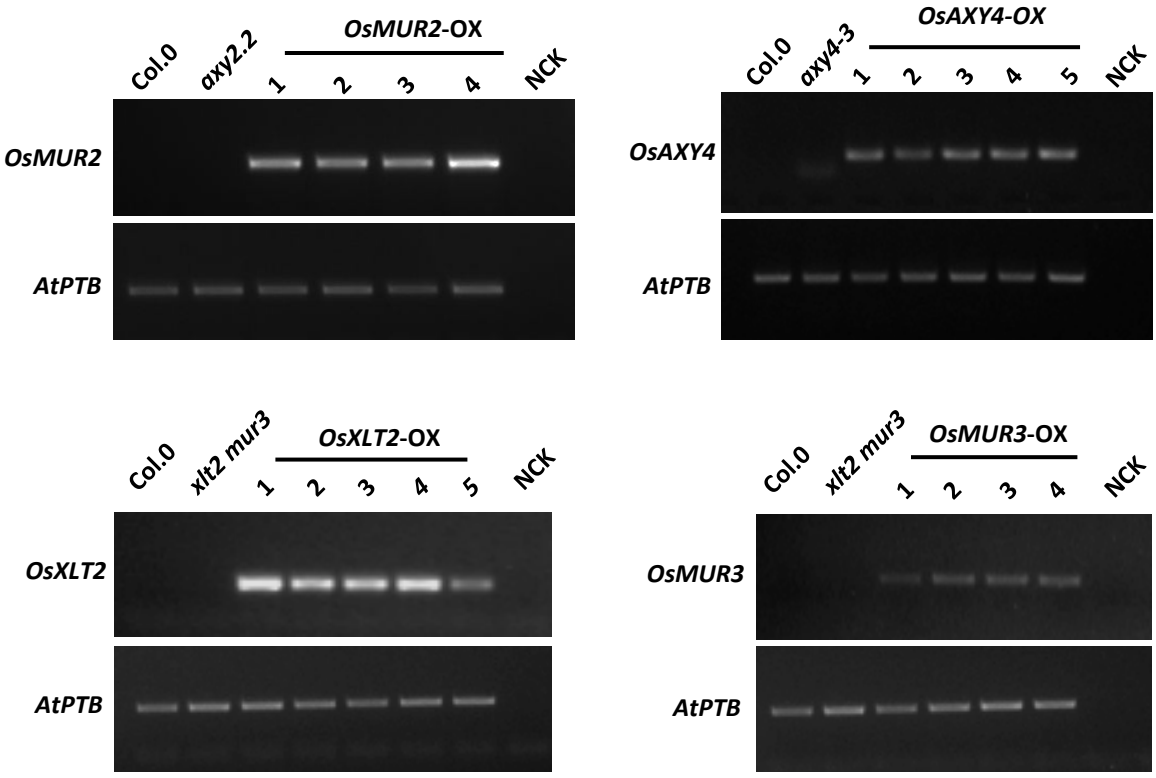

**Supplementary Figure S5.** Phylogenic tree of MUR3 and XLT2 homologs in Arabidopsis, rice and Brachypodium. Homologs were identified from Phytozome (http://www.phytozome.net). Genes listed in Table 1 are marked in yellow. Bootstrap values are shown.



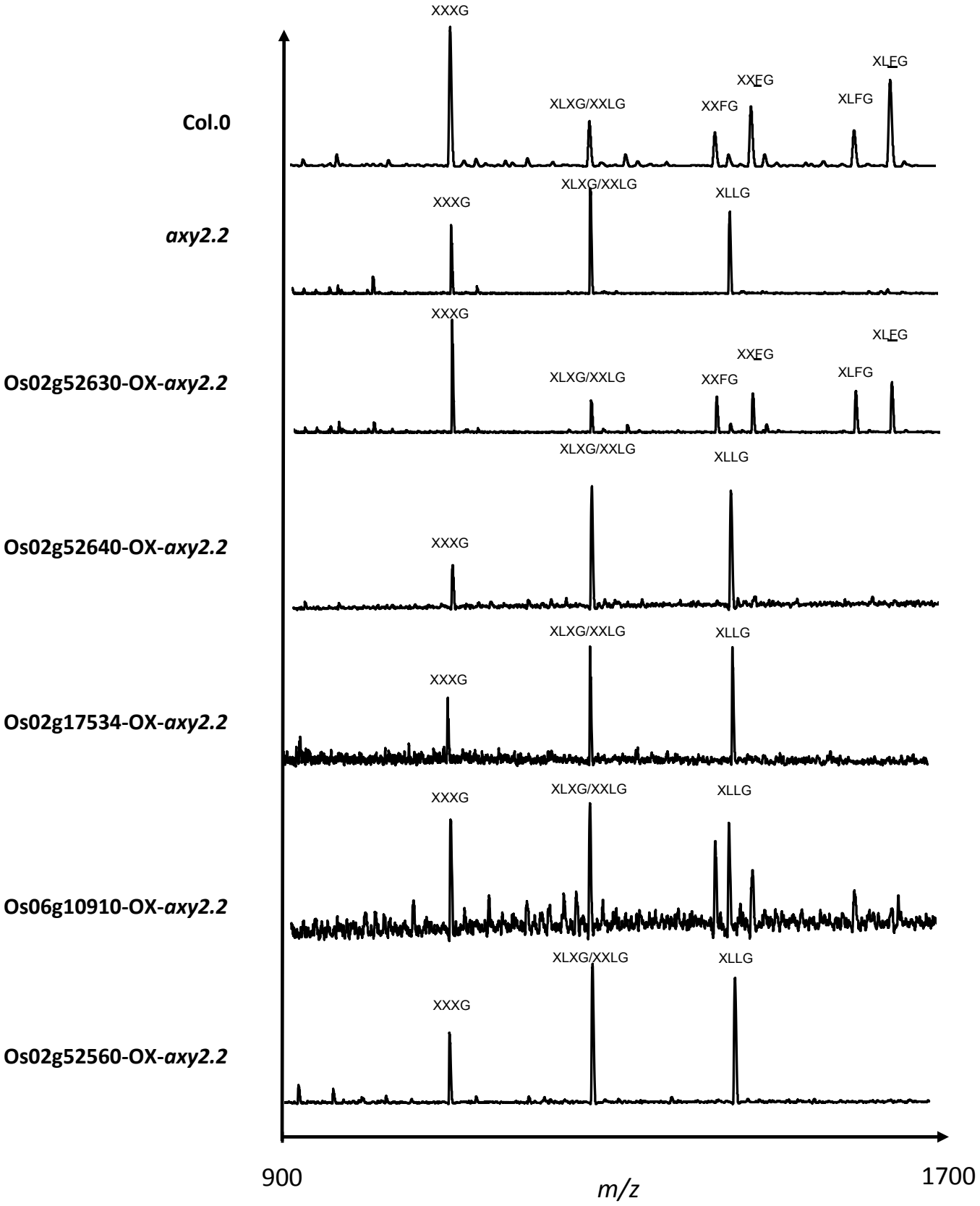

**Supplementary Figure S6.** XyG oligosaccharide mass profiling of 4-week-old leaves of Arabidopsis Col.0, *axy2.2/fut1* and *OsMUR2* transformants of the Arabidopsis *axy2.2* mutant. One representative line of the *OsMUR2* transformants is shown here. OX, independent overexpression line.



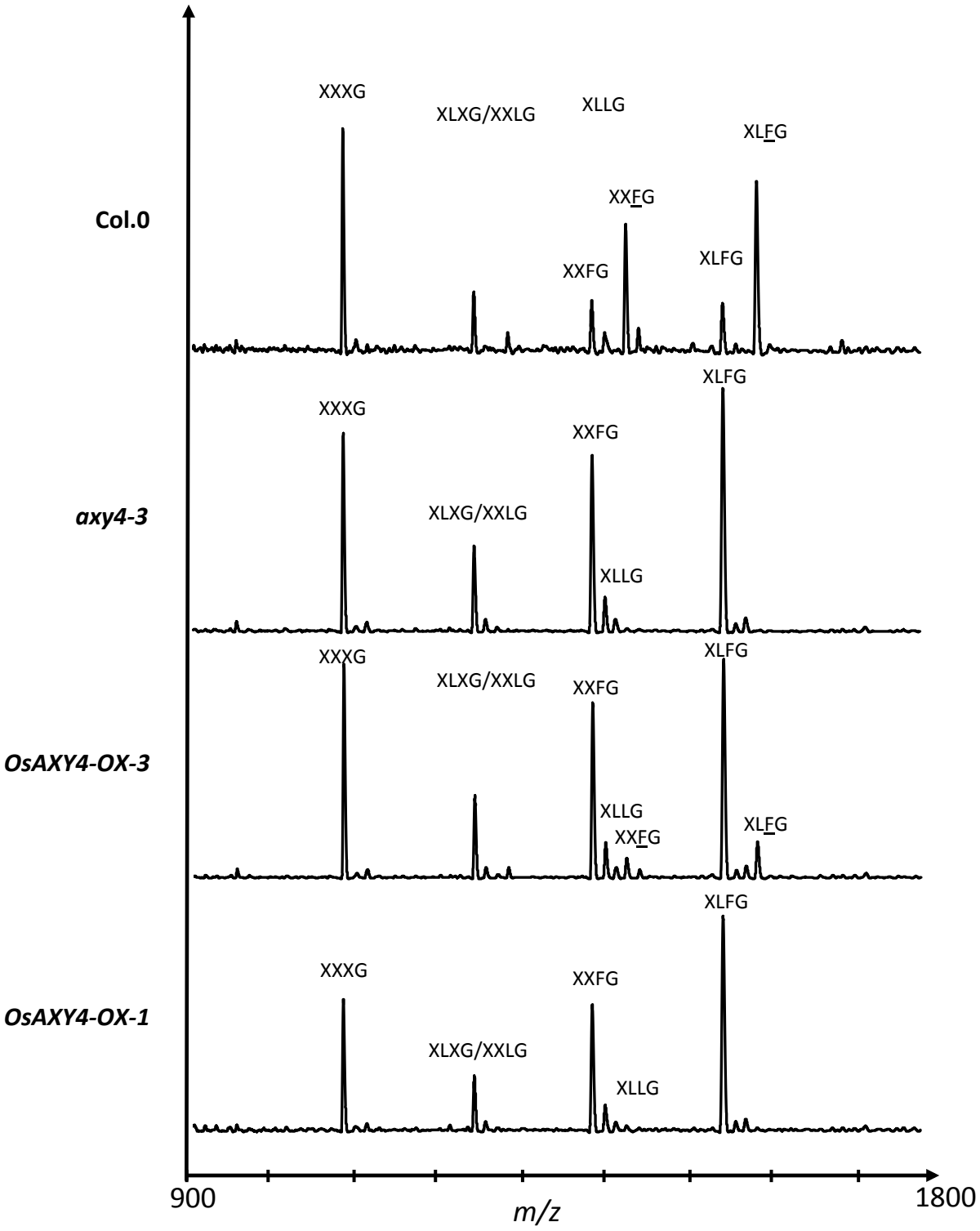

**Supplementary Figure S7.** Xyloglucan HPAEC spectra derived from walls of 4-week-old leaves from Col.0, *axy2.2* and *OsMUR2* transformants of Arabidopsis *axy2.2* mutants. One representative line of the *OsMUR2* transformants is shown here. OX, independent overexpression line.



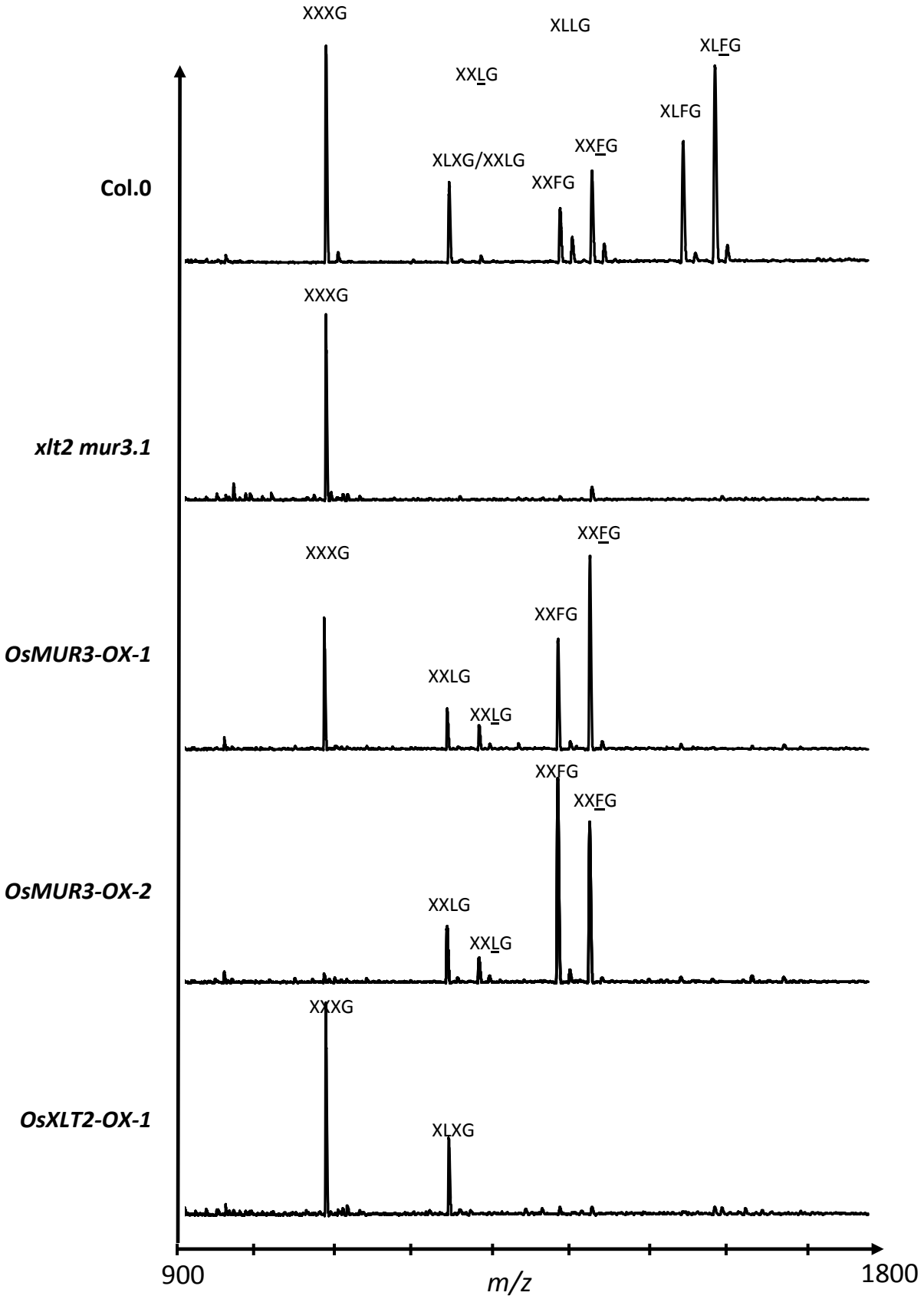

**Supplementary Figure S8.** RT-PCR analysis of total RNA extracted from 4-week-old leaves of Arabidopsis wild-type (Col.0), mutants and all transformants (*OsMUR2*-OX-*axy2.2*, *OsAXY4*-OX-*axy4-3*, *OsXLT2*-OX-*xlt2 mur3* and *OsMUR3*-OX-*xlt2 mur3*). The RT-PCR was performed using specific primers for each gene (See Supplementary Table S5). *AtPTB* transcript as a reference gene is shown on lower panel. OX, overexpression. NCK, no template control.



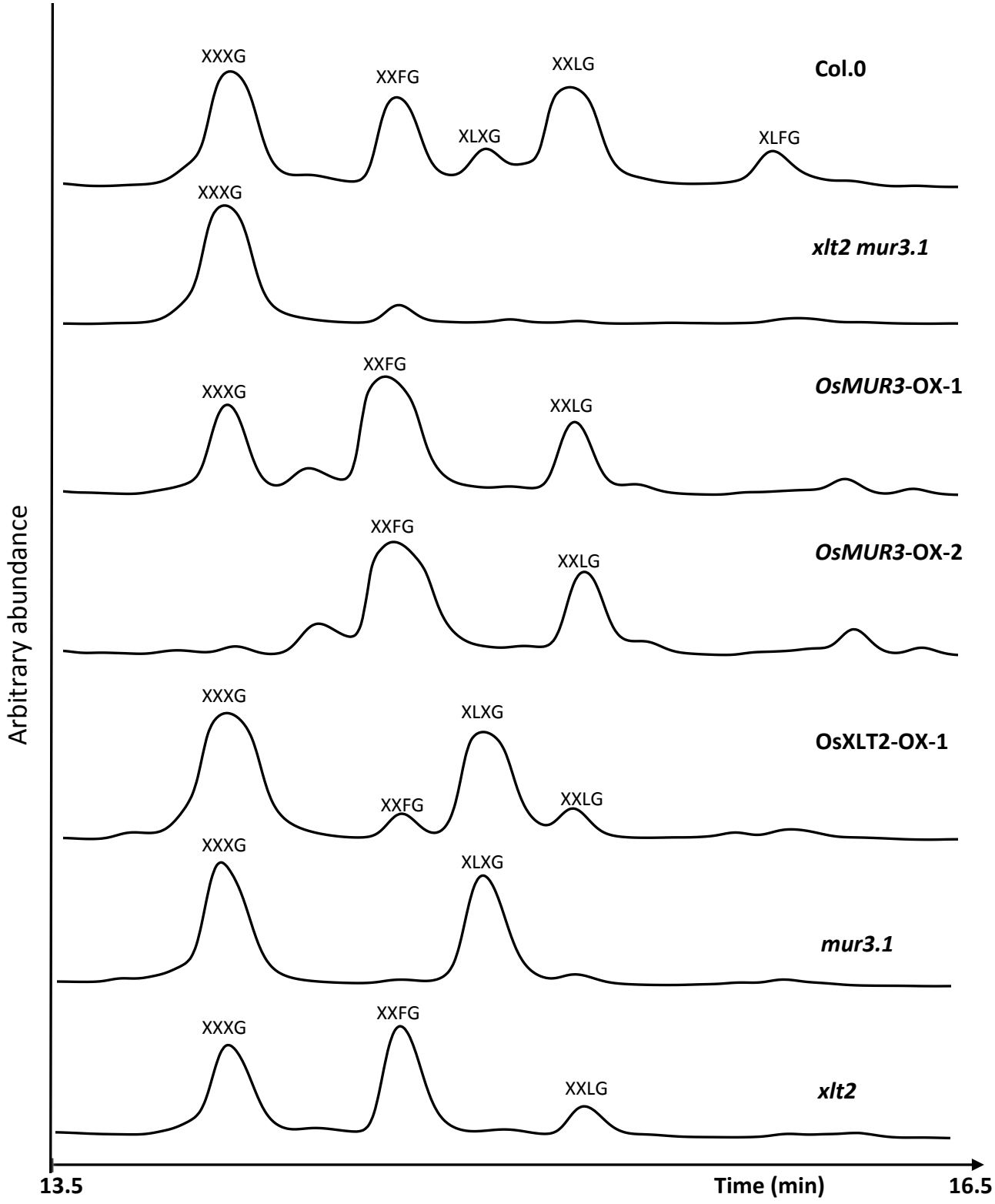

**Supplementary Figure S9.** XyG oligosaccharide mass profiling of 4-week-old leaves from Arabidopsis Col.0 and rice homologs of *AtMUR2* transformed into the Arabidopsis *axy2.2* mutant. One representative line of the transformants is shown here. OX, independent overexpression line.



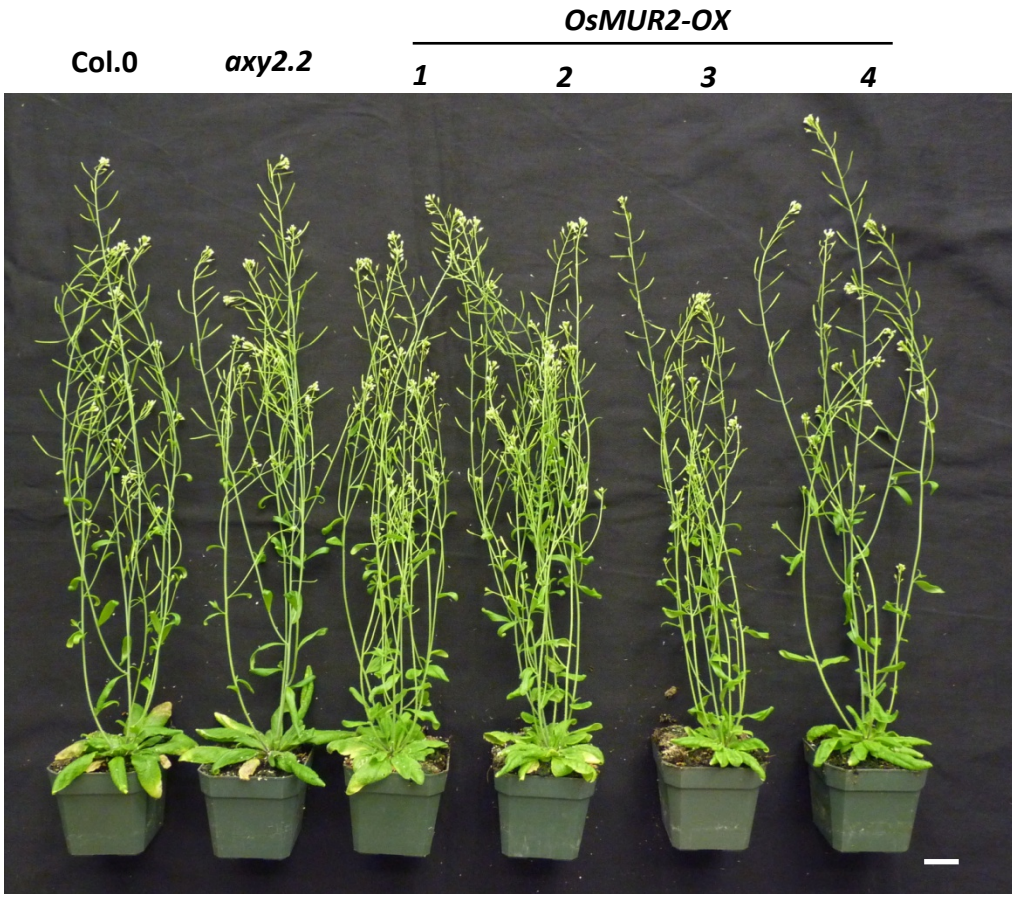

**Supplementary Figure S10.** XyG oligosaccharide mass profiling of 4-week-old leaves from Arabidopsis Col.0, *axy4-3* and *OsAXY4* transformants into the Arabidopsis *axy4-3* mutant. Two representative lines of the *OsAXY4* transformants are shown here. OX, independent overexpression line.



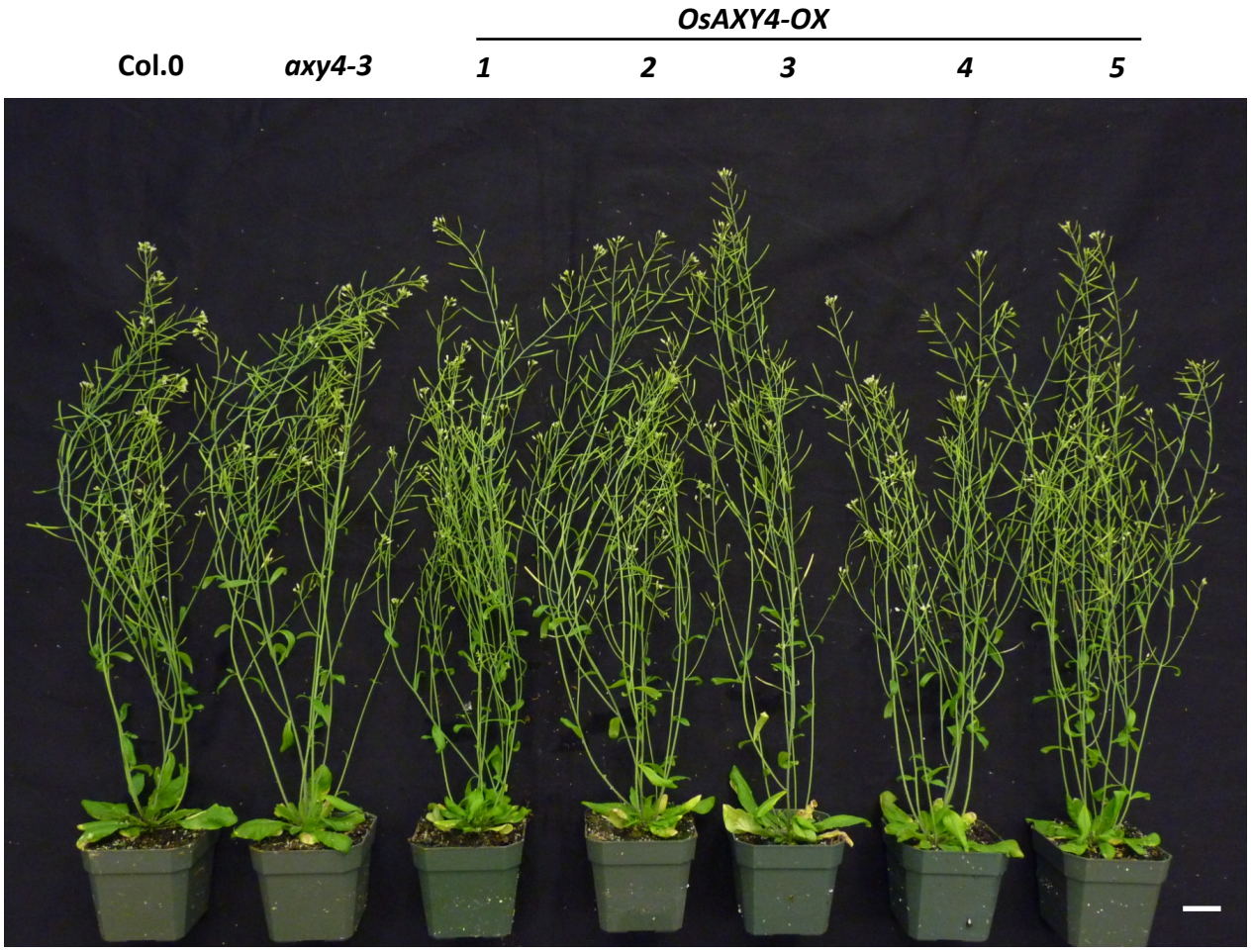

**Supplementary Figure S11.** XyG oligosaccharide mass profiling of 4-week-old leaves from Arabidopsis Col.0, *xlt2 mur3.1*, *OsMUR3* and *OsXLT2* transformants into the Arabidopsis *xlt2 mur3* mutant. Two representative lines of *OsMUR3* and one *OsXLT2* transformant is shown here. OX, independent overexpression line.



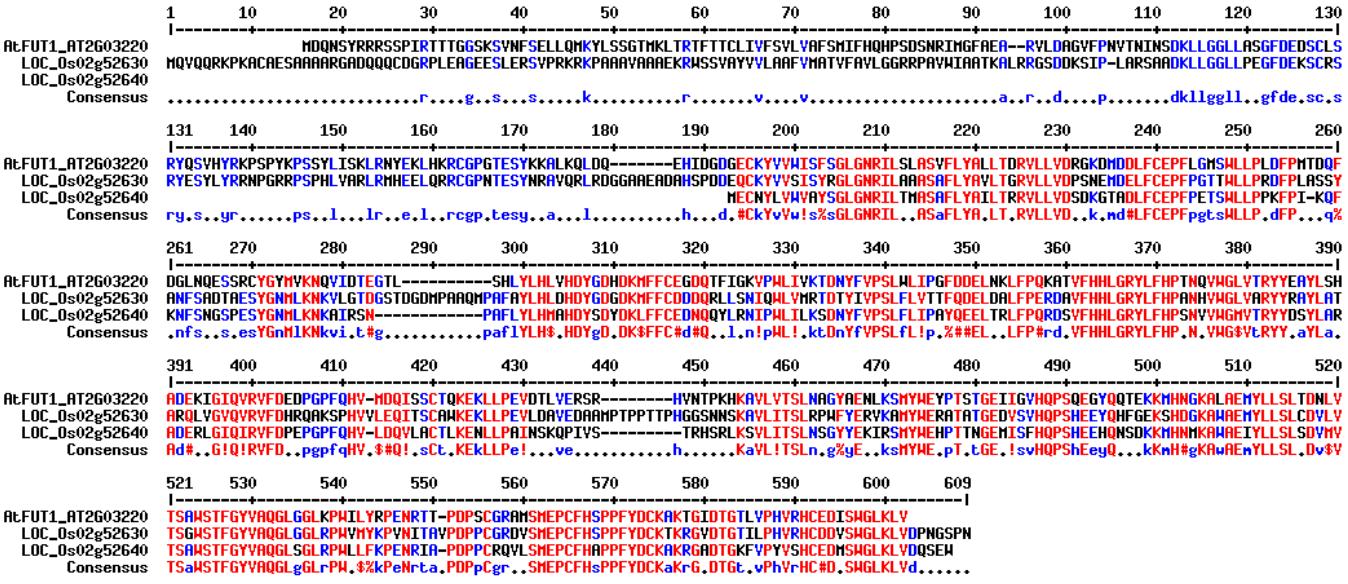

**Supplementary Figure S13.** XyG HPAEC spectra derived from walls of 4-week-old leaves from Col.0, *xlt2 mur3.1*, and *OsMUR3* and *OsXLT2* transformed into the Arabidopsis *xlt2 mur3* mutant. XyG oligosaccharides were identified based on their retention time and annotated as described in the text. *mur3.1* and *xlt2* were used as controls. Two representative lines of *OsMUR3* and one *OsXLT2* transformant is shown here. OX, independent overexpression line.



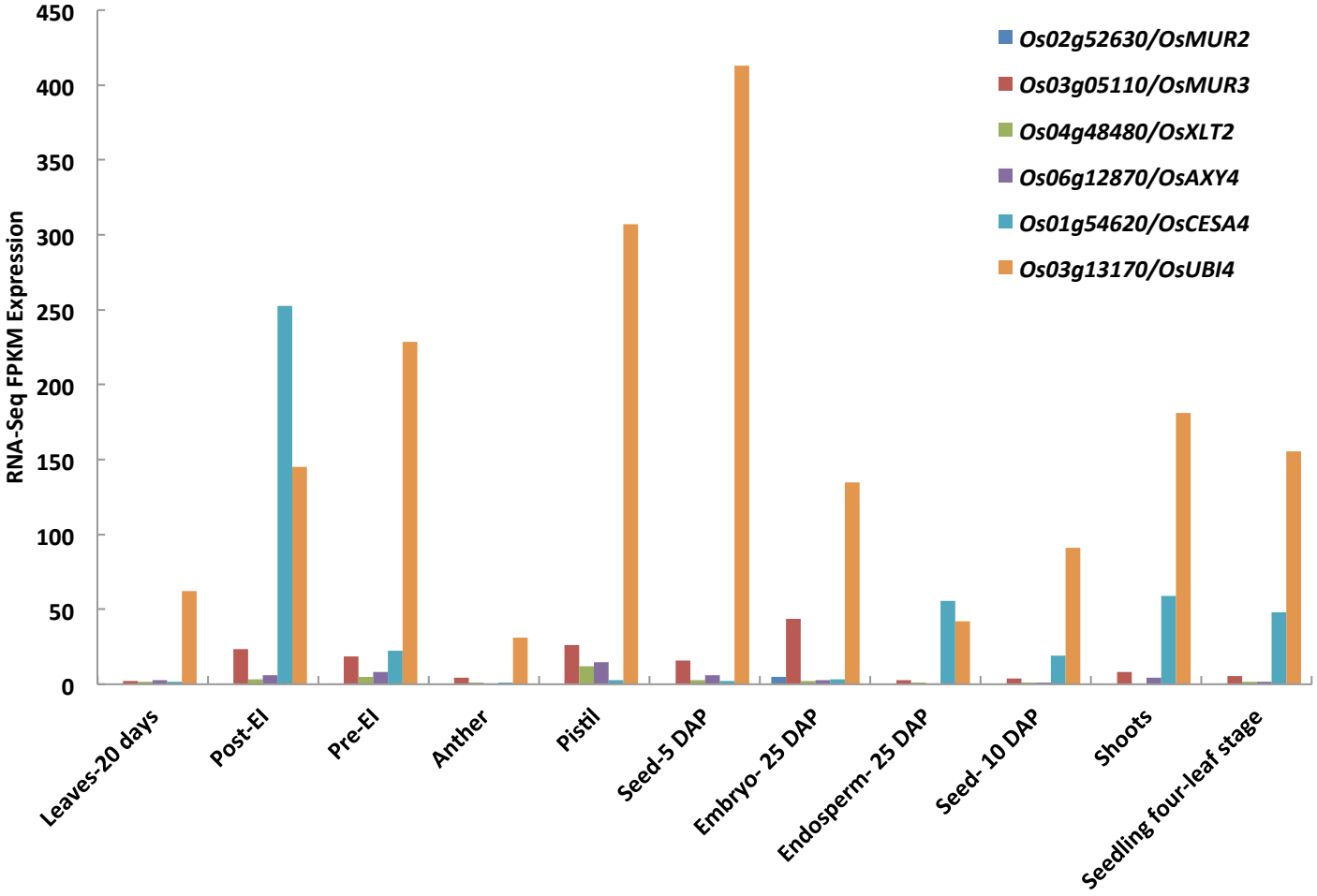

**Supplementary Figure S14.** Phenotype of 7-week-old plants of *Col.0, axy2.2* and *OsMUR2* transformed into the Arabidopsis *axy2.2* mutant. One representative plant from each line is shown here. OX, independent overexpression line. Bar=2 cm.




**Supplementary Figure S13.** Phenotype of 7-week-old plants of *Col.0, axy4-3* and *OsAXY4* transformed into the Arabidopsis *axy4-3* mutant. One representative plant from each line is shown here. OX, independent overexpression line. Bar=2 cm.




**Supplementary Figure S15.** Sequence alignment of AtFUT1/MUR2 with Os02g52630/ OsMUR2 and Os02g52640. Protein sequences are downloaded from TAIR (www.arabidopsis.org) and rice.plantbiology.msu.edu. Sequence alignment is done with the Multialign software at http://multalin.toulouse.inra.fr/multalin/cgi-bin/multalin.pl (Corpet, 1998).




**Supplementary Figure S16.** RNA-Seq FPKM expression values of rice genes in different tissues. RNA seq data was downloaded from rice.plantbiology.msu.edu. FPKM, fragments per kilobase of exon per million fragments mapped. EI, emergence inflorescence. DAP, day after pollination. *OsCESA4* and *OsUBI4* are used as controls.