

Article title: QTL mapping of wood FT-IR chemotypes shows promise for improving biofuel potential in short rotation coppice willow (*Salix spp.*).

Journal name: Bioenergy research

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Online resource 4. Populus cell wall related genes within the genomic regions corresponding to the QTL regions identified in Salix (marked with black in Figure 2).

Trait	Overlapping Trait	Group	No. Genes	Candidate gene	Description
1271 - G-lignin		LGIb	224	Potri.001G256400	cinnamyl-alcohol dehydrogenase (CAD)
1272 - G-lignin		LGIb	224	Potri.001G255100	possible beta-1,3-glucanase GH17_39
1273 - G-lignin		LGIb	224	Potri.001G255200	possible beta-1,3-glucanase GH17_9
1274 - G-lignin		LGIb	224	Potri.001G266400	primary wall cellulose synthase PtiCesA3-D
1275 - G-lignin		LGIb	224	Potri.001G256200	candidate beta-glycosyltransferase GT31_8
1276 - G-lignin		LGIb	224	Potri.001G252000	Putative glycosyl transferase
1593-lignin		LGII	969	Potri.002G189000	S-adenosylmethionine synthase 1 (EC 2.5.1.6)
1593-lignin		LGII	969	Potri.002G207500	hydroxyproline-rich glycoprotein extensin domain
1593-lignin		LGII	969	Potri.002G223300	similar to fasciclin-like AGP 12
1593-lignin		LGII	969	Potri.002G153200	candidate xyloglucan endotransglycosylase PtXTH8
1593-lignin		LGII	969	Potri.002G224600	possible beta-1,3-glucanase GH17_82
1593-lignin		LGII	969	Potri.002G202200	candidate polygalacturonase GH28_18
1593-lignin		LGII	969	Potri.002G202100	candidate polygalacturonase GH28_60
1593-lignin		LGII	969	Potri.002G202400	candidate beta-1,4-glucanase PtGH9B5
1593-lignin		LGII	969	Potri.002G225200	candidate beta-1,4-glucanase GH9_7
1593-lignin		LGII	969	Potri.002G225400	candidate beta-1,4-glucanase GH9_9
1593-lignin		LGII	969	Potri.002G227300	candidate polysaccharide-forming beta-glycosyltransferase GT2_41
1593-lignin		LGII	969	Potri.002G228900	candidate beta-glycosyltransferase

					GH3131, PtGT31B-1
1593-lignin		LGII	969	Potri.002G202300	candidate sucrose synthase GT4_28
1593-lignin		LGII	969	Potri.002G210000	candidate beta-glycosyltransferase GT47_47
1593-lignin		LGII	969	Potri.002G134400	candidate xylosyltransferase GT77_13
1593-lignin		LGII	969	Potri.002G139800	candidate xylosyltransferase GT77_3
1593-lignin		LGII	969	Potri.002G132900	candidate alpha-glycosyltransferase GT8_29
1593-lignin	Water content	LGII	969 560	Potri.002G207500	hydroxyproline-rich glycoprotein family protein; extensin domain
1593-lignin	Water content	LGII	969 560	Potri.002G191500	invertase/pectin methylesterase inhibitor family
1593-lignin	Water content	LGII	969 560	Potri.002G194800	invertase/pectin methylesterase inhibitor family
1593-lignin	Water content	LGII	969 560	Potri.002G185600	candidate pectin acetyltransferase CE13_1
1593-lignin	Water content	LGII	969 560	Potri.002G202500	candidate pectin methylesterase CE8_13
1593-lignin	Water content	LGII	969 560	Potri.002G145700	candidate pectin methylesterase CE8_40
1593-lignin	Water content	LGII	969 560	Potri.002G145500	candidate pectin methylesterase CE8_43
1593-lignin	Water content	LGII	969 560	Potri.002G202600	candidate pectin methylesterase CE_60
1593-lignin	Water content	LGII	969 560	Potri.002G184700	candidate expansin EXPN_14, PtEXPA19
1593-lignin	Water content	LGII	969 560	Potri.002G184800	candidate expansin EXPN_15
1593-lignin	Water content	LGII	969 560	Potri.002G165700	candidate chitinase GH18_19
1593-lignin	Water content	LGII	969 560	Potri.002G186500	candidate chitinase GH19_12
1593-lignin	Water content	LGII	969 560	Potri.002G162400	candidate polygalacturonase GH28_73
1593-lignin	Water content	LGII	969 560	Potri.002G186900	candidate polygalacturonase GH28_77
1593-lignin	Water content	LGII	969 560	Potri.002G190600	candidate polygalacturonase GH28_78
1593-lignin	Water content	LGII	969 560	Potri.002G197200	candidate beta-xylosidase GH3_11a
1593-lignin	Water content	LGII	969 560	Potri.002G184500	candidate beta-1,4-mannanase GH5_20: PtMAN1
1593-lignin	Water content	LGII	969 560	Potri.002G200300	candidate polysaccharide-

					forming beta-glycosyltransferase GT2_73
1593-lignin	Water content	LGII	969 560	Potri.002G195500	possible sucrose synthase GT4_1
1593-lignin	Water content	LGII	969 560	Potri.002G166000	candidate xylosyltransferase GT77_4
1593-lignin	Water content	LGII	969 560	Potri.002G200200	candidate alpha-glycosyltransferase GT8_30, PttGT8H, AtGALT7
1593-lignin	Water content	LGII	969 560	Potri.002G151400	homogalacturonan-galacturonic acid transferase 1(GAUT1) GT8_59
1593-lignin	Water content	LGII	969 560	Potri.002G157800	Putative glycosyl transferase
1593-lignin	Water content	LGII	969 560	Potri.002G157900	Putative glycosyl transferase
1169-acetyl		LGIII	155	Potri.003G139100	candidate polygalacturonase GH_28
1169-acetyl		LGIII	155	Potri.003G147600	beta-1,4-glucanase PtCel9B2
1169-acetyl		LGIII	155	Potri.003G139600	candidate beta-1,4-glucanase PtGH9C2
1169-acetyl		LGIII	155	Potri.003G142200	candidate polysaccharide-forming beta-glycosyltransferase GT2_16
1169-acetyl		LGIII	155	Potri.003G142400	candidate polysaccharide-forming beta-glycosyltransferase GT2_22
1169-acetyl		LGIII	155	Potri.003G142500	candidate polysaccharide-forming beta-glycosyltransferase GT2_44
1169-acetyl		LGIII	155	Potri.003G142300	candidate polysaccharide-forming beta-glycosyltransferase GT2_7
1169-acetyl		LGIII	155	Potri.003G136000	candidate beta-glycosyltransferase GT31_21
1169-acetyl		LGIII	155	Potri.003G140900	similar to UDP-glucose 4-epimerase
1229-G-lignin	1254-Acetyl	LGIII	143	Potri.003G196500	candidate beta-glycosidase GH2_3
1229-G-lignin	1254-Acetyl	LGIII	143	Potri.003G195600	similar to UDP-β-L-Araf:hydroxyproline β-L-arabinofuranosyltransferase (HPAT3)
1229-G-lignin	1254-Acetyl	LGIII	143	Potri.003G207000	similar to polygalacturonase inhibitor-like protein
1271-G-lignin		LGIII	294	Potri.003G177800	candidate polysaccharide-forming beta-glycosyltransferase

				GT2_54; CslD1
1271-G-lignin		LGIII	294	Potri.003G191200 candidate xyloglucan alpha-1,2-fucosyltransferase, GT37_2
1271-G-lignin		LGIII	294	Potri.003G191500 candidate xyloglucan alpha-1,2-fucosyltransferase, GT37_6
1271-G-lignin		LGIII	294	Potri.003G191300 member of Glycosyltransferase Family- 37 GT37_a
1271-G-lignin		LGIII	294	Potri.003G175900 pectate lyase PtPL1-27
1271-G-lignin		LGIII	294	Potri.003G188500 similar to 4-coumarate-CoA ligase (EC 6.2.1.12) - quaking aspen
1271-G-lignin		LGIII	294	Potri.003G168000 similar to glucose-6-phosphate dehydrogenase
1510/1593-G/S ratio		LGV_male	93	Potri.005G154200 candidate polysaccharide-forming beta-glycosyltransferase, similar to PtrCesA6, GT2_4
1510/1593-G/S ratio		LGV_male	93	Potri.005G151600 related to rhamnogalacturonan lyases PL4_6
1510/1593-G/S ratio		LGV_male	93	Potri.005G151500 related to rhamnogalacturonan lyases PL4_7
1510/1593-G/S ratio		LGV_male	93	Potri.005G153300 hydroxyproline-rich glycoprotein
1207-G-lignin	1510 - lignin	LGVI-1	808	Potri.006G186000 candidate pectin methylesterase CE8_11
1207-G-lignin	1510 - lignin	LGVI-1	808	Potri.006G186100 candidate pectin methylesteraseCE8_36
1207-G-lignin	1510 - lignin	LGVI-1	808	Potri.006G169900 candidate xyloglucan endotransglycosylase PtXTH20
1207-G-lignin	1510 - lignin	LGVI-1	808	Potri.006G160700 candidate xyloglucan endotransglycosylase PtXTH5
1207-G-lignin	1510 - lignin	LGVI-1	808	Potri.006G170000 xyloglucan endotransglycosylase-related protein (XTR6)
1207-G-lignin	1510 - lignin	LGVI-1	808	Potri.006G170100 xyloglucan endotransglycosylase-related protein (XTR6)
1207-G-lignin	1510 - lignin	LGVI-1	808	Potri.006G216700 possible beta-1,3-glucanase GH17_95
1207-G-lignin	1510 - lignin	LGVI-1	808	Potri.006G188300 related to chitinases GH18_25
1207-G-lignin	1510 - lignin	LGVI-1	808	Potri.006G188400 related to chitinases GH18_28
1207-G-lignin	1510 - lignin	LGVI-1	808	Potri.006G227500 candidate cell wall invertase PtCWIN1
1207-G-lignin	1510 - lignin	LGVI-1	808	Potri.006G227400 candidate cell wall invertase PtCWIN2

1207-G-lignin	1510 - lignin	LGVI-1	808	Potri.006G210600	candidate cell wall invertase PtCWIN3
1207-G-lignin	1510 - lignin	LGVI-1	808	Potri.006G219700	candidate beta-1,4-glucanase PtGH9_16
1207-G-lignin	1510 - lignin	LGVI-1	808	Potri.006G181900	secondary wall CesA GT2_51, PtiCesA7-A
1207-G-lignin	1510 - lignin	LGVI-1	808	Potri.006G176900	candidate alpha-1,2-mannosyltransferase involved in GPI anchor synthesis GT22_1
1207-G-lignin	1510 - lignin	LGVI-1	808	Potri.006G169500	candidate beta-glycosyltransferase GT31_10
1207-G-lignin	1510 - lignin	LGVI-1	808	Potri.006G228900	candidate beta-glycosyltransferase GT31_24
1207-G-lignin	1510 - lignin	LGVI-1	808	Potri.006G214400	candidate pectin/pectate lyase PL1_2
1207-G-lignin	1510 - lignin	LGVI-1	808	Potri.006G218500	related to rhamnogalacturonan lyases PL4_1
1207-G-lignin	1510 - lignin	LGVI-1	808	Potri.006G214000	UDP-xylose synthase PtUXS4, similar to ATUXS1
1207-G-lignin	1510 - lignin	LGVI-1	808	Potri.006G204000	hydroxyproline-rich glycoprotein extensin
1207-G-lignin	1510 - lignin	LGVI-1	808	Potri.006G217900	hydroxyproline-rich glycoprotein extensin
1207-G-lignin	1510 - lignin	LGVI-1	808	Potri.006G178700	similar to cinnamoyl-CoA reductase CAD
1207-G-lignin	1510 - lignin	LGVI-1	808	Potri.006G176300	similar to Expansin-related protein 2 (AtEXPR2) (Ath-ExpGamma-1.1)
1128/1207 - S/G ratio		LGVI-1	507	Potri.006G135100	candidate pectin methylesterase CE8_1a
1128/1207 - S/G ratio		LGVI-1	507	Potri.006G137100	candidate pectin methylesterase CE8_37
1128/1207 - S/G ratio		LGVI-1	507	Potri.006G120100	candidate pectin methylesterase CE8_42
1128/1207 - S/G ratio		LGVI-1	507	Potri.006G134500	candidate pectin methylesterase CE8_47
1128/1207 - S/G ratio		LGVI-1	507	Potri.006G134600	candidate pectin methylesterase CE8_53
1128/1207 - S/G ratio		LGVI-1	507	Potri.006G134800	candidate pectin methylesterase CE8_84
1128/1207 - S/G ratio		LGVI-1	507	Potri.006G134700	candidate pectin methylesterase CE8_85
1128/1207 - S/G ratio		LGVI-1	507	Potri.006G108000	alpha expansin PtEXPA14
1128/1207 - S/G ratio		LGVI-1	507	Potri.006G122900	candidate xyloglucan endotransglycosylase PtXTH32
1128/1207 - S/G ratio		LGVI-1	507	Potri.006G139500	candidate polygalacturonase PtGH28A
1128/1207 - S/G		LGVI-1	507	Potri.006G144500	candidate beta-

ratio				galactosidase PtGH35B
1128/1207 - S/G ratio	LGVI-1	507	Potri.006G139100	candidate beta-galactosidase GH35_8
1128/1207 - S/G ratio	LGVI-1	507	Potri.006G109900	candidate beta-1,4-mannanase PtMAN4
1128/1207 - S/G ratio	LGVI-1	507	Potri.006G116900	mannan synthase PtCSLA3
1128/1207 - S/G ratio	LGVI-1	507	Potri.006G106100	candidate alpha-glycosyltransferase GT4_12
1128/1207 - S/G ratio	LGVI-1	507	Potri.006G136700	sucrose synthase PtSUS1
1128/1207 - S/G ratio	LGVI-1	507	Potri.006G131000	xylan synthase-related PtGT43A
1128/1207 - S/G ratio	LGVI-1	507	Potri.006G118000	candidate beta-glycosyltransferase GT47_38
1128/1207 - S/G ratio	LGVI-1	507	Potri.006G114300	candidate alpha-glycosyltransferase, GAUT-A like, GT8_54
1128/1207 - S/G ratio	LGVI-1	507	Potri.006G122000	candidate pectin/pectate lyase PL1_3
1128/1207 - S/G ratio	LGVI-1	507	Potri.006G145900	hydroxyproline-rich glycoprotein
1128/1207 - S/G ratio	LGVI-1	507	Potri.006G129200	similar to fasciclin-like AGP 13
1128/1207 - S/G ratio	LGVI-1	507	Potri.006G107000	similar to peroxidase (EC 1.11.1.7)
1128/1207 - S/G ratio	LGVI-1	507	Potri.006G129900	similar to Peroxidase 21 precursor (EC 1.11.1.7) (Atperox P21) (PRXR5)
1128/1207 - S/G ratio	LGVI-1	507	Potri.006G126800	similar to phenylalanine ammonia-lyase (EC 4.3.1.5)
1169-Acetyl	LGVII	182	Potri.007G015700	candidate pectin methylesterase CE8_30
1169-Acetyl	LGVII	182	Potri.007G008500	candidate xyloglucan endotransglycosylase PtXTH36
1169-Acetyl	LGVII	182	Potri.007G018100	candidate beta-galactosidase GH35_12
1169-Acetyl	LGVII	182	Potri.007G010000	candidate beta-glycanase GH5_11
1169-Acetyl	LGVII	182	Potri.007G022000	candidate beta-1,4-mannanase GH5_19
1169-Acetyl	LGVII	182	Potri.007G005900	candidate galactomannan alpha-1,6-galactosyltransferase GT34_5
1169-Acetyl	LGVII	182	Potri.007G013900	GDP-D-mannose dehydratase 1) (GMD 1). EC 4.2.1.47
1169-Acetyl	LGVII	182	Potri.007G019300	similar to Peroxidase 49 (EC 1.11.1.7) (Atperox P49) (ATP31)
1128-S-lignin	LGIX	1077	Potri.009G096400	Carbohydrate esterase

				CE6_b
1128-S-lignin	LGIX	1077	Potri.009G117700	candidate pectin methylesterase CE8_22
1128-S-lignin	LGIX	1077	Potri.009G141400	EXPANSIN-LIKE EXPN-a
1128-S-lignin	LGIX	1077	Potri.009G132600	endoxyranase PtXyn10B
1128-S-lignin	LGIX	1077	Potri.009G129000	neutral invertase PtNINV7
1128-S-lignin	LGIX	1077	Potri.009G163900	candidate xyloglucan endotransglycosylase PtXTH22
1128-S-lignin	LGIX	1077	Potri.009G163700	possible beta-1,3-glucanase GH17_46
1128-S-lignin	LGIX	1077	Potri.009G115400	possible beta-1,3-glucanase GH17_49
1128-S-lignin	LGIX	1077	Potri.009G076500	possible beta-1,3-glucanase GH17_80
1128-S-lignin	LGIX	1077	Potri.009G141700	candidate chitinase GH19_16
1128-S-lignin	LGIX	1077	Potri.009G142000	candidate chitinase GH19_19, PtChiB
1128-S-lignin	LGIX	1077	Potri.009G141800	candidate chitinase GH19_20, PtChiC
1128-S-lignin	LGIX	1077	Potri.009G142300	candidate chitinase GH19_21
1128-S-lignin	LGIX	1077	Potri.009G142100	candidate chitinase GH19_5
1128-S-lignin	LGIX	1077	Potri.009G153900	candidate beta-glucosidase GH3_19
1128-S-lignin	LGIX	1077	Potri.009G154000	hydrolyzing O-glycosyl compounds GH3_4
1128-S-lignin	LGIX	1077	Potri.009G154800	hydrolyzing O-glycosyl compounds GH3_6
1128-S-lignin	LGIX	1077	Potri.009G134400	candidate beta-galactosidase GH35_9
1128-S-lignin	LGIX	1077	Potri.009G123900	cellulase (EC 3.2.1.4) PtGH9B8
1128-S-lignin	LGIX	1077	Potri.009G093500	related to bacterial alpha-L-fucosidases GH95_3
1128-S-lignin	LGIX	1077	Potri.009G093900	related to bacterial alpha-L-fucosidases GH95_4
1128-S-lignin	LGIX	1077	Potri.009G149700	glycosyl transferase family 2 protein; similar to beta-(1-3)-glucosyl transferase GT2_32
1128-S-lignin	LGIX	1077	Potri.009G113300	candidate xylosyltransferase GT77_14
1128-S-lignin	LGIX	1077	Potri.009G070000	similar to UDP-β-L-Araf:hydroxyproline β-L-arabinofuranosyltransferase (HPAT3)
1128-S-lignin	LGIX	1077	Potri.009G098800	similar to glucuronoxylan methyltransferase 1 AtGXM1
1128-S-lignin	LGIX	1077	Potri.009G113900	hydroxyproline-rich glycoprotein extensin

1128-S-lignin		LGIX	1077	Potri.009G150600	similar to UDP-D-APIOSE/UDP-D-XYLOSE SYNTHASE 1
1128-S-lignin	1360-Cell., hemi	LGIX	1077, 149	Potri.009G087600	endoxyalanase PtXyn10F
1128-S-lignin	1360-Cell., hemi	LGIX	1077, 149	Potri.009G087700	endoxyalanase PtXyn10E
1128-S-lignin	1360-Cell., hemi	LGIX	1077, 149	Potri.009G087900	endoxyalanase PtXyn10C
1128-S-lignin	1360-Cell., hemi	LGIX	1077, 149	Potri.009G087800	endoxyalanase PtXyn10D
1128-S-lignin	1360-Cell., hemi	LGIX	1077, 149	Potri.009G083800	candidate xyloglucan endotransglycosylase PtXTH29
1128-S-lignin	1360-Cell., hemi	LGIX	1077, 149	Potri.009G088800	hydrolyzing O-glycosyl compounds GH3_8
1128-S-lignin	1360-Cell., hemi	LGIX	1077, 149	Potri.009G086300	candidate beta-galactosidase GH35_3
1128-S-lignin	1360-Cell., hemi	LGIX	1077, 149	Potri.009G092300	similar to ARABINO GALACTAN PROTEIN 9
1128-S-lignin	1169-Acetyl,1429-Cell., hemi	LGIX	1077, 57, 166	Potri.009G060800	cellulose synthase PtCesA3-C
1128-S-lignin	1169-Acetyl,1429-Cell., hemi	LGIX	1077, 57, 166	Potri.009G060400	candidate polygalacturonase GH28_62
1429-Cell., hemi		LGIX	166	Potri.009G050300	possible beta-1,3-glucanase GH17_16
1429-Cell., hemi		LGIX	166	Potri.009G050400	possible beta-1,3-glucanase GH17_38
1429-Cell., hemi		LGIX	166	Potri.009G051700	candidate beta-glycosyltransferase GT31_23
1429-Cell., hemi		LGIX	166	Potri.009G051600	candidate beta-glycosyltransferase GT31_37
1429-Cell., hemi		LGIX	166	Potri.009G052000	similar to cinnamyl-alcohol dehydrogenase CAD
1429-Cell., hemi		LGIX	166	Potri.009G057800	similar to putative cinnamoyl-CoA reductase CCR
1429-Cell., hemi		LGIX	166	Potri.009G057500	similar to putative cinnamoyl-CoA reductase CCR
1429-Cell., hemi		LGIX	166	Potri.009G057700	similar to putative cinnamoyl-CoA reductase CCR
1429-Cell., hemi		LGIX	166	Potri.009G057600	similar to putative cinnamoyl-CoA reductase CCR
1510-lignin		LGXII	331	Potri.012G033900	candidate chitinase GH18_2
1510-lignin		LGXII	331	Potri.012G037200	candidate sucrose synthase GT4_24
1510-lignin		LGXII	331	Potri.012G051500	candidate beta-glycosyltransferase GT61_1
1510-lignin		LGXII	331	Potri.012G051700	candidate beta-glycosyltransferase GT61_4

1510-lignin	LGXII	331	Potri.012G037300	candidate xylosyltransferase GT77_10
1510-lignin	LGXII	331	Potri.012G048900	high-pI laccase
1360-Cell., hemi 1429-Cell., hemi, 1466- lignin, 1605-lignin, 1666- water	LGXIV_male	94	Potri.014G022600	acetyl esterase CE6-a
1666-Water	LGXIV_male	33		
1128/1207-S/G ratio	LGXV	304	Potri.015G013700	candidate pectin methylesterase CE8_87
1128/1207-S/G ratio	LGXV	304	Potri.015G010100	possible beta-1,3-glucanase GH17_88
1128/1207-S/G ratio	LGXV	304	Potri.015G023900	candidate chitinase GH18_13
1128/1207-S/G ratio	LGXV	304	Potri.015G024100	candidate chitinase GH18_14
1128/1207-S/G ratio	LGXV	304	Potri.015G024000	candidate chitinase GH18_15
1128/1207-S/G ratio	LGXV	304	Potri.015G024200	candidate chitinase GH18_18
1128/1207-S/G ratio	LGXV	304	Potri.015G023700	candidate beta-glycosyltransferase GT31_20
1128/1207-S/G ratio	LGXV	304	Potri.015G029100	candidate sucrose synthase GT4_25
1128/1207-S/G ratio	LGXV	304	Potri.015G029200	candidate xylosyltransferase GT77_8
Water content	LGXVII	84	Potri.017G054700	candidate pectin methylesterase CE8_25
Water content	LGXVII	84	Potri.017G052800	neutral invertase PtNINV13
Water content	LGXVII	84	Potri.017G057900	candidate beta-galactosidase GH35_16
1709-Carbonyl	LGXVIII	126	Potri.018G024200	possible beta-glucuronidase GH79_1a
1709-Carbonyl	LGXVIII	126	Potri.018G024500	candidate beta-glycosyltransferase GT31_19
1709-Carbonyl	LGXVIII	126	Potri.018G025400	candidate beta-glycosyltransferase GT47_30
1709-Carbonyl	LGXVIII	126	Potri.018G025200	candidate beta-glycosyltransferase GT47_31
1709-Carbonyl	LGXVIII	126	Potri.018G023100	similar to UDP-β-L-Araf:hydroxyproline β-L-arabinofuranosyltransferase (HPAT1)