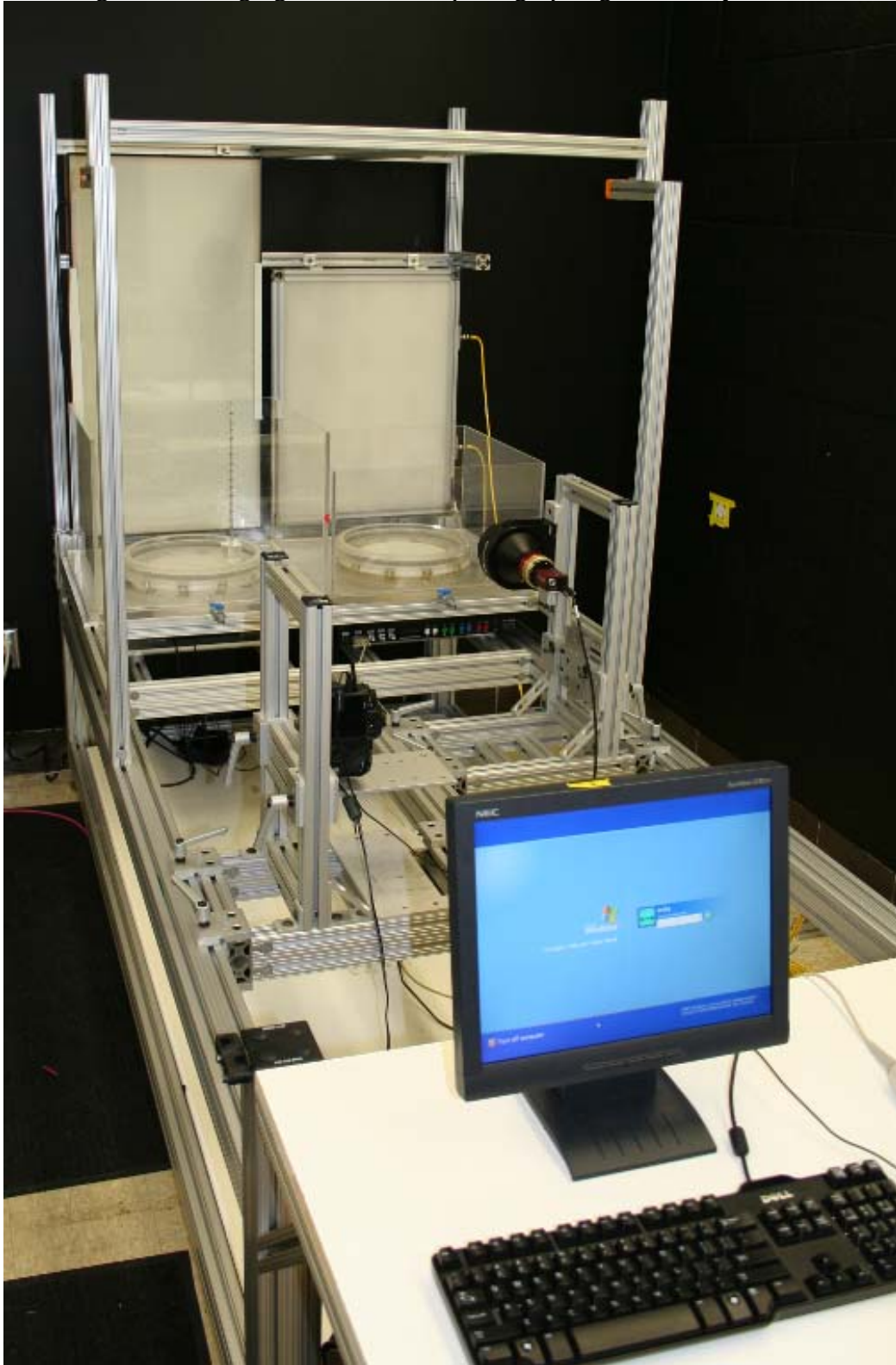
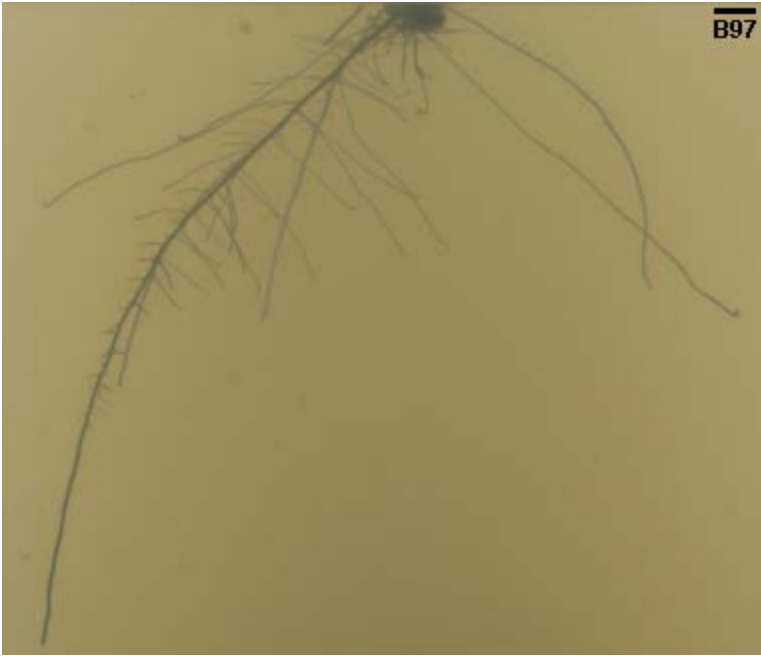


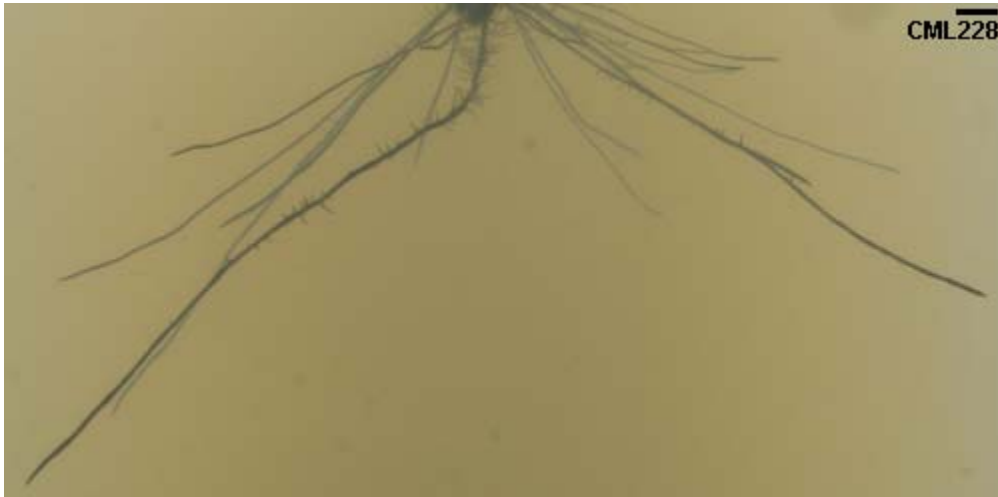
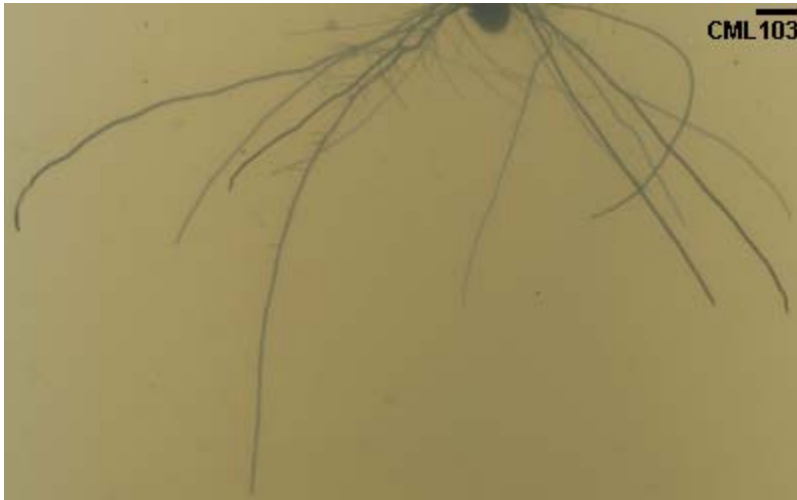
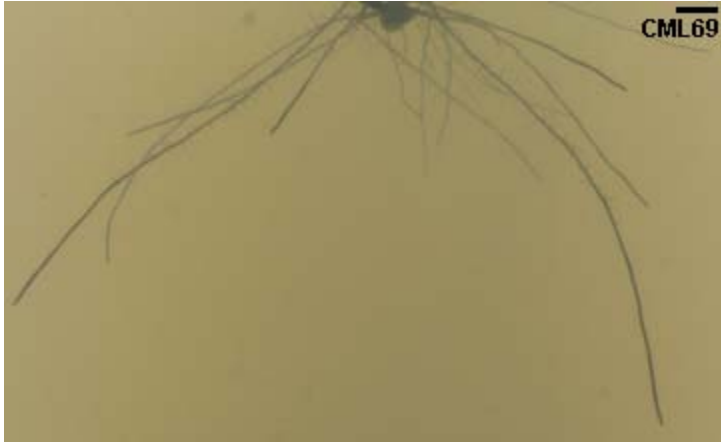
Supporting Information

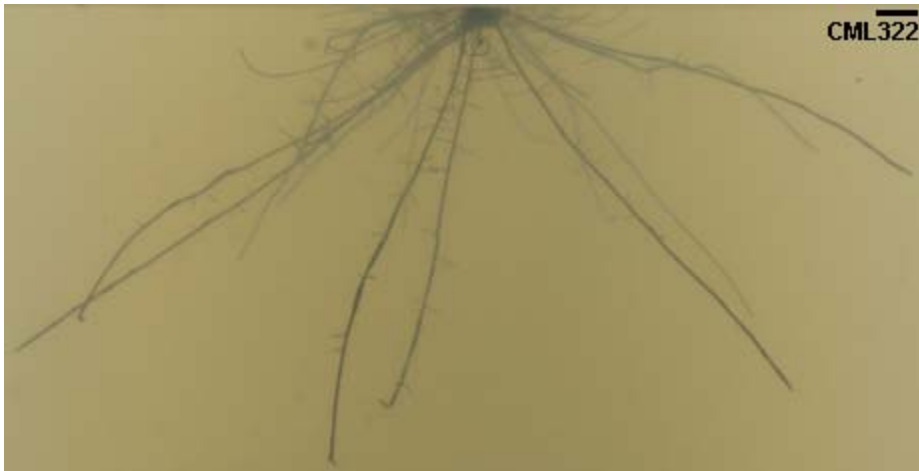
Supplemental Figure S1: Imaging table used for photographing the root systems of maize.

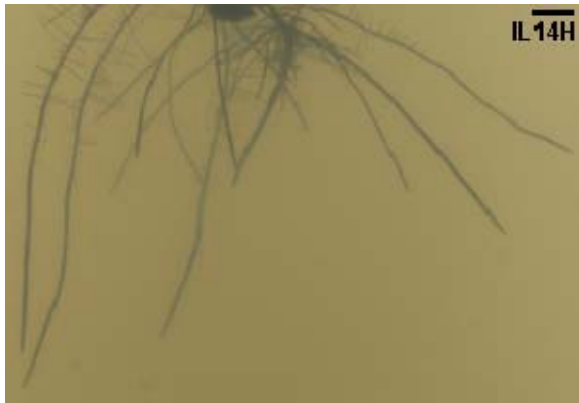
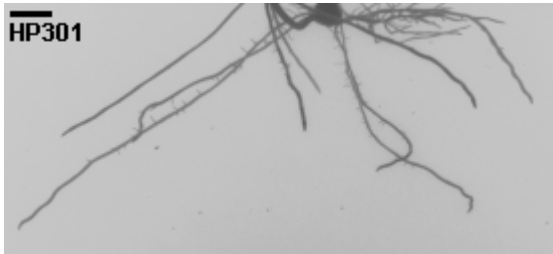
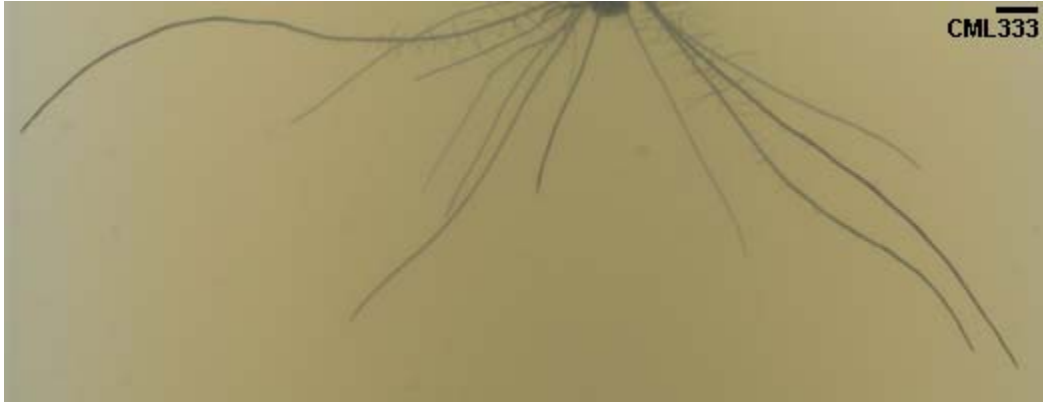


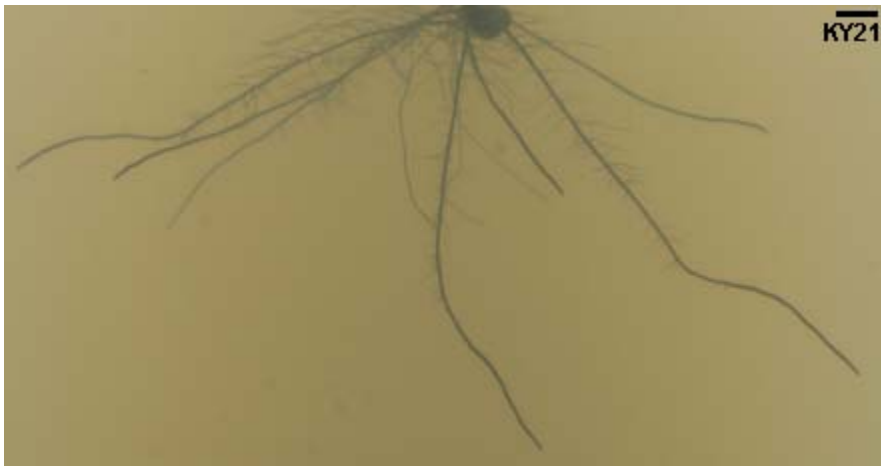
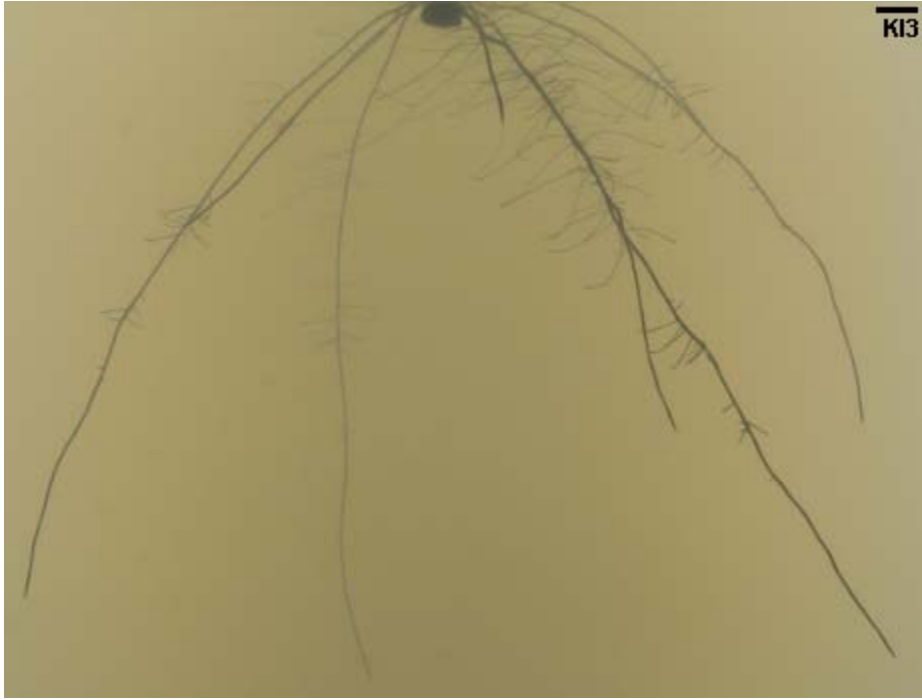
Supplemental Figure S2: Representative image of each NAM founder for day 9. The scale bar represents a scale of 1 centimeter. All images are presented at the same scale.

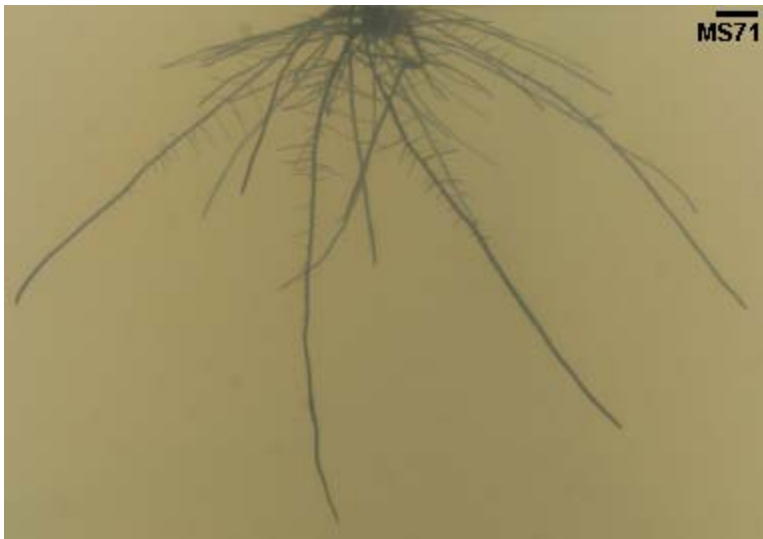


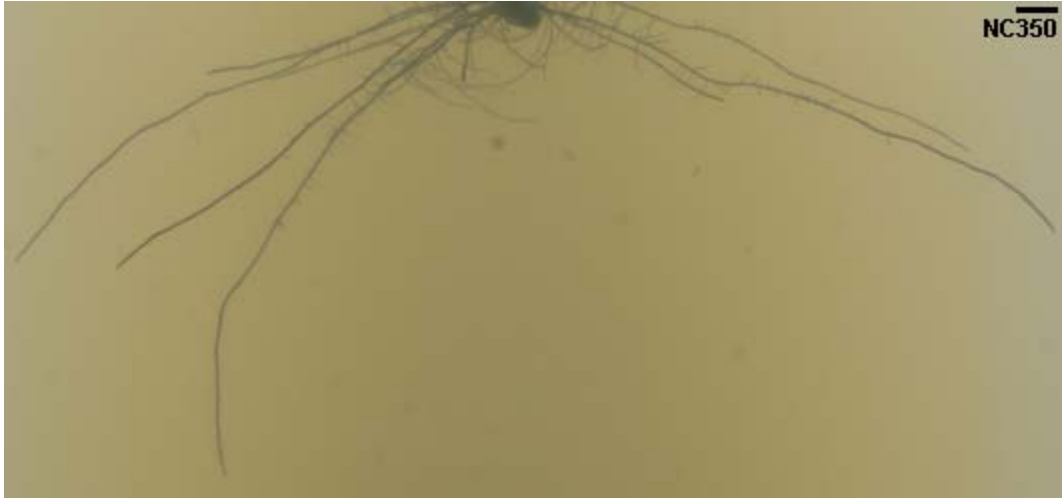






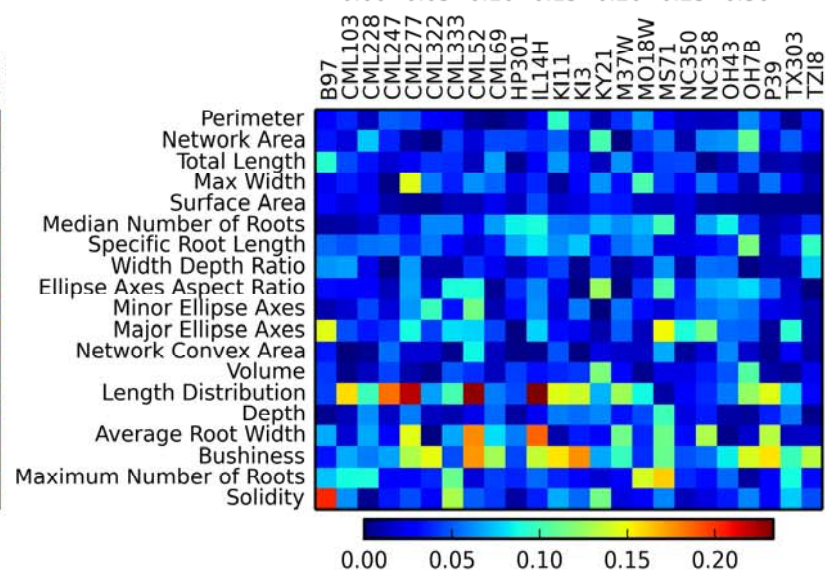
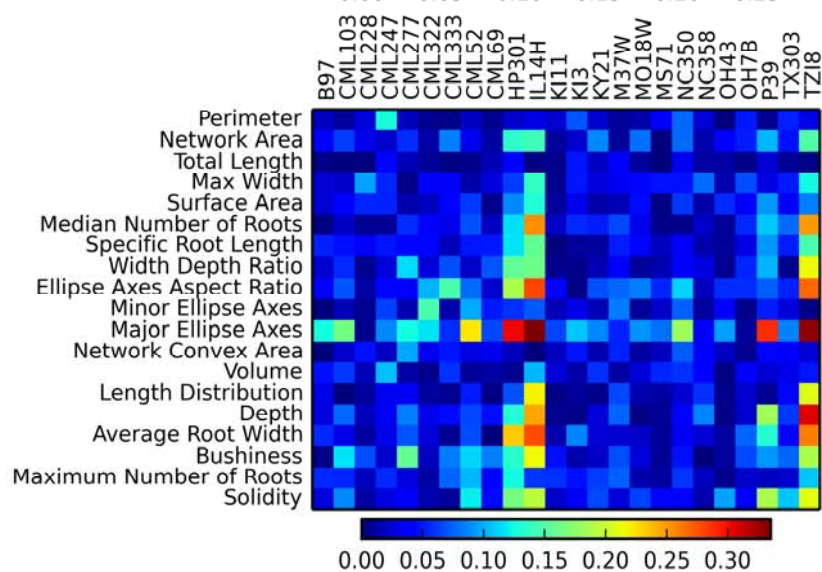
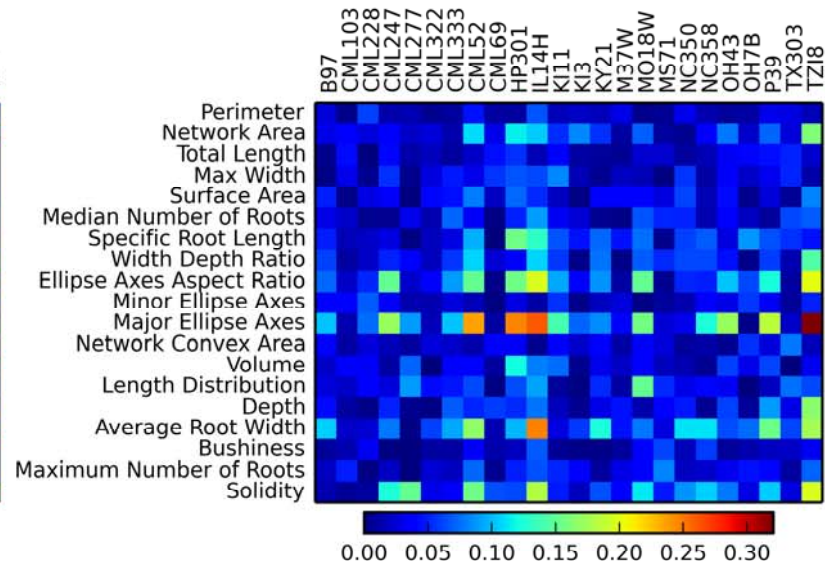
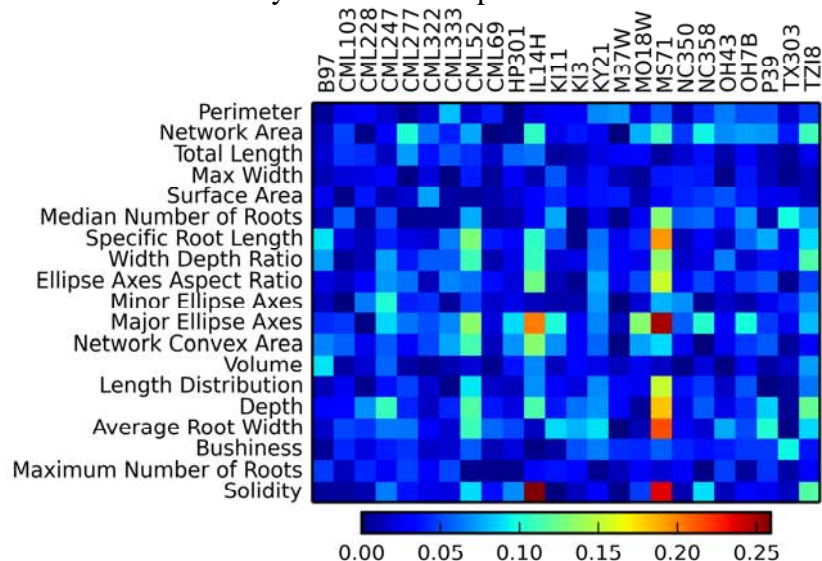




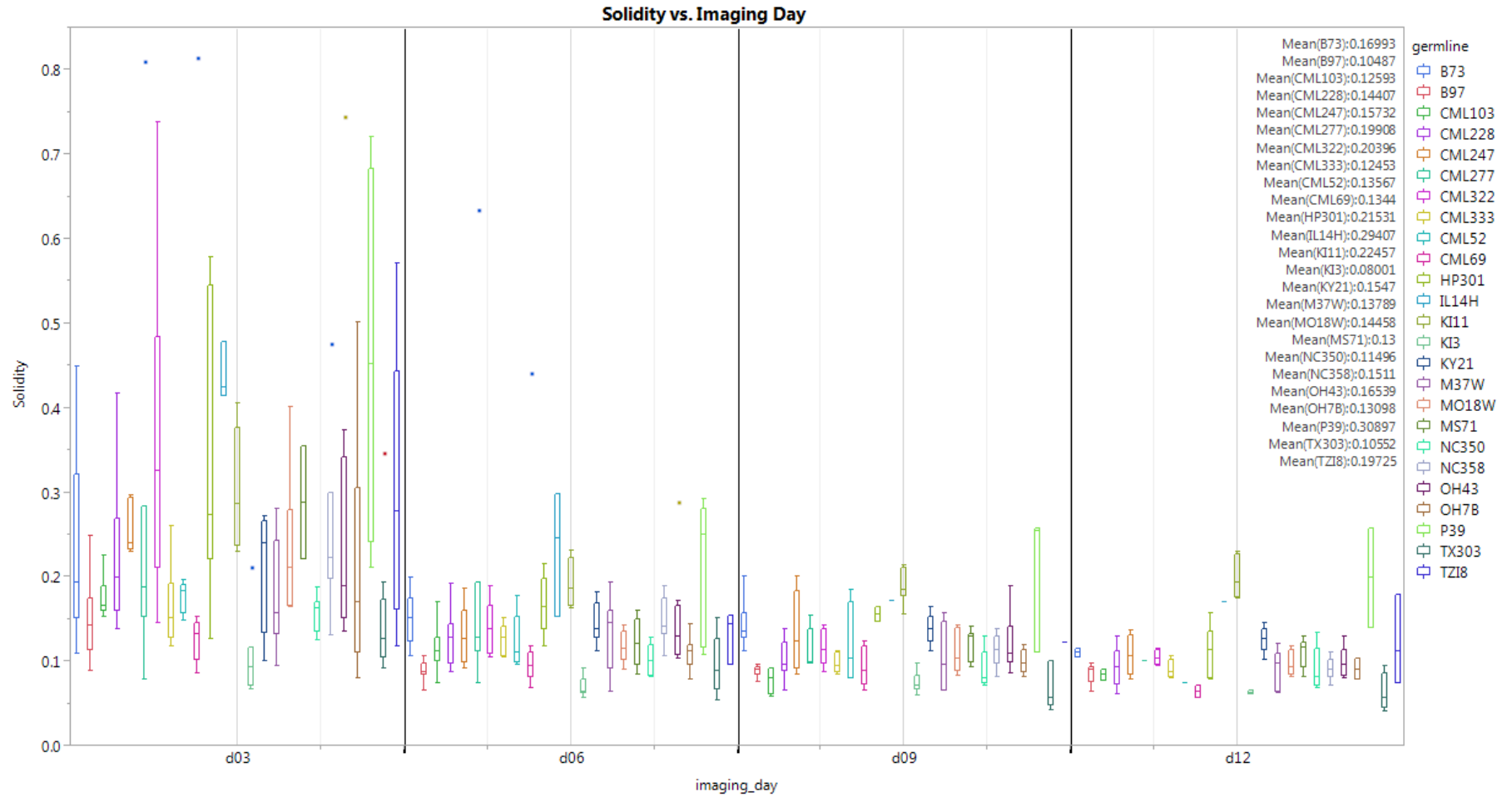




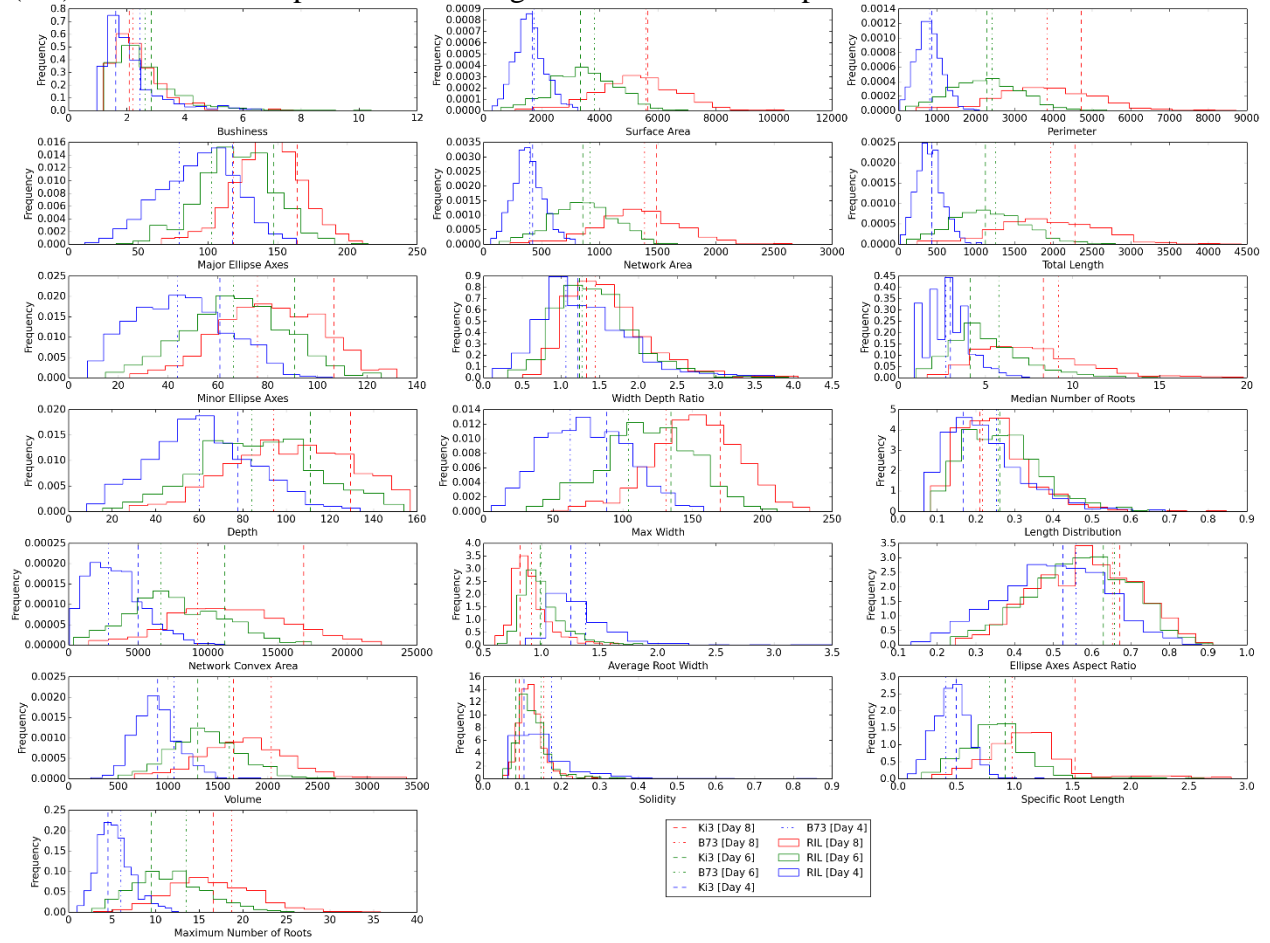
Supplemental Figure S3: Logistic regression control. To determine the predictive power of the logistic regression, the data were randomized and analyzed with 1000 permutations.



Supplemental Figure S4. Mean solidity of NAM founder lines versus imaging day for day 9. The boxes indicated the first or third quartile, while the whiskers indicated first or third quartile times 1.5 interquartile range.



Supplemental Figure S5: Distribution of individual trait values in the B73 x Ki3 mapping population. Plot of the line represents distribution of trait values for days 4 (blue), 6 (green) and 8 (red). Vertical lines represent the average of the Ki3 and B73 parental varieties.



Supplemental Table S1: Trait descriptions. Adapted from (Galkovskyi et al., 2012; Topp et al., 2013)

Minor ellipse axis (mm)	Length of the minor axis of the best fitting ellipse to the network.
Major ellipse axis (mm)	Length of the major axis of the best fitting ellipse to the network
Ellips axis ratio	Ratio of the minor to the major axis of best fitting ellipse.
Maximum number of roots	Result of a vertical line sweep in which the number of roots that crossed a horizontal line was estimated, and then the 84 th percentile of all values for the extent of the network was calculated.
Median number of roots	Result of a vertical line sweep in which the number of roots that crossed a horizontal line was estimated, and then the median of all values for the extent of the network was calculated.
Network area (mm ²)	Number of network pixels in the image.
Bushiness	Ratio of the maximum to the median number of roots
Network convex area (mm ²)	Area of the convex hull that encompasses the image.
Depth (mm)	Number of pixels in the vertical direction from the upper-most network pixel to the lower-most network pixel
Network length (mm)	Total number of pixels in the network skeleton.
Network length distribution (mm)	The fraction of network pixels found in the lower 2/3 of the network.
Perimeter (mm)	Total number of pixels connected to a background pixel
Solidity	Total network area divided by the network convex area.
Surface area (mm ³)	Sum of the local surface area at each pixel of the network skeleton, as approximated by a tubular shape whose radius is estimated from the image.
Volume (mm ³)	Sum of the local volume at each pixel of the network skeleton, as approximated by a tubular shape whose radius is estimated from the image.
Average root width (mm)	Mean value of the root width estimation computed for all pixels of the medial axis of the entire root system.
Width (mm)	Number of pixels in the horizontal direction from the left-most network pixel to the right-most network pixel.
Width to depth ratio	Value of the network width divided by the value of network depth.

Specific root length	Total root length divided by root system volume. Volume is estimated as the sum of cross sectional areas for all pixels of the medial axis of the root system. The total root length is the number of pixels in the medial axis of the root system.
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Supplemental Table S2. Breakdown of the components for the first five principal components (vector loadings) for the PCA analysis on NAM founder lines.

	Day 3					Day 6				
Principal Component #	PC1	PC2	PC3	PC4	PC5	PC1	PC2	PC3	PC4	PC5
Variation Explained (%)	51.62	13.64	9.74	9.40	5.87	43.98	15.69	12.10	10.24	8.58
Bushiness	0.14	-0.69	0.55	-0.32	0.03	0.09	-0.56	-0.39	0.67	-0.01
Surface Area	0.91	0.03	0.23	0.27	-0.05	0.85	0.28	0.29	0.28	0.02
Perimeter	0.98	0.00	0.08	-0.02	0.03	0.94	0.11	0.03	0.13	0.23
Major Ellipse Axes	0.81	-0.21	-0.27	0.01	-0.43	0.78	0.01	-0.27	-0.20	-0.48
Network Area	0.93	0.04	0.12	0.22	-0.04	0.89	0.23	0.25	0.21	0.07
Total Length	0.97	-0.02	0.11	0.03	0.03	0.93	0.13	0.08	0.17	0.20
Minor Ellipse Axes	0.90	0.11	-0.14	0.21	0.17	0.84	-0.25	0.27	-0.26	-0.16
Width-Depth Ratio	0.00	0.70	0.25	-0.40	-0.40	-0.08	0.70	-0.54	0.00	-0.29
Median Number of Roots	0.42	0.80	-0.03	-0.22	0.12	0.19	0.82	-0.04	-0.26	0.35
Depth	0.78	-0.42	-0.26	0.28	0.07	0.80	-0.45	0.27	-0.10	-0.09
Max Width	0.84	0.27	0.03	-0.12	-0.27	0.76	0.24	-0.34	-0.13	-0.39
Length Distribution	0.21	-0.58	0.63	-0.25	0.05	0.24	-0.47	-0.36	0.70	-0.07
Average Root Width	-0.73	0.17	0.32	0.48	-0.13	-0.61	0.25	0.47	0.27	-0.38
Network Convex Area	0.92	0.04	-0.10	0.14	-0.10	0.91	-0.08	0.07	-0.15	-0.27
Ellipse Axes Aspect Ratio	0.34	0.38	0.20	0.24	0.72	0.27	-0.34	0.63	-0.11	0.36
Volume	0.62	0.09	0.47	0.49	-0.18	0.53	0.45	0.40	0.43	-0.24
Solidity	-0.81	0.19	0.29	0.20	0.03	-0.65	0.36	0.32	0.36	0.18
Specific Root Length	0.60	-0.17	-0.39	-0.55	0.24	0.49	-0.29	-0.44	-0.31	0.51
Maximum Number of Roots	0.56	0.30	0.49	-0.50	0.11	0.51	0.44	-0.40	0.34	0.46

Vector Loadings

	Day 9					Day 12				
Principal Component #	PC1	PC2	PC3	PC4	PC5	PC1	PC2	PC3	PC4	PC5
Variation Explained (%)	36.43	20.06	16.74	10.34	9.45	35.99	23.49	15.37	10.83	7.33
Bushiness	0.17	-0.51	-0.01	0.48	0.63	0.08	-0.61	-0.11	0.62	0.36
Surface Area	0.70	0.49	0.48	0.15	0.04	0.75	0.60	0.06	0.11	0.17
Perimeter	0.88	0.34	0.04	-0.16	0.23	0.90	0.24	0.21	0.23	-0.11
Major Ellipse Axes	0.73	-0.05	-0.41	0.31	-0.38	0.59	-0.45	0.30	-0.45	0.30
Network Area	0.77	0.44	0.39	0.05	0.01	0.82	0.52	0.06	0.07	0.08
Total Length	0.86	0.38	0.11	-0.10	0.24	0.88	0.30	0.21	0.26	-0.06
Minor Ellipse Axes	0.81	-0.36	0.23	-0.18	-0.28	0.84	-0.08	-0.37	-0.32	-0.07
Width-Depth Ratio	-0.20	0.57	-0.60	0.37	-0.19	-0.34	-0.06	0.86	-0.21	0.14
Median Number of Roots	-0.09	0.88	-0.14	-0.32	-0.08	-0.07	0.72	0.49	-0.17	-0.33
Depth	0.78	-0.48	0.26	-0.15	-0.06	0.81	-0.15	-0.50	-0.10	0.00
Max Width	0.70	0.19	-0.41	0.37	-0.32	0.59	-0.29	0.57	-0.35	0.24
Length Distribution	0.27	-0.43	-0.04	0.60	0.54	0.15	-0.60	-0.08	0.61	0.39
Average Root Width	-0.50	0.06	0.63	0.38	-0.36	-0.42	0.59	-0.33	-0.28	0.43
Network Convex Area	0.93	-0.14	-0.05	0.05	-0.27	0.91	-0.19	-0.03	-0.29	0.07
Ellipse Axes Aspect Ratio	0.19	-0.35	0.69	-0.45	0.07	0.44	0.34	-0.69	0.06	-0.29
Volume	0.20	0.43	0.71	0.43	-0.05	0.29	0.79	-0.09	0.07	0.46
Solidity	-0.61	0.54	0.41	-0.08	0.27	-0.49	0.75	-0.01	0.34	-0.01
Specific Root Length	0.49	-0.13	-0.60	-0.49	0.26	0.43	-0.58	0.18	0.20	-0.54
Maximum Number of Roots	0.26	0.74	-0.20	0.01	0.52	0.33	0.31	0.63	0.57	-0.06

Vector Loadings

Supplemental Table S3. Logistic regression accuracies for experimental and control conditions. For each day and each B73 x other founder pair we report accuracy of the experimental and control analysis.

Founder 1	Founder 2	Imaging Day	Accuracy Real	Accuracy Control
B73	B97	d03	93.68371593	64.61080402
B73	B97	d06	99.9995	68.95847704
B73	B97	d09	100	66.085494
B73	B97	d12	100	68.98175622
B73	CML103	d03	96.84685857	64.51133076
B73	CML103	d06	98.97634113	61.23275358
B73	CML103	d09	99.92792445	74.8150662
B73	CML103	d12	100	55.64624752
B73	CML228	d03	91.27583456	55.62142441
B73	CML228	d06	98.14588195	61.24782836
B73	CML228	d09	98.6358257	54.73447404
B73	CML228	d12	99.5743323	59.68798913
B73	CML247	d03	93.4286303	74.9619096
B73	CML247	d06	94.30521656	74.98729253
B73	CML247	d09	97.54898046	66.09359495
B73	CML247	d12	99.58935157	53.26037994
B73	CML277	d03	90.41725211	67.84518141
B73	CML277	d06	95.80141665	69.02054075
B73	CML277	d09	99.84756943	70.19005434
B73	CML277	d12	100	73.46618827
B73	CML322	d03	89.16268982	58.49013932
B73	CML322	d06	92.367748	66.35892825
B73	CML322	d09	97.21279389	62.05490468
B73	CML322	d12	99.99078014	53.34987842
B73	CML333	d03	94.09571686	67.72894146
B73	CML333	d06	95.54644112	71.84220439

B73	CML333	d09	99.41202346	70.3543764
B73	CML333	d12	99.98435157	53.23135258
B73	CML52	d03	97.08556608	74.82244077
B73	CML52	d06	98.23688668	78.28123408
B73	CML52	d09	99.08636471	74.87986079
B73	CML52	d12	99.99625	73.24899691
B73	CML69	d03	93.84628304	55.70627307
B73	CML69	d06	99.51006857	56.56726456
B73	CML69	d09	99.80888504	66.22727301
B73	CML69	d12	100	55.79116832
B73	HP301	d03	99.25874304	67.86790713
B73	HP301	d06	99.94050363	78.2152886
B73	HP301	d09	100	85.65350153
B73	HP301	d12	100	59.92146351
B73	IL14H	d03	99.18083795	83.35354648
B73	IL14H	d06	99.51010859	85.762692
B73	IL14H	d09	99.74162983	92.31702328
B73	IL14H	d12	100	72.95899691
B73	KI11	d03	94.55173057	67.8069898
B73	KI11	d06	99.67553373	71.88432814
B73	KI11	d09	99.9174665	62.08188562
B73	KI11	d12	100	59.82485248
B73	KI3	d03	95.51231506	61.52831861
B73	KI3	d06	99.71037317	52.38084904
B73	KI3	d09	99.72932449	61.93421053
B73	KI3	d12	100	55.91407921
B73	KY21	d03	93.13797647	71.19066282
B73	KY21	d06	93.1476347	74.92349489
B73	KY21	d09	95.50678516	66.0461896
B73	KY21	d12	99.36519644	65.22014426
B73	M37W	d03	81.44678705	50.06903852
B73	M37W	d06	96.0515078	61.25153214

B73	M37W	d09	98.61785234	70.26236243
B73	M37W	d12	99.28708103	65.04808471
B73	MO18W	d03	89.47588747	71.26578611
B73	MO18W	d06	97.50996437	74.97711712
B73	MO18W	d09	97.72331814	70.38058479
B73	MO18W	d12	98.14706572	53.42585106
B73	MS71	d03	95.27398781	88.17886924
B73	MS71	d06	96.52725561	66.32431334
B73	MS71	d09	98.00140271	58.11881546
B73	MS71	d12	99.18740469	72.44088235
B73	NC350	d03	85.7964279	64.51841696
B73	NC350	d06	95.19749741	71.85866747
B73	NC350	d09	99.67777562	70.1857961
B73	NC350	d12	99.86871227	59.47479814
B73	NC358	d03	97.37530251	67.79971861
B73	NC358	d06	98.05577246	71.87247026
B73	NC358	d09	99.1819091	62.08588272
B73	NC358	d12	99.83989801	69.11048507
B73	OH43	d03	94.92908516	64.54961332
B73	OH43	d06	96.21999889	69.0751207
B73	OH43	d09	97.23004973	61.99085923
B73	OH43	d12	99.96008901	64.64741866
B73	OH7B	d03	90.58078894	71.25014761
B73	OH7B	d06	97.55859785	63.8506519
B73	OH7B	d09	99.70193635	70.33639469
B73	OH7B	d12	99.94690771	49.10440083
B73	P39	d03	97.06774688	67.8528927
B73	P39	d06	97.11916821	74.98298467
B73	P39	d09	99.96640975	79.88862569
B73	P39	d12	100	55.90915842
B73	TX303	d03	90.82933493	58.6423984
B73	TX303	d06	98.54593833	61.20551457

B73	TX303	d09	99.96357513	70.37400466
B73	TX303	d12	99.97722898	53.26781155
B73	TZI8	d03	86.02802307	74.91613529
B73	TZI8	d06	96.91653829	85.66179222
B73	TZI8	d09	99.32524793	92.35030062
B73	TZI8	d12	100	48.89353994

Supplemental Table S4: All of the QTLs found by the Composite Interval Mapping analysis, sorted by the effect size of the QTL.

Trait	Chromosome	Marker	LR-Score	Effect Size	Left 2-LOD	Left 1-LOD	Right 1-LOD	Right 2-LOD
depth(mm)_d08	10	56	53.282	0.238	50.521	55.543	58.532	60.374
depth(mm)_d06	10	56	49.215	0.189	50.689	55.554	61.112	62.154
minorellipseaxes(mm)_d08	10	60	47.756	-0.191	50.873	55.662	62.330	62.816
minorellipseaxes(mm)_d06	10	54	47.670	-0.198	46.776	46.961	54.805	55.157
networkconvexarea(mm ²)_d08	10	46	44.429	-0.170	43.077	43.775	47.150	47.463
networkconvexarea(mm ²)_d06	10	46	43.045	-0.176	43.274	45.212	46.888	47.369
majorellipseaxes(mm)_d06	10	44	39.146	0.156	41.981	43.308	46.592	47.739
lengthdistr(mm)_d06	6	12	38.571	0.154	7.144	9.507	15.321	15.855
totallength(mm)_d08	7	59	33.272	-0.135	57.369	58.065	59.706	64.546
ellipseaxesaspectratio_d08	10	60	32.690	0.119	53.251	53.927	60.699	62.889
majorellipseaxes(mm)_d08	10	46	32.049	0.121	42.440	43.721	47.311	48.075
widthdeptratio_d08	10	57	31.060	0.125	53.132	53.666	60.364	62.417
solidity_d06	2	122	30.953	0.127	113.416	116.814	122.802	130.250
ellipseaxesaspectratio_d08	7	117	30.295	0.106	111.584	112.816	122.467	130.548
widthdeptratio_d06	10	57	30.047	0.116	53.603	55.424	60.056	61.165
majorellipseaxes(mm)_d06	2	117	28.604	-0.107	105.470	113.930	122.030	127.319
networkconvexarea(mm ²)_d06	2	121	28.235	-0.109	112.246	115.568	122.227	122.711
totallength(mm)_d06	7	59	28.088	-0.116	57.298	58.196	60.806	65.434
maximumnumberofroots_d06	8	74	27.596	0.110	72.223	72.983	75.910	77.050
lengthdistr(mm)_d08	6	10	27.256	0.123	6.884	9.084	17.326	17.847
minorellipseaxes(mm)_d04	10	46	26.741	-0.116	43.006	45.102	47.374	50.130
surfacearea(mm ²)_d04	10	46	26.441	-0.114	42.756	45.319	47.242	47.801
depth(mm)_d04	10	46	26.427	0.108	43.341	45.330	51.270	56.062
perimeter(mm)_d08	7	59	26.336	-0.102	49.895	57.717	64.259	65.188
majorellipseaxes(mm)_d08	3	88	25.719	-0.094	82.917	84.960	92.970	95.431
solidity_d06	10	57	25.679	0.105	46.997	53.776	62.486	64.760

perimeter(mm)_d06	7	59	25.552	-0.106	57.647	58.399	60.173	62.907
networkarea(mm ²)_d04	10	46	25.230	-0.106	44.389	45.347	47.193	47.672
networkconvexarea(mm ²)_d08	3	86	25.093	-0.089	83.160	83.797	88.173	88.971
ellipseaxesaspectratio_d06	10	58	24.890	0.107	50.609	55.519	64.160	66.246
minorellipseaxes(mm)_d06	3	86	24.871	-0.084	78.652	83.370	86.916	88.835
majorellipseaxes(mm)_d08	2	104	24.641	-0.093	97.458	100.169	108.574	114.169
solidity_d08	10	58	24.386	0.098	46.813	50.315	66.105	66.334
specificrootlength(1/mm ²)_d08	4	30	24.352	-0.101	20.645	21.143	32.081	33.250
networkconvexarea(mm ²)_d04	10	46	24.342	-0.096	43.131	45.299	47.158	47.579
specificrootlength(1/mm ²)_d08	2	121	24.172	-0.099	116.806	119.606	123.497	131.061
majorellipseaxes(mm)_d04	2	121	23.843	-0.095	109.944	111.486	122.480	123.327
averagerootwidth(mm)_d06	2	121	23.727	0.096	116.926	119.368	122.264	124.338
mediannumberofroots_d08	2	85	23.486	-0.109	82.770	83.759	88.359	89.172
depth(mm)_d06	2	122	23.478	-0.083	112.580	118.716	130.848	131.246
specificrootlength(1/mm ²)_d06	8	13	23.144	0.098	2.622	11.519	14.492	15.595
depth(mm)_d04	2	121	22.805	-0.093	112.746	115.913	122.891	131.200
networkconvexarea(mm ²)_d06	3	86	22.706	-0.076	78.529	83.310	88.603	93.183
averagerootwidth(mm)_d08	2	121	22.516	0.086	118.230	119.873	122.541	131.237
majorellipseaxes(mm)_d04	10	46	22.505	0.091	43.677	45.470	47.397	51.383
depth(mm)_d08	2	128	22.277	-0.085	119.563	127.293	130.029	130.923
majorellipseaxes(mm)_d08	1	68	22.258	-0.081	56.831	61.579	71.231	76.078
solidity_d04	2	116	21.922	0.095	109.853	111.956	122.317	122.974
surfacearea(mm ²)_d06	10	46	21.770	-0.091	42.118	44.886	47.226	47.811
surfacearea(mm ²)_d08	7	59	21.329	-0.086	49.273	50.110	65.044	65.822
depth(mm)_d06	1	201	21.275	-0.074	198.360	198.898	202.218	208.000
volume(mm ³)_d06	10	26	21.200	-0.088	23.299	24.409	29.021	35.204
averagerootwidth(mm)_d08	4	31	21.079	0.081	22.336	27.308	33.229	37.380
perimeter(mm)_d08	4	30	20.863	-0.079	19.907	21.714	31.549	36.414

maxwidth(mm)_d06	3	88	20.770	-0.087	78.844	84.843	92.570	95.524
minorellipseaxes(mm)_d06	2	121	20.722	-0.071	109.985	112.643	122.696	131.249
surfacearea(mm ²)_d06	7	59	20.522	-0.084	56.929	58.084	62.357	68.008
networkconvexarea(mm ²)_d04	2	116	20.241	-0.077	109.976	112.094	122.191	122.792
widthdepthratio_d06	7	117	20.006	-0.075	109.970	112.646	124.175	131.014
majorellipseaxes(mm)_d06	1	64	19.874	-0.071	53.811	59.908	70.671	73.024
totallength(mm)_d04	9	65	19.864	0.082	56.959	61.734	67.748	70.760
majorellipseaxes(mm)_d06	3	88	19.759	-0.071	78.136	83.292	92.812	96.208
networkarea(mm ²)_d08	7	59	19.734	-0.079	49.249	50.015	64.681	65.654
averagerootwidth(mm)_d06	4	28	19.722	0.079	19.457	23.011	31.394	36.592
maximumnumberofroots_d06	7	59	19.710	-0.078	49.059	58.274	59.893	68.048
totallength(mm)_d08	4	27	19.686	-0.074	21.143	21.964	31.541	36.178
networkarea(mm ²)_d06	10	46	19.682	-0.082	41.940	42.990	47.253	47.791
widthdepthratio_d06	10	91	19.466	0.072	80.758	85.725	93.293	95.868
widthdepthratio_d08	10	92	19.326	0.073	85.255	85.934	93.254	96.219
widthdepthratio_d08	7	122	19.243	-0.074	109.629	111.365	124.641	131.121
minorellipseaxes(mm)_d08	3	86	19.178	-0.066	78.860	83.480	87.020	89.911
networkarea(mm ²)_d08	10	26	19.127	-0.078	22.653	23.574	27.369	30.720
maximumnumberofroots_d08	4	28	18.874	0.072	21.965	24.706	29.969	35.166
maxwidth(mm)_d06	10	46	18.757	-0.079	35.666	39.900	47.082	47.764
networkarea(mm ²)_d06	3	86	18.665	-0.075	78.769	83.682	89.321	93.722
surfacearea(mm ²)_d08	10	26	18.606	-0.075	22.230	23.484	27.483	30.792
maximumnumberofroots_d08	2	83	18.377	-0.070	78.710	81.662	89.449	92.534
solidity_d08	1	76	18.261	0.072	65.493	65.820	77.459	85.468
perimeter(mm)_d04	9	65	18.153	0.075	60.528	61.814	68.925	70.674
maximumnumberofroots_d08	7	59	18.087	-0.069	49.528	56.575	62.060	66.256
bushiness_d08	6	12	18.072	0.079	6.629	6.963	17.711	21.294
maxwidth(mm)_d04	10	46	17.956	-0.080	35.781	39.062	47.217	49.064

averagerootwidth(mm)_d06	8	39	17.885	-0.075	33.240	33.877	46.081	46.392
networkconvexarea(mm ²)_d08	9	54	17.863	0.062	48.821	51.905	54.792	55.877
volume(mm ³)_d06	9	37	17.792	0.073	30.831	31.644	39.637	46.239
majorellipseaxes(mm)_d08	5	29	17.634	0.064	26.806	28.367	32.221	37.247
maximumnumberofroots_d06	9	64	17.338	0.067	60.503	60.805	74.781	80.046
bushiness_d06	6	21	17.190	0.077	1.549	1.856	21.281	21.556
solidity_d08	3	96	17.126	0.066	85.636	95.040	99.285	101.040
networkconvexarea(mm ²)_d06	9	54	16.991	0.064	47.764	51.845	54.667	58.227
bushiness_d04	1	0	16.940	0.075	0.000	0.000	3.589	6.799
mediannumberofroots_d04	9	64	16.935	0.076	58.192	58.853	69.114	69.967
minorellipseaxes(mm)_d04	9	34	16.746	0.064	31.063	31.669	39.189	40.395
networkarea(mm ²)_d06	7	60	16.733	-0.067	48.966	57.745	65.750	68.288
solidity_d04	10	46	16.656	0.070	37.823	45.197	48.278	51.834
totallength(mm)_d06	3	88	16.438	-0.059	79.589	85.035	92.569	94.742
minorellipseaxes(mm)_d06	9	54	16.287	0.055	47.750	51.790	57.012	62.338
averagerootwidth(mm)_d08	8	38	16.239	-0.063	33.134	33.780	39.890	46.361
averagerootwidth(mm)_d04	9	64	16.021	-0.069	57.639	60.682	67.933	70.971
totallength(mm)_d06	9	64	15.931	0.062	54.863	61.247	67.367	70.992
lengthdistr(mm)_d06	1	191	15.830	-0.074	182.788	185.765	199.259	200.392
depth(mm)_d04	7	107	15.545	0.062	96.418	105.858	108.850	117.296