

Phenotype Screening

C O R P O R A T I O N

enabling discovery

Product Description

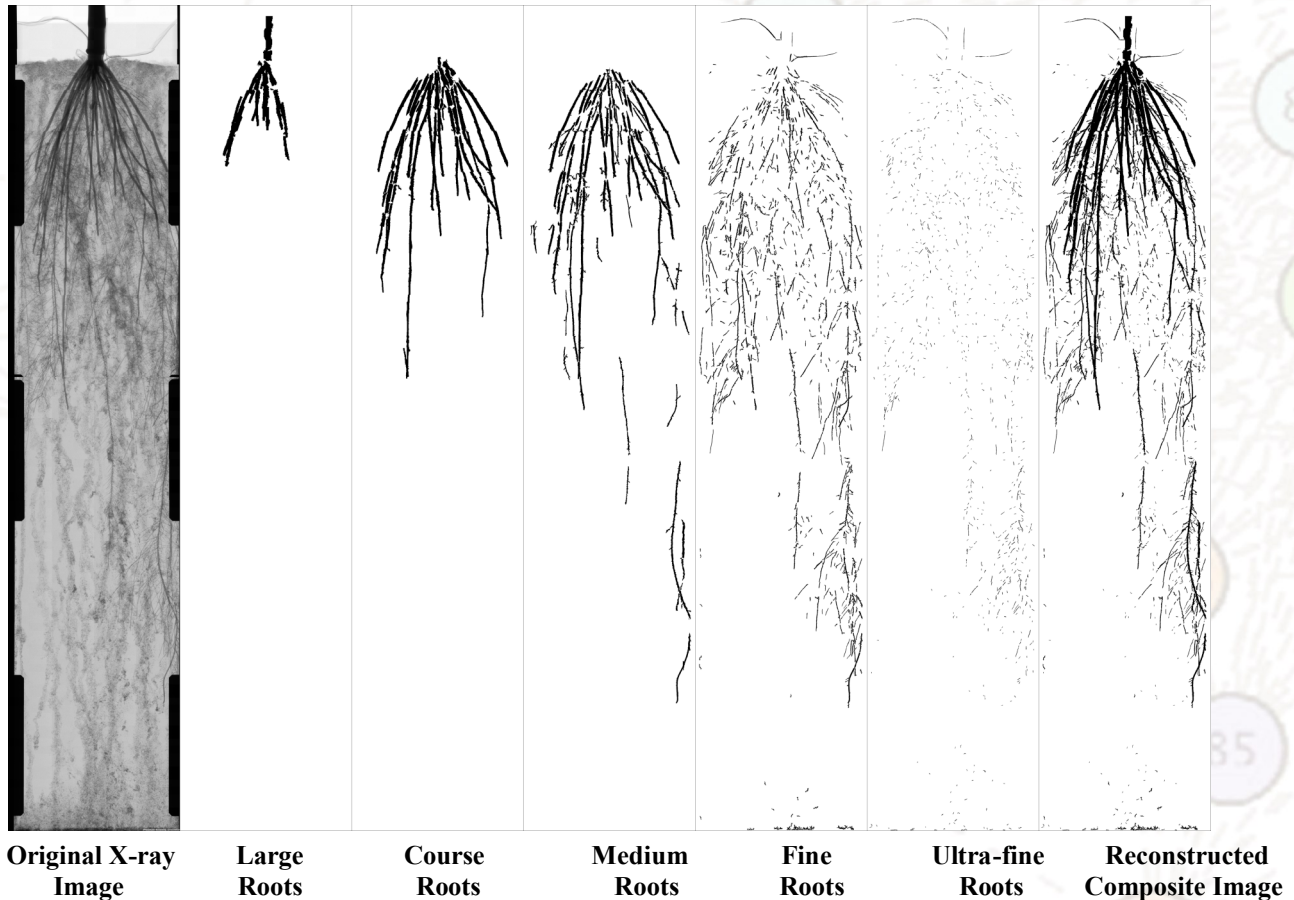
Extracting Root Traits from Digital X-ray Images

The analysis of digital plant root images can be a labor intensive task. In high noise images, convolution, watershed, and derivative based methods do not work. The human eye tires rapidly when asked to trace root images for hours.

Phenotype Screening Corporation's Rhizo-Traits® root segmentation and analysis software automates the tasks of segmenting roots from background and extracting important root traits from digital images. This quantitative data provides insight into treatment effects on root system development. Our software provides uniform, unbiased, re-

peatable segmentation of gray scale or color images and can be extended to multi-spectral applications.

We segment roots into overlapping root diameter ranges varying from a few tens of microns in diameter up to 20 mm in diameter. The picture below shows the segmentation of maize roots from X-ray images by root diameter ranges. The breakout of information by root diameter range gives further insight into the benefits of a specific treatment. A increase in large roots can enhance lodging resistance. An increase in fine roots can enhance water and nutrient uptake.



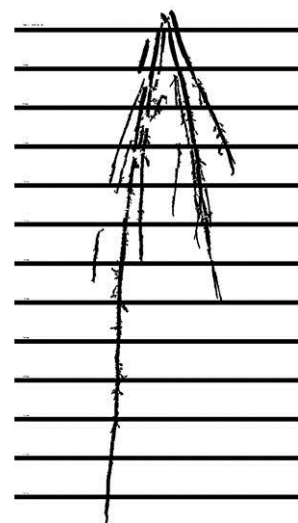
Product Description

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(continued)

Once segmented out from the background powerful image processing routines are used to filter residual noise. What remains is a two dimensional projection of the root system. The area of the projected root system is then calculated as a representation of the extent of the root system. Additional software modules determine the total root length of the root system. Both projected root area and total root length are provided for each of the five root diameter ranges.

RhizoTraits[®] also extracts information on the root system at specified depths. This feature provides you with a count of the number of times a root segment crosses each depth, the widths of those roots and the density of roots at that depth for each of the five root diameter ranges.



Roots falling within a preselected root diameter range are analyzed by depth.

The resulting quantitative data is preserved in an Excel compatible digital format.

Plant_ID	Size_Class	Projected_Area	TRL_(m)	xval_(px)	yval_(px)	RC#	Rtdiam_(mm)	TDepth_(mm)	WidthAtDepth_(mm)	CountDensity_DSFlag
M1101	SizeClass3	6357270	5.576	3235.781	3312	1	1.477	25	30.769	0.1 DSF
M1101	SizeClass3	6357270	5.576	3775.241	3312	2	0.116	25	30.769	0.1
M1101	SizeClass3	6357270	5.576	3880.75	3312	3	1.826	25	30.769	0.1
M1101	SizeClass3	6357270	5.576	4174.241	3312	4	2.784	25	30.769	0.1
M1101	SizeClass3	6357270	5.576	2829.812	4174	1	0.953	50	62.234	0.123 DSF
M1101	SizeClass3	6357270	5.576	3088.741	4174	2	1.595	50	62.234	0.123
M1101	SizeClass3	6357270	5.576	3486.741	4174	3	2.871	50	62.234	0.123
M1101	SizeClass3	6357270	5.576	3658.241	4174	4	1.334	50	62.234	0.123
M1101	SizeClass3	6357270	5.576	4089.741	4174	5	3.045	50	62.234	0.123
M1101	SizeClass3	6357270	5.576	4155.241	4174	6	0.116	50	62.234	0.123
M1101	SizeClass3	6357270	5.576	4181.741	4174	7	0.319	50	62.234	0.123
M1101	SizeClass3	6357270	5.576	4342.784	4174	8	0.839	50	62.234	0.123
M1101	SizeClass3	6357270	5.576	4704.741	4174	9	3.045	50	62.234	0.123
M1101	SizeClass3	6357270	5.576	4879.741	4174	10	3.045	50	62.234	0.123
M1101	SizeClass3	6357270	5.576	2003.873	5036	1	1.877	75	89.639	0.12 DSF
M1101	SizeClass3	6357270	5.576	2136.741	5036	2	2.581	75	89.639	0.12
M1101	SizeClass3	6357270	5.576	2256.741	5036	3	1.131	75	89.639	0.12
M1101	SizeClass3	6357270	5.576	2409.741	5036	4	0.957	75	89.639	0.12
M1101	SizeClass3	6357270	5.576	2703.741	5036	5	2.175	75	89.639	0.12
M1101	SizeClass3	6357270	5.576	3277.241	5036	6	2.842	75	89.639	0.12
M1101	SizeClass3	6357270	5.576	3473.741	5036	7	2.175	75	89.639	0.12
M1101	SizeClass3	6357270	5.576	3553.241	5036	8	0.754	75	89.639	0.12
M1101	SizeClass3	6357270	5.576	3628.751	5036	9	0.434	75	89.639	0.12
M1101	SizeClass3	6357270	5.576	3737.741	5036	10	2.001	75	89.639	0.12
M1101	SizeClass3	6357270	5.576	4065.741	5036	11	1.247	75	89.639	0.12
M1101	SizeClass3	6357270	5.576	4491.741	5036	12	1.769	75	89.639	0.12
M1101	SizeClass3	6357270	5.576	4596.803	5036	13	2.055	75	89.639	0.12
M1101	SizeClass3	6357270	5.576	4997.241	5036	14	2.32	75	89.639	0.12