

Introduction

Progress in imaging and robotics technologies improves our ability to capture ever more and finer details of root morphology at high throughput. The bottleneck in most root phenotyping pipelines remains the realtime automated extraction of biological information from thousands of raw images.

In aeroponics, roots growing unimpeded can be accessed non-invasively. With backlight illumination, sharp images are produced on 1000 plants with a 2-hr time resolution. The short displacement of roots in one time lapse makes it possible to track the progression of root tips during more than two weeks.

Reconstruction

Three procedures are used to estimate growth and branching dynamics from root tip space-time coordinates.

A. Tips of seed- and shoot-borne roots are filtered out and chunks of trajectories are reconstructed to estimate growth rates, root numbers and branching frequencies.

B. The space-time distribution of the root tip population is processed by machine learning techniques trained on simulated root systems, yielding model parameters.

C. Tip features are analysed with multi-objects tracking techniques and a root system is reconstructed (at least partially).

Examples

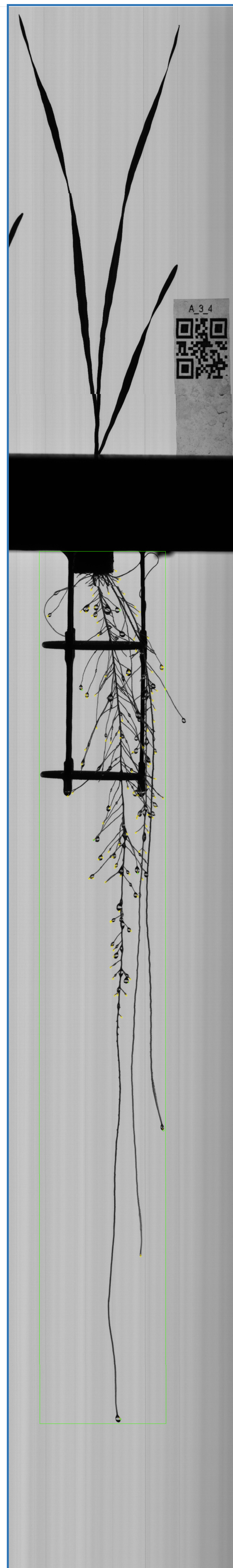
The platform is mostly used for capturing root growth dynamics in diversity panels (GWAS).

The fine temporal and spatial resolution combined allows systems-wide analysis of growth distribution in a root population.

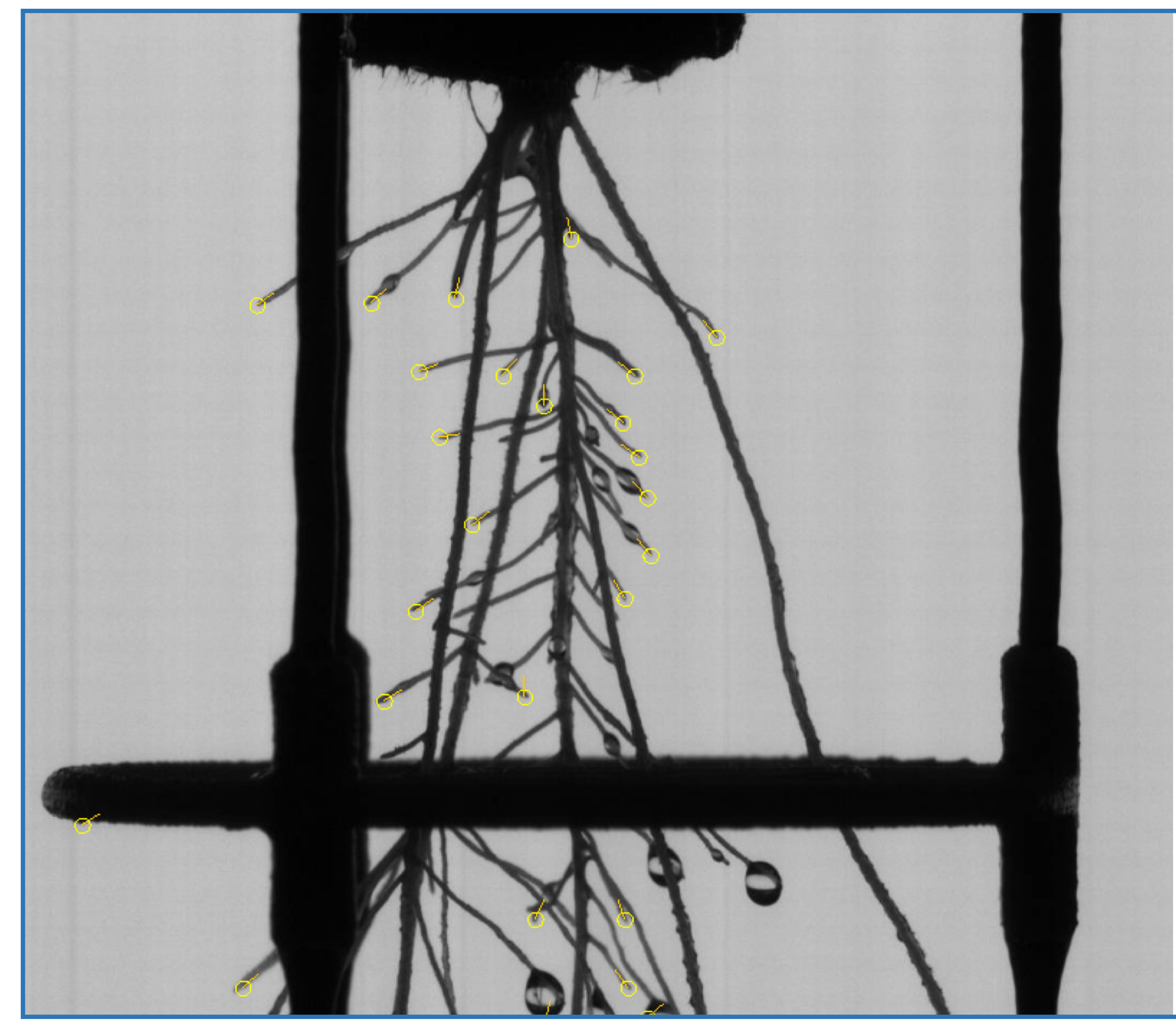
The low phenotyping cost (*from seed to data*) allows large number of replicates to analyse biological instability.

Figures

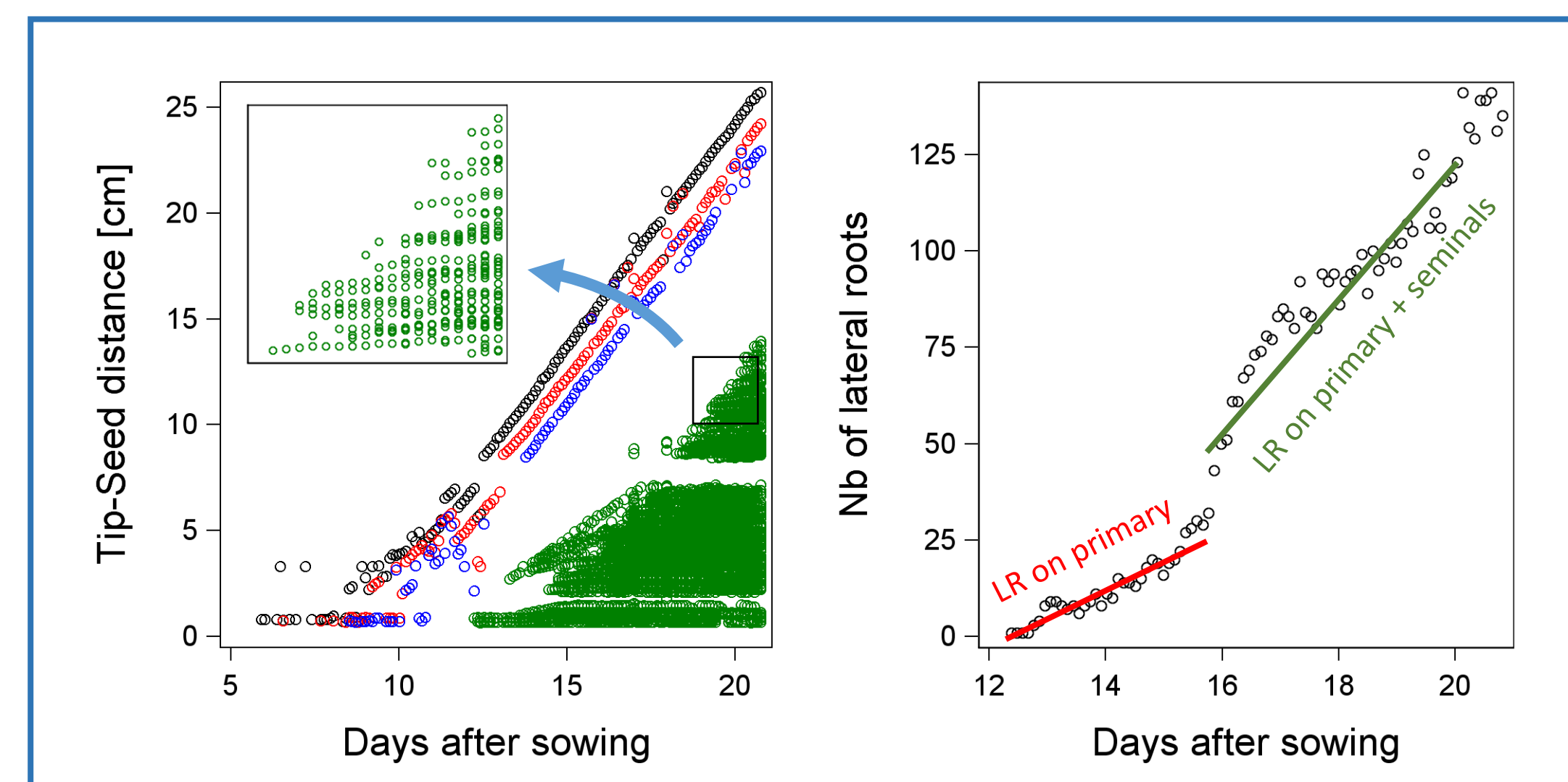
Capacity: 2 x 495 plants
Limits: 21 days (60 cm roots)
Spatial resolution: 35 μ m
Time resolution: 2 hrs
Imaging: grayscale linear camera
14 accesses offered through EPPN2020



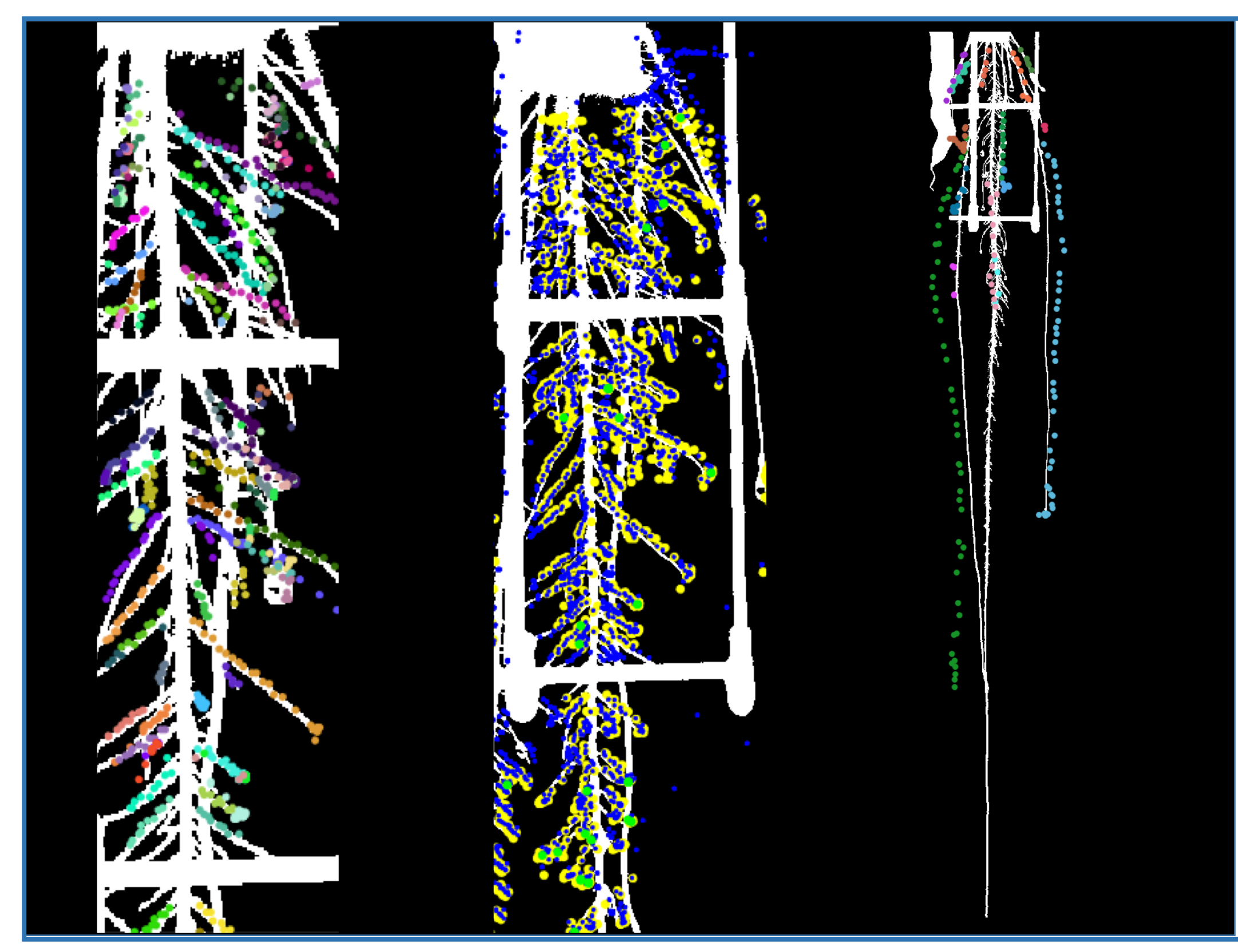
Tip detection



Filtering



Multi-objects tracking



Machine learning

