Automated Minirhizotron for Non-Destructive Continuous Phenotyping of Root Systems

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Introduction

Non-destructive continuous root monitoring without disturbing the plants is a challenging task. Present minirhizotron (MR) system (Bartz MR) is operated manually (Fig 1.).

An automated MR camera may offer a solution to continuously monitor root development of crops in situ.

Objectives

To develop new automated minirhizotron (MR) system for continuous root phenotyping.

Compare two MR systems: a regular manually operated system (Bartz MR) and a newly developed automated minirhizotron system.

Materials and Methods

Experiment was conducted on tomato (*Lycopersicon esculentum* Mill, Var. Ka 15) crop in a controlled greenhouse at Robert H. Smith Faculty of Agriculture, Food and Environment, Rehovot, Israel.

Transparent tubes were installed to a depth of 100 cm at distance of 25 cm from plant.

Root photographs were taken at 15 days interval (02/03/2017, 20/03/2017 and 05/04/2017) using the two minirhizotron (MR) camera systems (BTC100, Bartz Technology Corporation and an automated minirhizotron system) (Fig .1. & Fig. 6.).

Schematic description of MR system

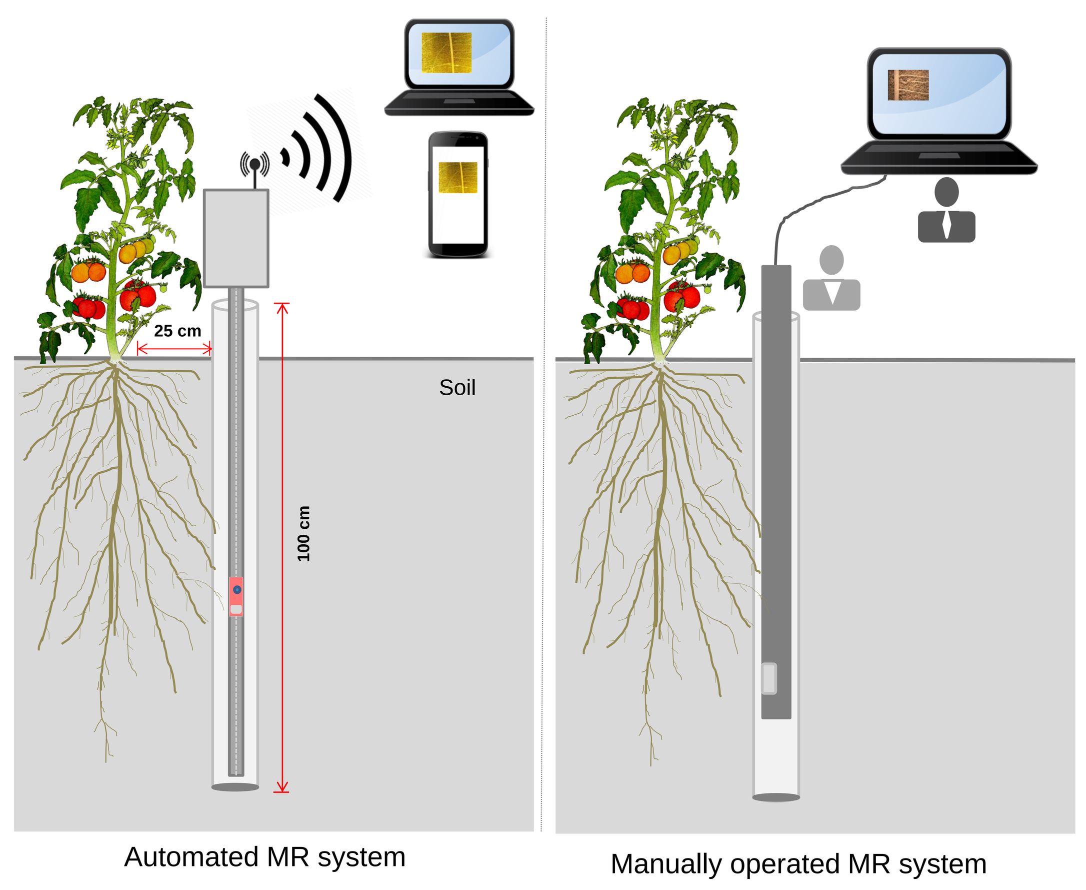

Figure 1. Schematic description of two minirhizotron (MR) systems to observe root development

Findings

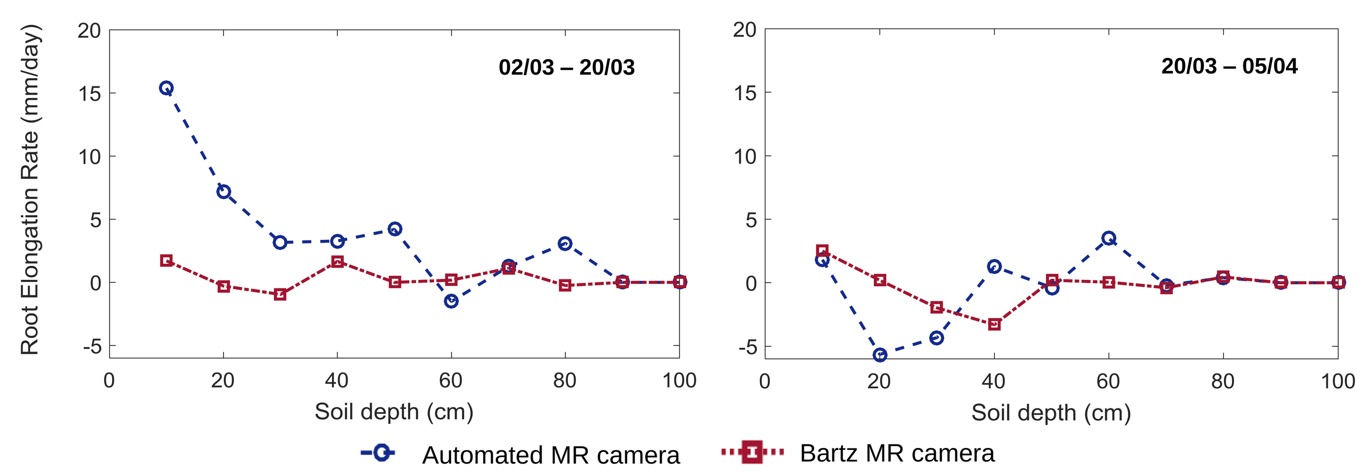

Figure 2. Root elongation rate of tomato measured using two minirhizotron (MR) systems

Findings

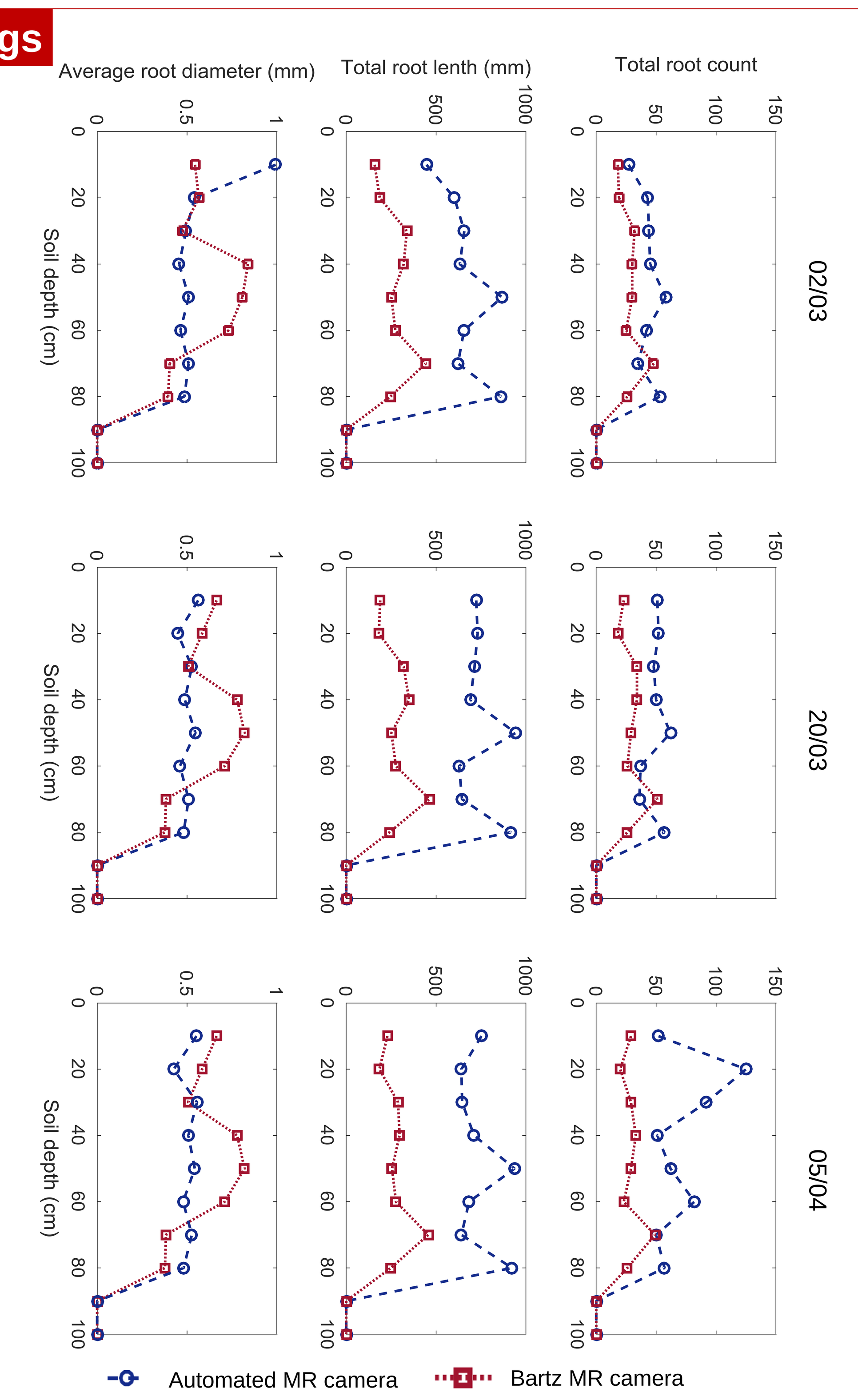

Figure 3. Root properties (average root diameter, total root length and root count) measured using two minirhizotron camera systems

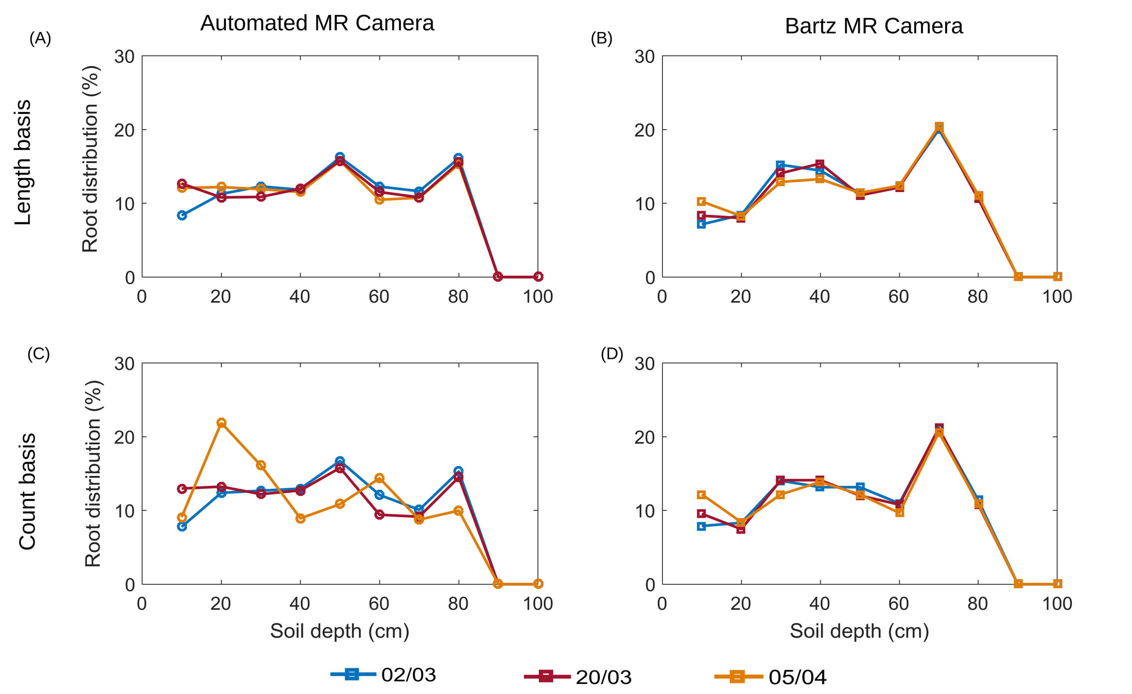

Figure 4. Root distribution (A-D) of tomato (Ka 15) measured using two minirhizotron camera systems

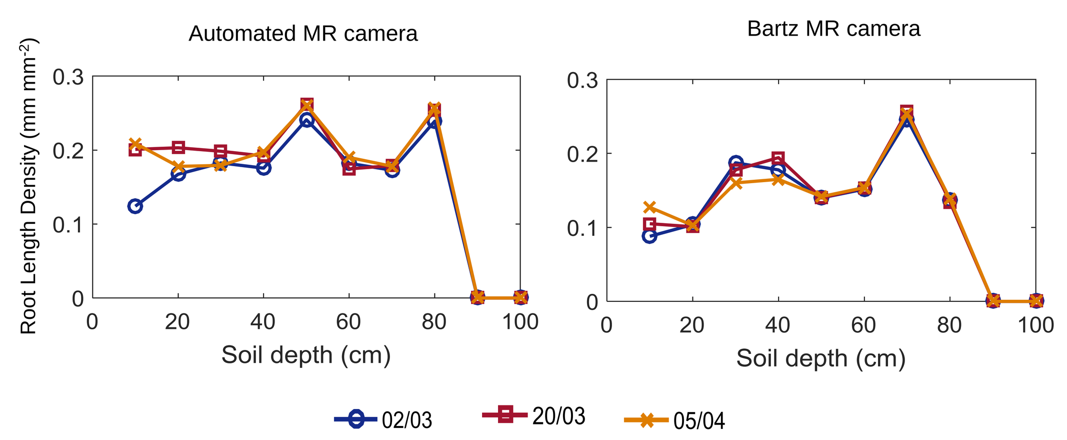

Figure 5. Root length density (RLD) of tomato (Ka 15) measured using two minirhizotron camera systems

Roots at time series : March to April 2017

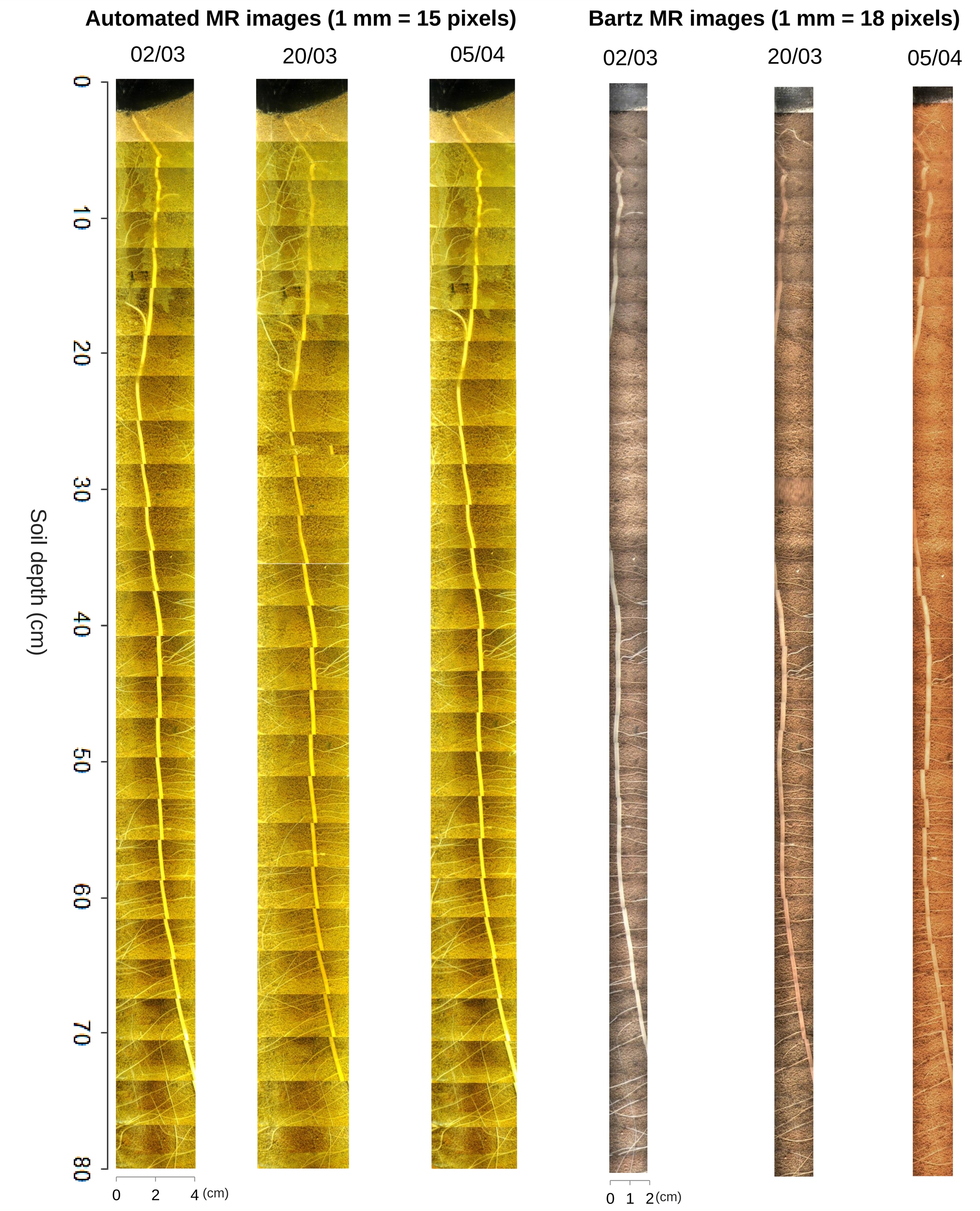

Figure 6. Roots of tomato (Ka 15) measured using two minirhizotron camera systems.

Results

Automated MR camera had no difference in image quality (Fig. 6) and ease of use without human intervention.

Automated MR camera recorded the root system continuously with higher number of roots (Fig 3.), total root length and root length density (Fig. 5) due to large image width (4 cm).

It provide precise results of root distribution, root elongation (Fig 2.& 4.) and is capable of detecting fine roots.

Conclusion

Root development and root zone processes can be continuously monitored by using automated MR system.

This low-cost automated MR camera system will be an excellent solution for non-destructive continuous monitoring of root systems.

Acknowledgement

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