

Root morphology of two modern high-erucic acid oilseed rape varieties (*Brassica napus* var. *oleifera*) in response to reduced agricultural inputs

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ABSTRACT

Oilseed rape (*Brassica napus* var. *oleifera*) is considered a multifunctional crop, as a source of food, feed and several industrial compounds. It includes low erucic varieties (i.e., Canola) and high erucic ones (i.e., HEAR, High Erucic Acid Rapeseed), very rich in this fatty acid, and mainly destined for non-food applications. This experiment examined root responses of two new commercial HEAR varieties (Hearty, Maplus) to marked reduction of agricultural inputs. Two input levels (high, low) were compared. Root growth was studied, to check its possible key role in low input adaptation. Profiles of volumetric root length density (RLD) were revealed by the auger sampling method, at phase G1 (onset of pod formation) in 2006 and 2007 in a silty-loam soil at the experimental farm of the University of Padova (NE Italy). Root densities of both Maplus and Hearty were much higher, especially in deep layers, compared with older Canola varieties at the same location. High inputs led to significantly higher RLD compared with extensive management, without substantial differences between varieties. In view of the obtained results, we conclude that modern HEAR varieties, with denser root systems, are more suitable for low input management, for greater N uptake and seed yields.

KEYWORDS: erucic acid, low input, nitrogen fertilization, root length density.

INTRODUCTION

Winter oilseed rape (*Brassica napus* var. *oleifera*) is widespread throughout Europe. This crop reaches its highest yields in central Europe, but has recently also spread around the Mediterranean basin. Breeding of this crop has now selected new varieties with improved seed yields and good adaptability to varying environmental conditions. In view of the high requirements of *B. napus* for fertilization, in particular nitrogen, and the autumn-winter cycle that may lead to considerable risks of N leaching, the possibility of adopting low input management must be carefully evaluated. Many studies (e.g., Kage et al., 2000; Vamerali et al., 2000; Kamh et al., 2005) have highlighted how the root system may be a good indicator of crop adaptation and its potential for N uptake. The root system of two recently released varieties of high erucic oilseed rape were therefore investigated by auger sampling in response to low input.

MATERIALS AND METHODS

A large field trial was set up during 2005-2007 at the experimental farm of University of Padova (Legnaro, 45°21'N, 11°58'E, NE Italy). Two new varieties of HEAR: Maplus (NPZ Lembke, Germany) and Hearty (Monsanto, France) were compared in response to different types of agronomic management (high and low input). Agronomic inputs differ in: soil tillage, fertilization (NPK), weed management and inter-rows distance. The experimental design was a split plot with three replicates. The root system was investigated by the core sampling method at initial pod formation (G1), in both years. Roots were collected down to 1 m depth, two cores being taken for

each plot. Soil cores were split in 0.1-m sub-samples and frozen at -18°C until washing. Roots were separated from soil particles by a flotation method with water and a solution of oxalic acid. Roots were preserved in ethanol solution (10% v/v), until their acquisition on a flatbed scanner. Automatic analysis with KS 300 Rel. 3.0 software (Karl Zeiss, Germany) provided the length of roots and their average diameter. Analysis of variance was performed to determine the effects of input level, genotype, year, depth and their interactions. Means were compared by least significance differences (LSD) at 5% probability level.

RESULTS AND DISCUSSION

Our new HEAR varieties reached significantly higher values of RLD when compared to older “00” genotypes, showing good colonization of soil even in the deepest layers. The two years were characterized by different environmental conditions which led to a significant increase in root density in 2006 (almost double). In both years, input significantly influenced root system (Fig. 1), higher values of root density being associated with high input.

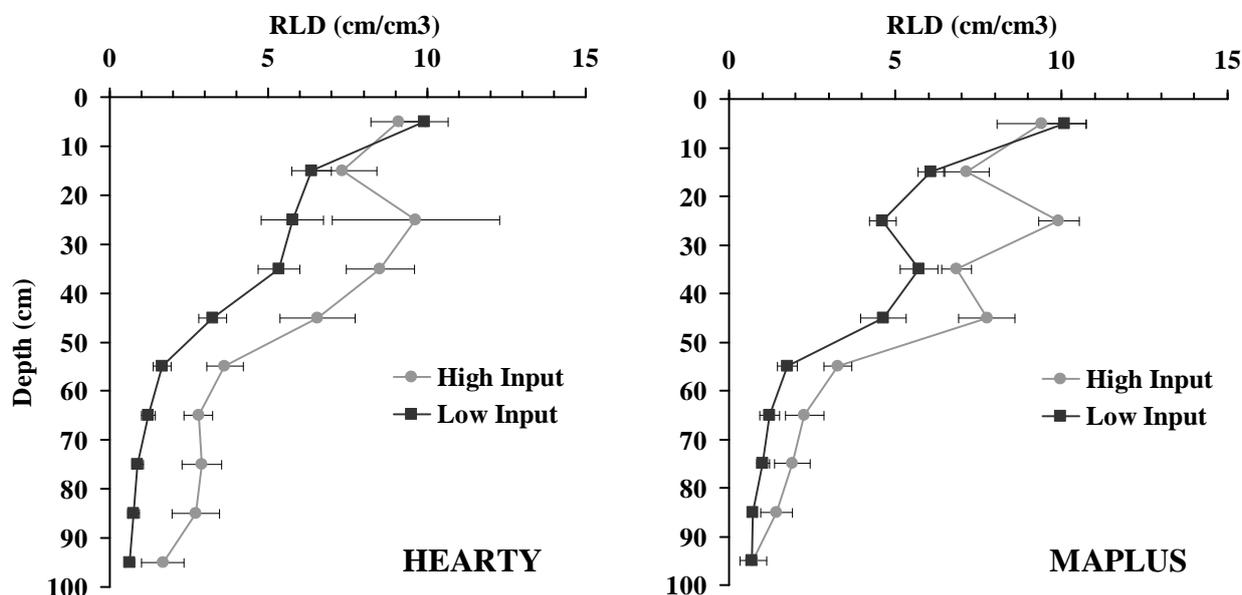


Fig. 1. Root profiles of Hearty and Maplus in 2007, at high and low input (\pm S.E.).

Considering root distributions along profile, extensive management was related to an over-concentration of roots in the shallow layer and a poorer colonization at depth. No significant differences emerged between varieties nor in their interactions with input level. A significant correlation emerged between RLD values and shoot N (g m^{-2}) in 2006 ($R^2=0.43$), but not in 2007, indicating that further studies on N uptake will have to be considered in the future.

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