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Seasonal changes of fine root and vascular cambium of a Quercus ilex L. forest

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We investigated the effects of seasonal changes in soil moisture and temperature on the morphological growth traits of fine roots (<2 mm in diameter) and vascular cambium activity of stems and roots in a mature Quercus ilex (L.) stand in the South of Italy. Fine roots were sampled by soil core method, and cambium tissues were carefully collected by hammer and chisel. Mean annual fine root mass and length were 115 g m-2 (live 45g m-2; dead 70 g m-2) and 471 m m-2 (live 244 m m-2, dead 227 m m-2), respectively. Mean specific root length (SRL) was 3.7 m g-1 and turnover rate was 3 year-1. Fine root traits displayed a complex pattern related to season. In particular, biomass and length peaked in summer and late autumn. The summer maximum was characterized by an increase of the thinner part of the root population (smallest diameter size and highest SRL) and was mainly driven by soil temperature. Our results suggest that Q. ilex adopted an intensive strategy modifying the root length per unit mass, channeling carbon preferentially into the production of very fine roots. This allowed trees to exploit transient periods of low soil water content through increased nutrient and water uptake. The autumn maximum was characterized by an increase in mean diameter size of the fine root population (largest mean diameter size and lowest SRL). Thus, once precipitation sufficiently recharged soil moisture, it is reasonable to state that in addition to trees producing new roots, their percentage of very fine roots that did not die after the summer flush continued their growth in a radial pattern to function for starch concentration. Shoot and root cambial activity significantly changed during the season from the winter minimum (4.8 shoot and 4.7 root) to three- and two-fold higher values measured during the summer maximum. Although a peak number of meristematic cells for shoots and roots occurred during the summer, a second peak of shoot meristematic cells during autumn suggests that shoot and root meristematic activity is independent and perhaps driven by different activation mechanisms. These growth traits are important for forests growing under natural conditions because they enable plants to survive the typically dry summer in the Mediterranean area, which is likely to become drier and longer given the increase in temperature expected in this century.