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(143) Physiological responses to water stress and temperature on the pine wilt disease development in *Pinus* spp.

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ABSTRACT

Four to five-years-old *Pinus pinaster*, *P. pinea* and *P. radiata* trees were inoculated with 6000 pinewood nematodes (PWN) and symptoms evolution, trees physiological responses and PWN population densities were assessed under high and low water availability conditions, at 25 and 30ºC. Pine wilt disease symptoms were observed in all infected *P. pinaster* and *P. radiata* leading to a decrease in photosynthetic activity and water potential values, under the highest temperature and low water availability. *Pinus pinea* did not develop symptoms and no significant changes in physiological status were detected. Nematodes were found in higher numbers, in high temperatures and low water availability, in *P. pinaster* followed by *P. radiata* and *P. pinea*.

INTRODUCTION

After entering into the host tree, the pinewood nematodes (PWN), *Bursaphelenchus xylophilus*, multiply intensively and migrate throughout the plant. During this process, the blockage of xylem water conduction by tracheid embolisms causes high decrease in leaf water potential and cessation of photosynthesis (Kuroda 2008). To develop proper control methods, based on early diagnosis of the disease, is important to understand the physiological responses and internal changes of infected host species. The main objectives of this study were to understand the effect of water stress and temperature on PWN development and to evaluate the photosynthetic activity and water potential values of PWN infected *P. pinaster*, *P. pinea* and *P. radiata*.

MATERIALS AND METHODS

A total of 120 four to five-years-old trees (40 trees/*Pinus* species) were grown in a greenhouse under high and low water availability conditions at 25 and 30ºC. Trees were inoculated with 6000 PWN and trees inoculated with sterilized water were used as controls. Predawn xylem pressure potential of needles was measured using a Scholander pressure chamber and photosynthetic and transpiration rates of needles were taken, twice a week, using a portable infra-red gas analyzer (GFS-3000, Walz) equipped with a red led light source. Symptoms development was followed for 50 days and classified in six stages based on the wilting and consequent discoloration of the needles according to Proença *et al*. (2010). At the end of the experiment, the trees were cut and the final PWN population was estimated, in each tree, at the branches, trunk, roots and soil.

RESULTS

Pine wilt disease symptoms (PWD) were observed in all infected *P. pinaster* and *P. radiata* leading to a decrease in photosynthetic activity and water potential values, under the highest temperature and low water availability. *Pinus pinea* did not develop symptoms and no significant changes in physiological status were detected. Nematodes were found, in higher numbers, in the highest temperature and low water availability, in *P. pinaster* followed by *P. radiata* and *P. pinea*. In *P. pinaster* and *P. radiata*, nematodes were detected in all PWN inoculated trees, at the branches, trunk and roots while in *P. pinea* they were detected only in four trees, at the branches and trunk. Pine species reacted differently to PWN, water stress conditions and temperature, enhancing the development of the PWD, which may have implications on the enlargement of infected area and on the shortening period of PWD development under climate change scenarios.

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