

Histology of *Austrocedrus chilensis* roots during infection by *Phytophthora austrocedri*

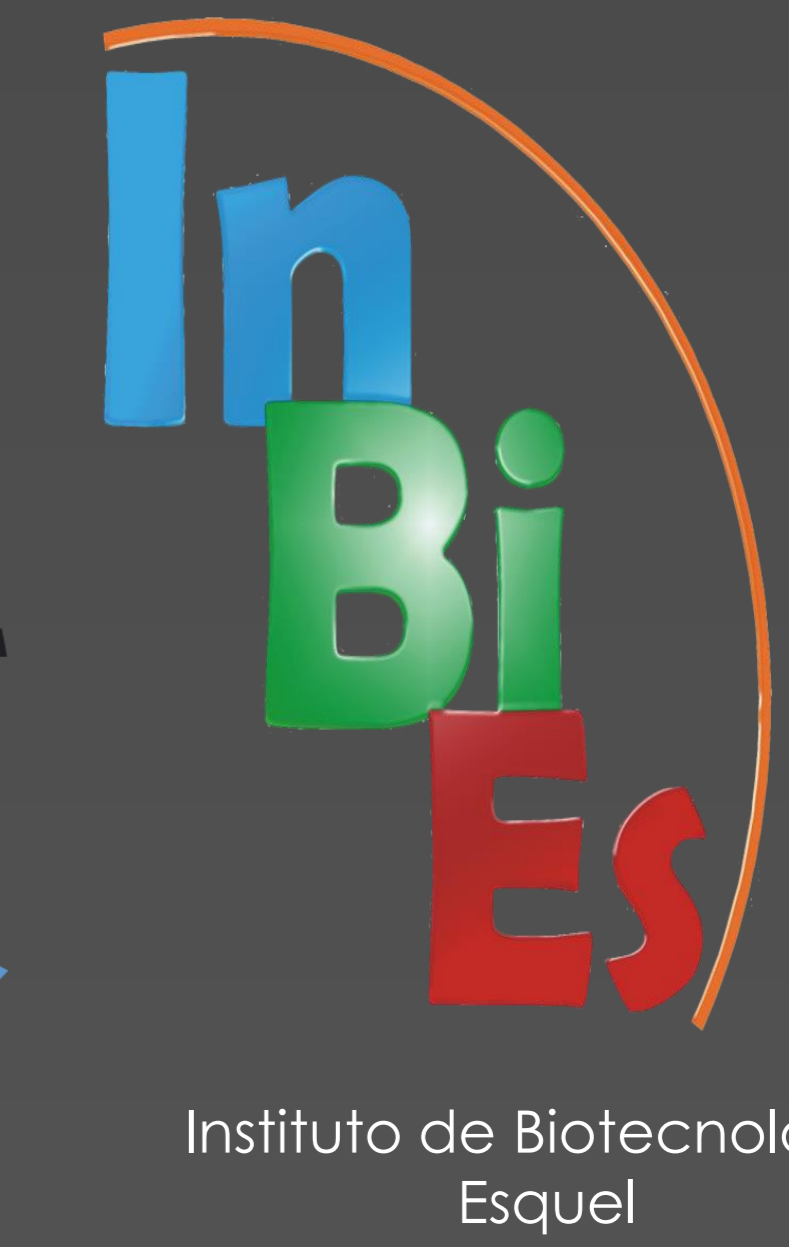
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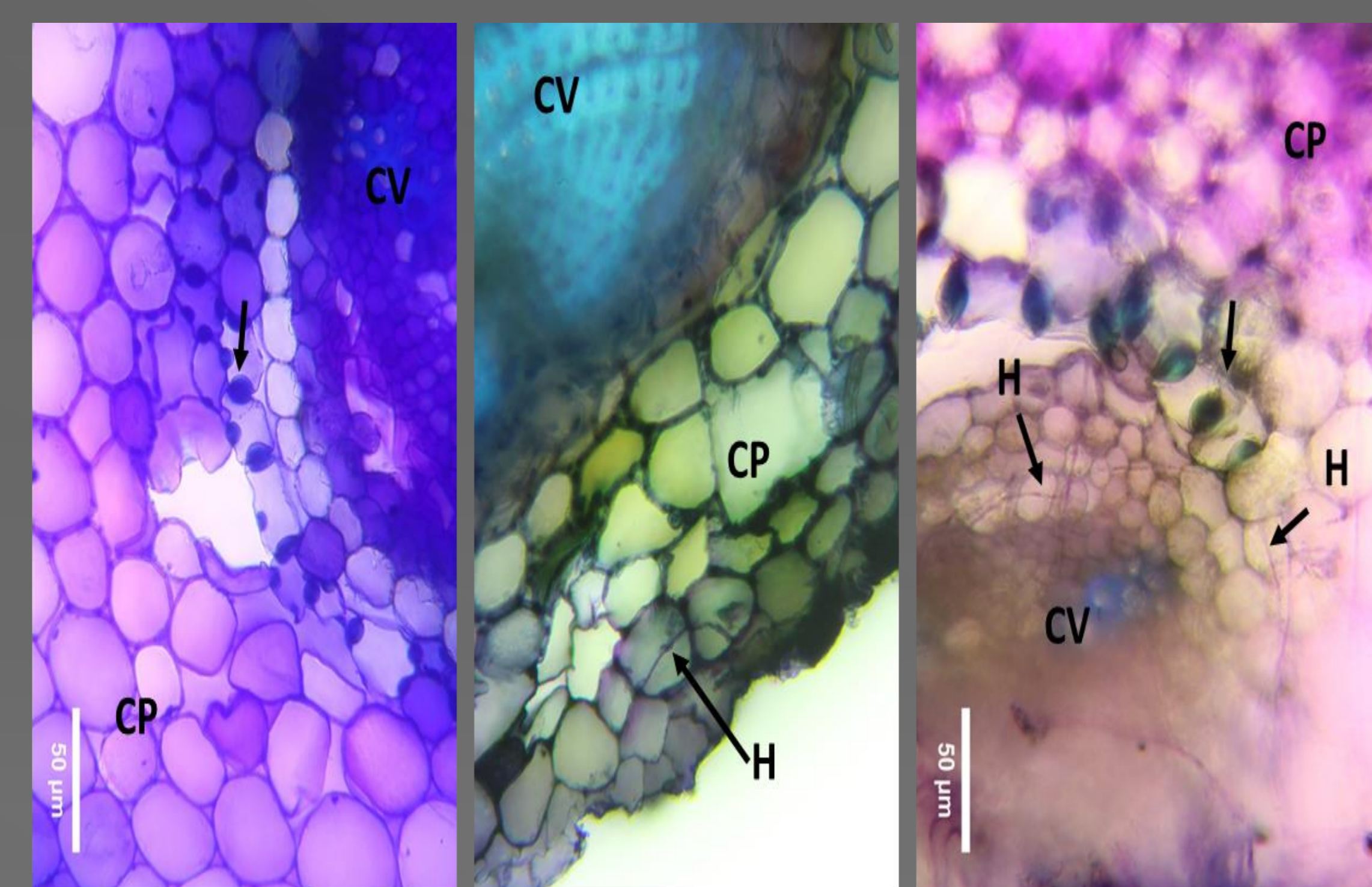
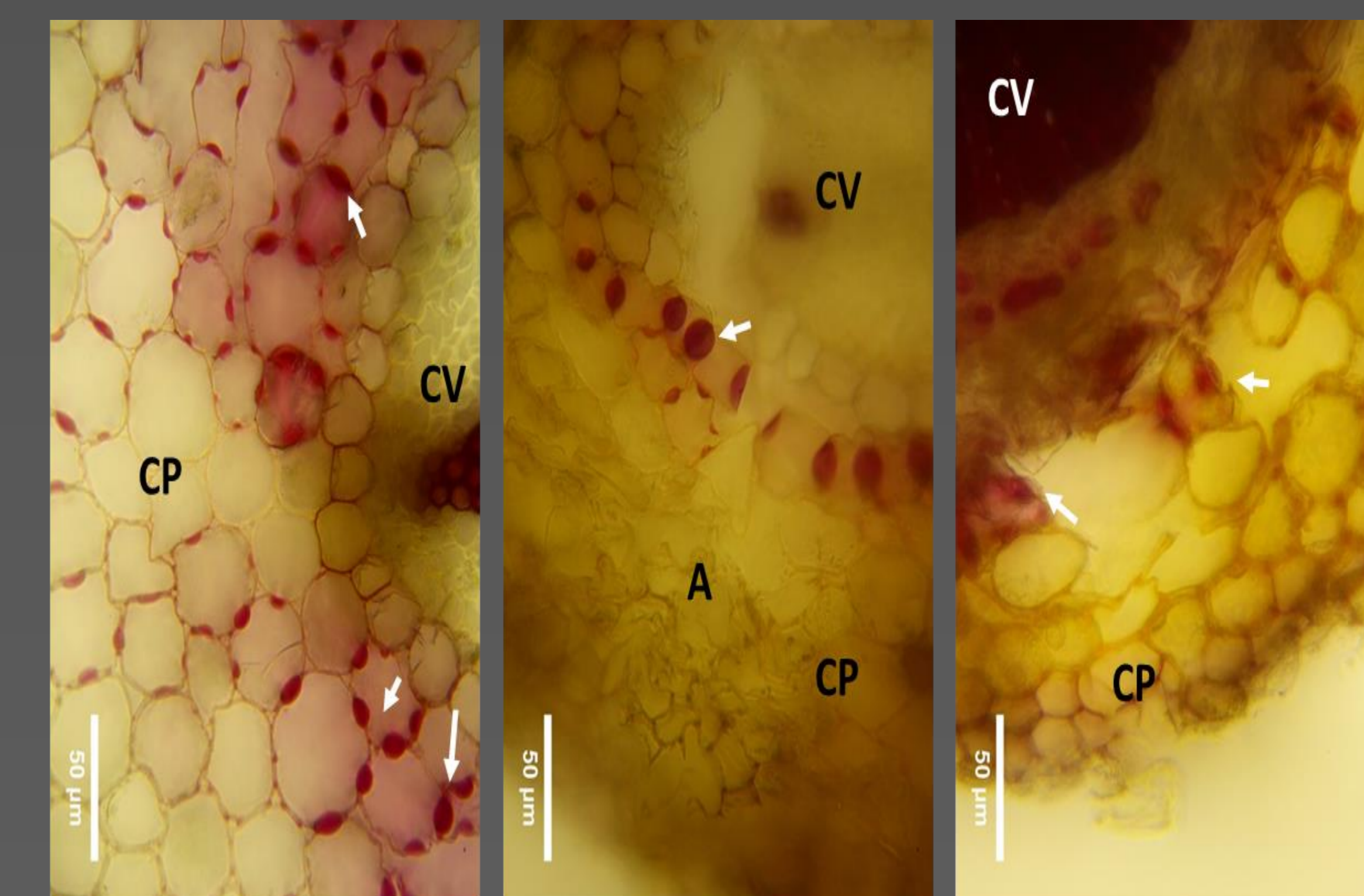
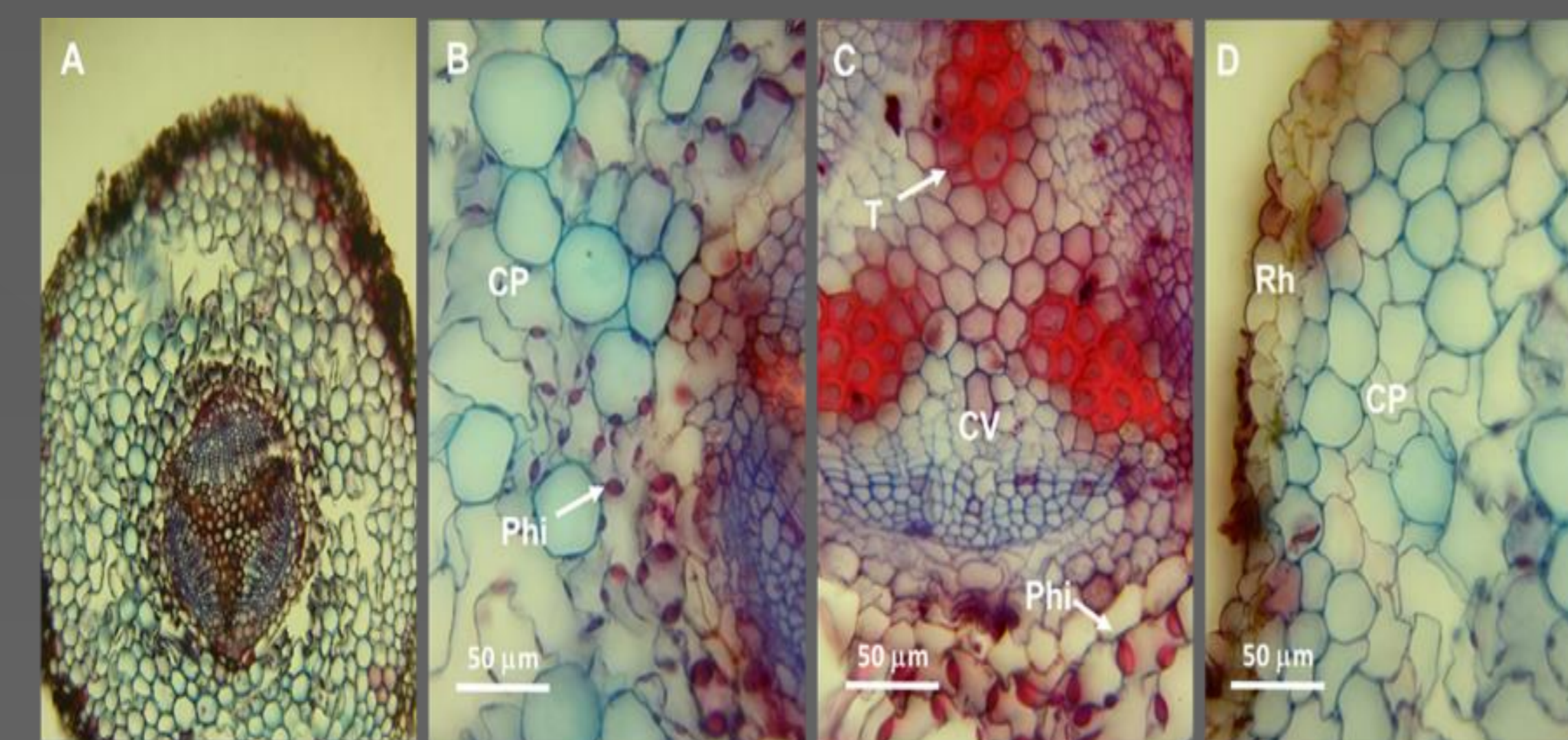
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ABSTRACT

Phytophthora austrocedri was identified as the primary pathogen causing the “Mal del ciprés” disease in Patagonia, which affects the endemic conifer *Austrocedrus chilensis*. Trees present root necrosis that may extend to the stem. This study aimed to describe the histological alterations occurring during *P. austrocedri* infection of roots of *A. chilensis* seedlings. Plants were inoculated at the roots and histological studies were performed four weeks post-inoculation. Safranin-fast green, phloroglucinol-HCl, toluidine blue, lugol and diaminobenzidine stains were used to describe and compare anatomo-histological features observed in roots of non-inoculated versus inoculated seedlings. In healthy tissues, the presence of Phi thickenings in cortical cells is reported for the first time for *A. chilensis*. In inoculated roots it was observed necrosis of the epidermis and of the cortical parenchyma, and alterations in parenchymal cells (loss of turgor and content, without starch, presence of phenolic compounds). Lignin content remained unaffected by the presence of *P. austrocedri*. The area occupied by Phi thickenings was smaller in *P. austrocedri*-colonized tissues, and these structures showed an accumulation of polyphenols, absent in healthy tissue. Parenchymal cells, tracheids, and rays, showed production of hydrogen peroxide. Results evidenced that *A. chilensis* triggers mechanisms to restrict the infection, but *P. austrocedri* manages to evade them.

Figure 3: Sections of root tissue of *A. chilensis* seedlings inoculated with *P. austrocedri* stained with phloroglucinol-HCl (400X). A. Non-inoculated healthy tissue. B. Inoculation zone. C. Advance zone. Vascular cylinder (CV), cortical parenchyma (CP), abnormality (A), arrows indicate Phi thickenings.

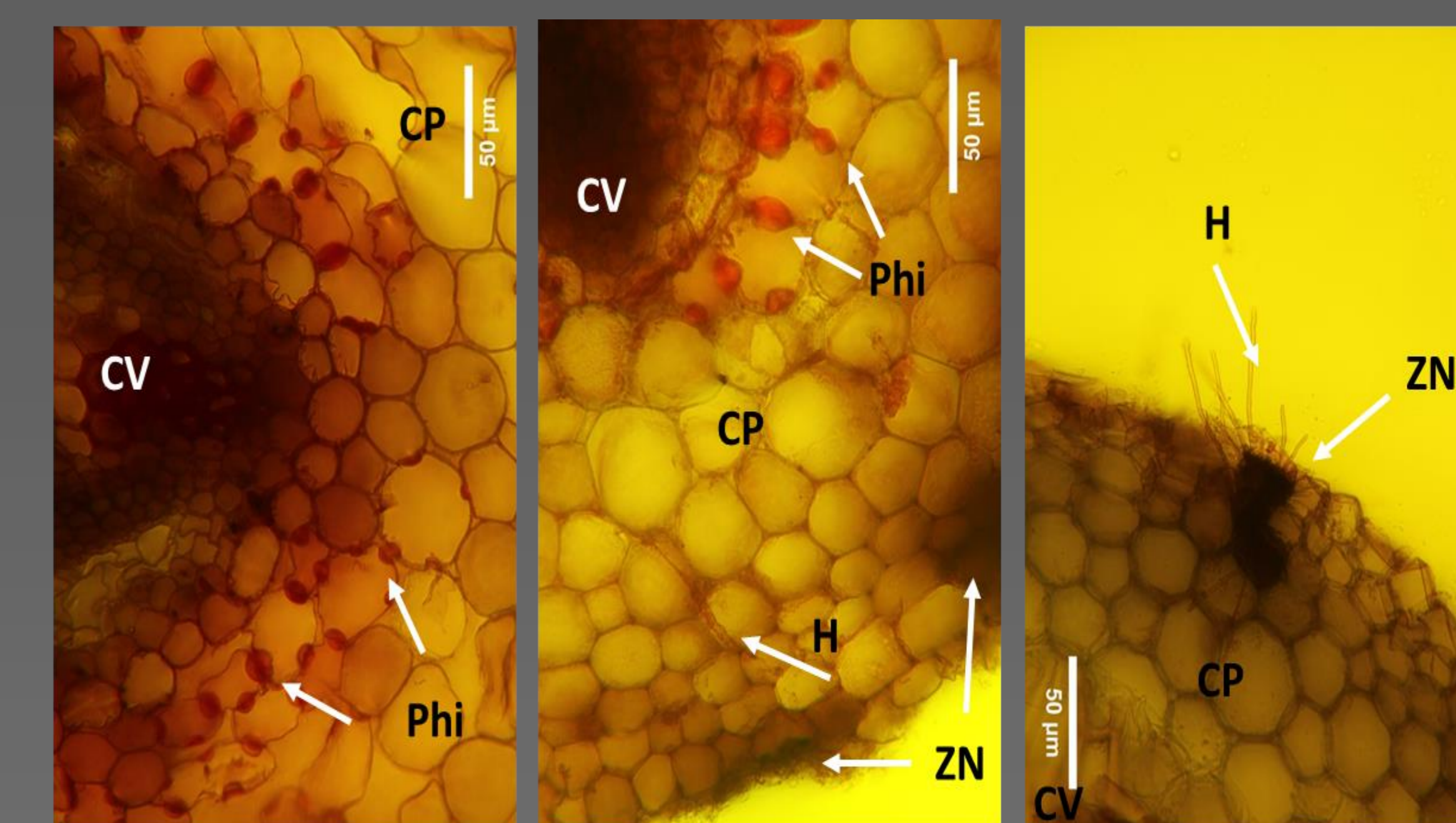


Figure 4: Sections of root tissue of *A. chilensis* seedlings inoculated with *P. austrocedri* stained with lugol (400X). A. Non-inoculated healthy tissue. B. Inoculation zone. C. Advance zone. Vascular cylinder (CV), cortical parenchyma (CP), necrotic zone (ZN), hyphae (H), arrows indicate Phi thickenings.

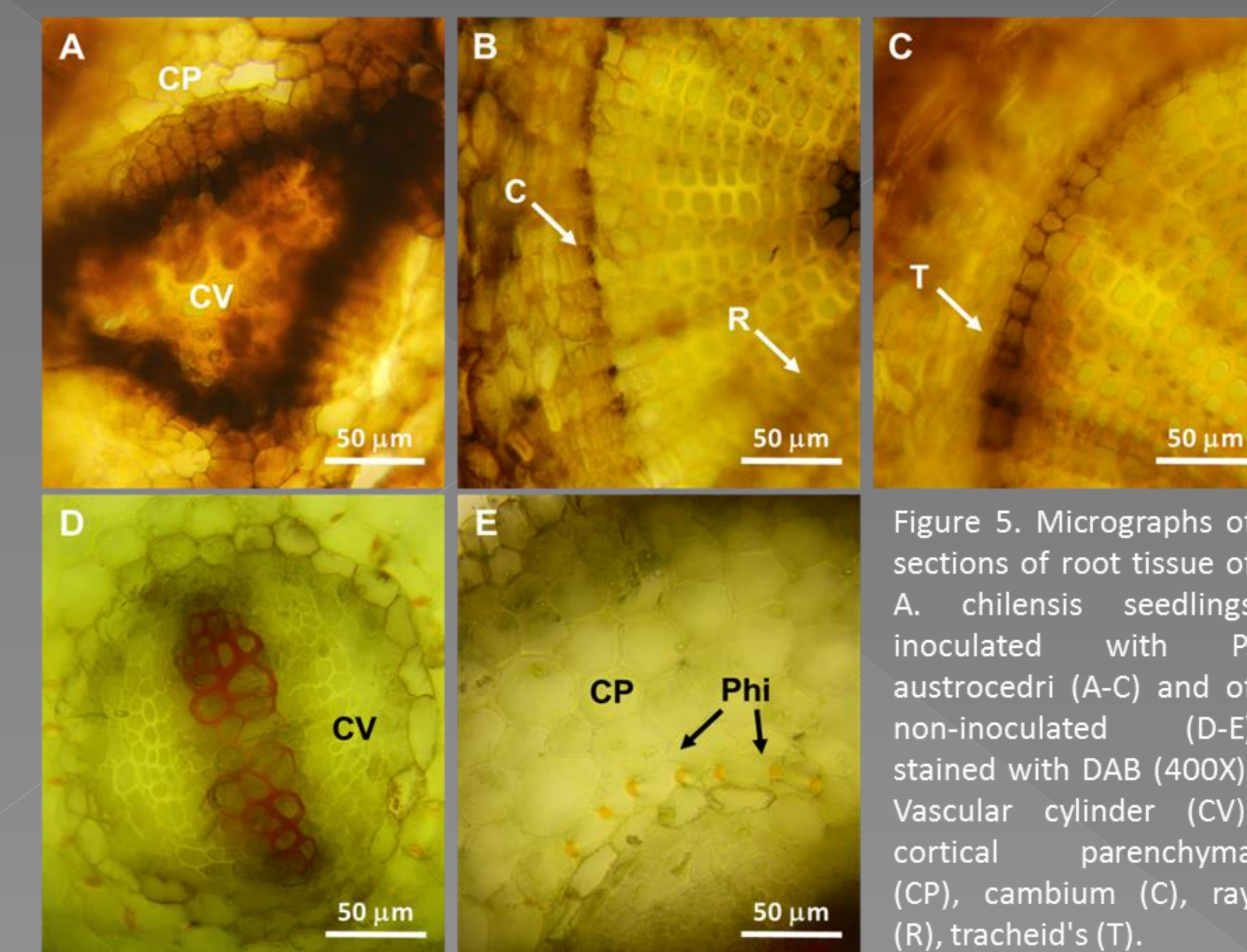


Figure 5: Micrographs of sections of root tissue of *A. chilensis* seedlings inoculated with *P. austrocedri* (A-C) and of non-inoculated (D-E) stained with DAB (400X). Vascular cylinder (CV), cortical parenchyma (CP), cambium (C), ray (R), tracheid's (T).

In conclusion this is the first anatomo-histological study done on *A. chilensis* roots. Some alterations occur in a similar way to what was observed at the stems of inoculated seedlings (Vélez et al. 2012) and at the stems of adult trees naturally or artificially infected (Troncoso 2018). Results evidenced that *A. chilensis* triggers mechanisms to restrict and resist the infection, but *P. austrocedri* manages to evade them and finally colonizes and degrades host tissues.