

The pathogenicity of the blue stain fungus *Ophiostoma clavatum* in Scots pine seedlings

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Introduction

The blue stain *Ophiostoma clavatum* (Fig.1) is the most important disease vectored by the bark beetle *Ips acuminatus* (Linnakoski et al. 2016). In recent years Scots pine mortality in trees with *I. acuminatus* galleries has increased in Southern Finland and the alpine regions of Europe following a change in climate towards warmer and drier summers (Wermelinger et al. 2008; Siitonens 2014). In this study we wanted to examine if *O. clavatum* could contribute to tree death by assessing its pathogenicity with inoculation treatment of Scots pine seedlings in a controlled environment.



Figure 1: a) *Ophiostoma clavatum* stained Scots pine branch, b) entry holes made by *Ips acuminatus*, and c) galleries under the bark. (Photos: Heikki Nuorteva).

Method

One year old Scots pine seedlings (66) were inoculated with *O. clavatum* (Fig.2). Two control groups, one of which (10) received the same treatment as the inoculated seedlings, but without mycelium, and the other (12) was left untreated. The seedlings were monitored for 8 weeks during which they were kept in stable conditions to limit environmental stress. After the observation period, the seedlings were examined for infection, and assigned a class (0-3) according to infection severity. Class 0 for no infection, class 1 < 0.5 mm staining around the lesion side, class 2 0.5-2 mm staining, and, class 3 > 2 mm staining. The seedlings were then dried and measured, and statistical analysis made of the findings. Additionally, samples from the infection site were randomly selected for later reisolation and confirmation of *O. clavatum* infection.

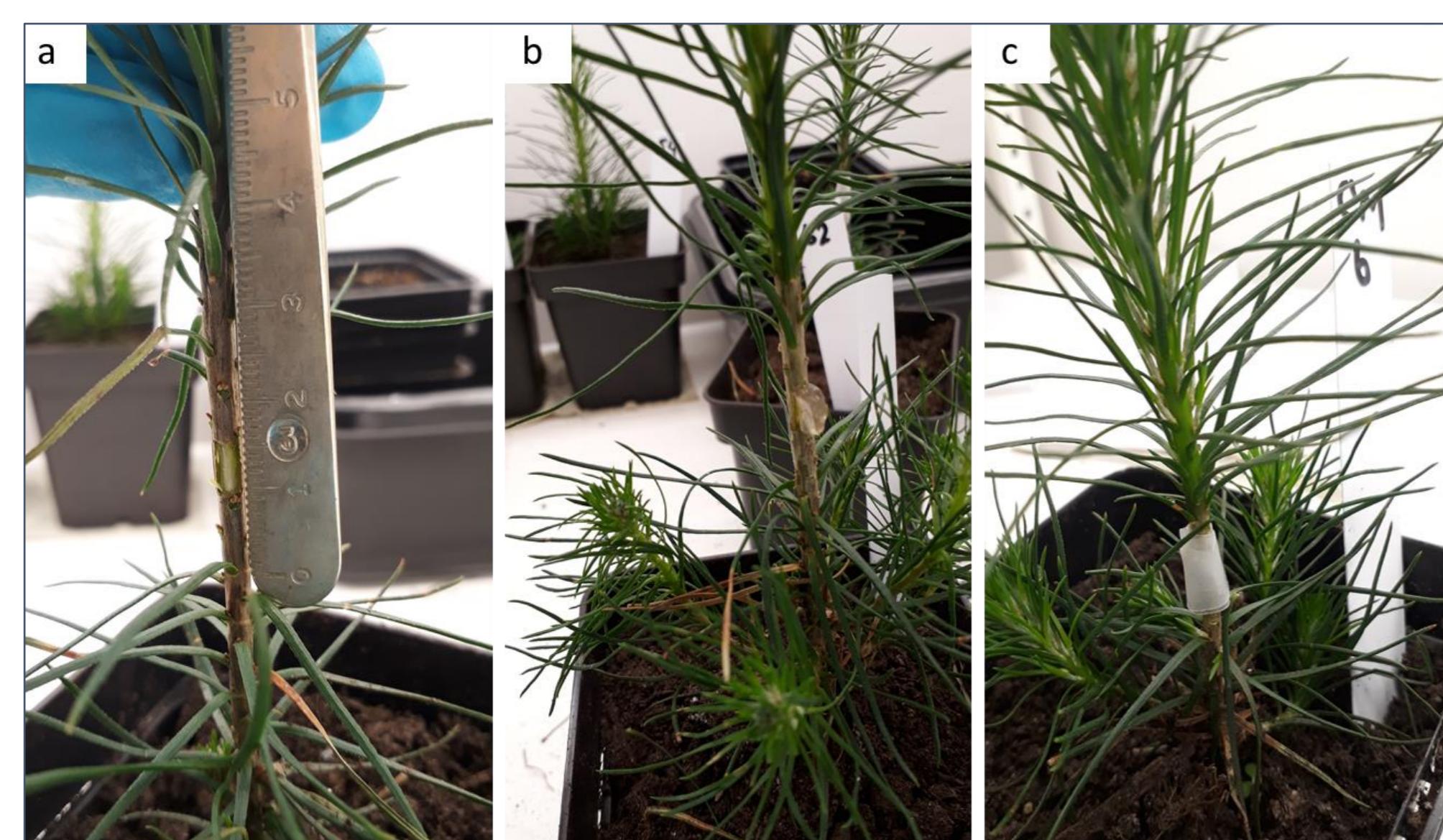


Figure 2: Inoculation method: a) small lesion cut into the woody stem, b) *O. clavatum* grown on MEA applied to the open wound, and c) the wound closed with Parafilm® (Photos: Thorhildur Isberg).

Results

During the observation period no signs of stress were visible on the seedlings. When examining under the bark around the inoculation site infection was observed in 30 of the 66 inoculated seedlings, or 45%. Spearman's test was run but found no significant correlation between the infection class and other measured components (not shown). A further ANCOVA analysis was performed where the initial size difference between the individual seedlings was the covariate. The result of that analysis showed a significant difference in total dry weight between the inoculated seedlings and the untreated control group (Fig. 3).

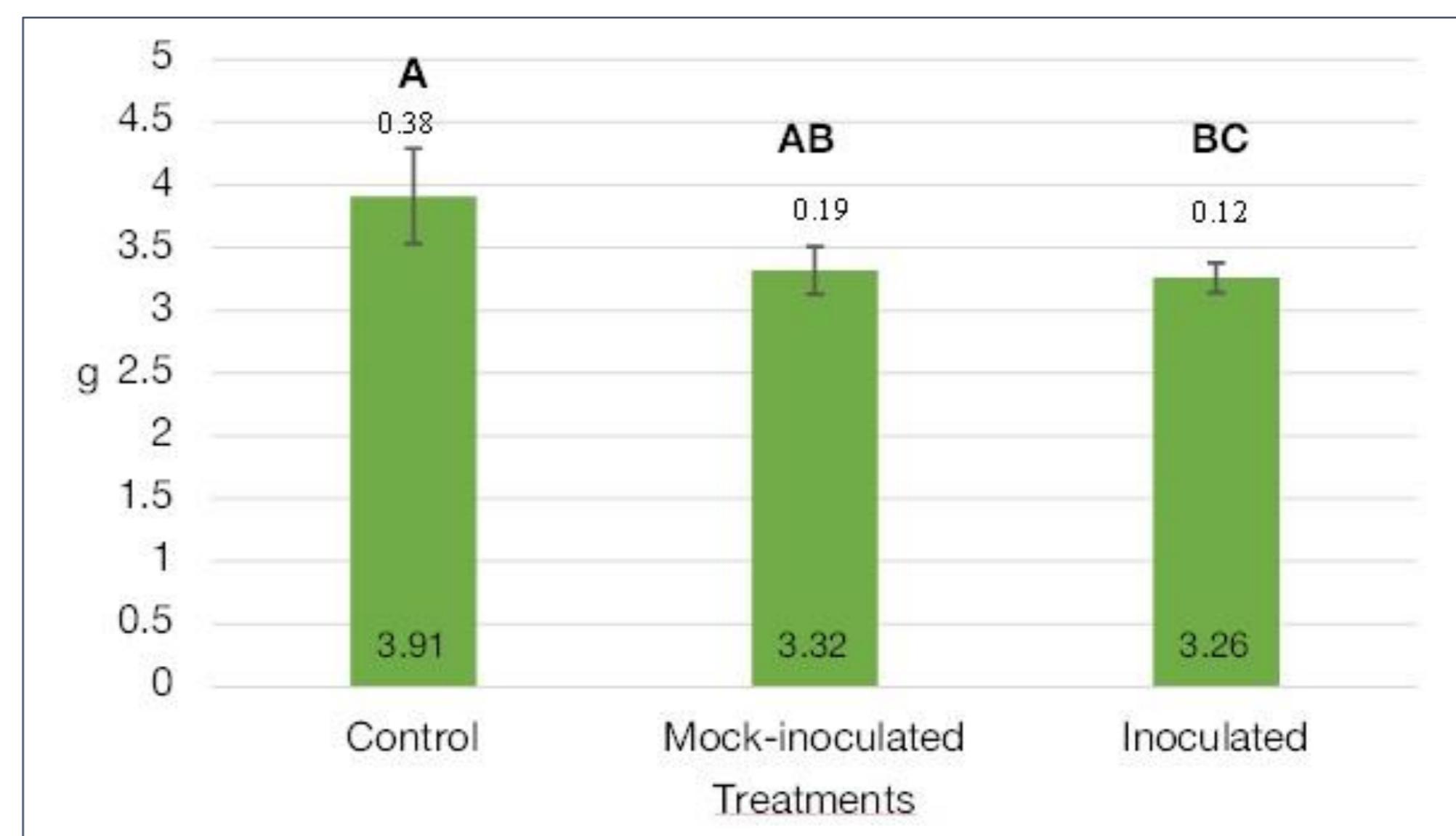


Figure 3: Results of ANCOVA test showing means and standard error of dry weight (g) of Scots pine seedlings. A significant difference is between the control group and inoculated seedlings, $P < 0.05$.

Discussion

The blue stain fungus *O. clavatum* does not seem to seriously stress Scots pine seedlings, kept in favourable conditions, when a single infection is introduced through mechanical wounding on the woody stem, and only low level of aggressiveness was detected. Scots pine mortality in recent years cannot be traced to the blue stain alone and is more likely to be caused by combination of environmental stress where a blue stain infection is one of the manifestations of increased bark beetle activity.

References

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