Molecular indicators of resistance to *Microdochium nivale* in *Lolium multiflorum/Festuca arundinacea* introgression forms

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INTRODUCTION

Lolium multiflorum (Italian ryegrass) possesses high forage quality but low tolerance to abiotic and biotic stresses. *Festuca arundinacea* (tall fescue) expresses higher winter-hardiness, drought tolerance and resistance to diseases. The intergeneric hybrids of both species and their introgression derivatives combine those complementary attributes (Perlikowski et al. 2014). Winter-hardiness is mainly associated with frost tolerance and resistance to winter pathogens. These two traits were shown to be very often negatively correlated. The molecular nature of this phenomenon has not been recognized. Snow mould, which leads to significant yield losses in crop production, is caused mostly by *Microdochium nivale*. This pathogen evokes injuries, which can lead ultimately to plant death observed soon after snow melting (Pociecha et al. 2009). In the research presented here we demonstrate the alterations in total soluble carbohydrates (TSC), phenolic compounds (PC) and abscisic acid (ABA) contents after pre-hardening and hardening periods, and also on the first and seventh day of inoculation in the BC_5 *L. multiflorum/F. arundinacea* introgression forms with distinct levels of resistance to *M. nivale* and frost tolerance.

PLANT MATERIALS

Out of 20 *L. multiflorum/F. arundinacea* forms four individuals were selected for further molecular research - two (180/30/19 and 180/30/75) with a high level of resistance and the other two (180/30/84 and 180/30/138), with no resistance to *M. nivale*. Interestingly, the forms 180/30/19 and 180/30/75 were simultaneously revealed to be less frost tolerant, compared to the other two introgression forms, analyzed here (data not shown). A scheme demonstrating a workflow of the experiment is shown in the Fig. 1. Leaves and crown tissues were harvested after seven days of pre-hardening, 21 days of hardening, on the first and seventh day of inoculation. As a control, plant tissues harvested at the corresponding time-points from non-inoculated plants, were used.

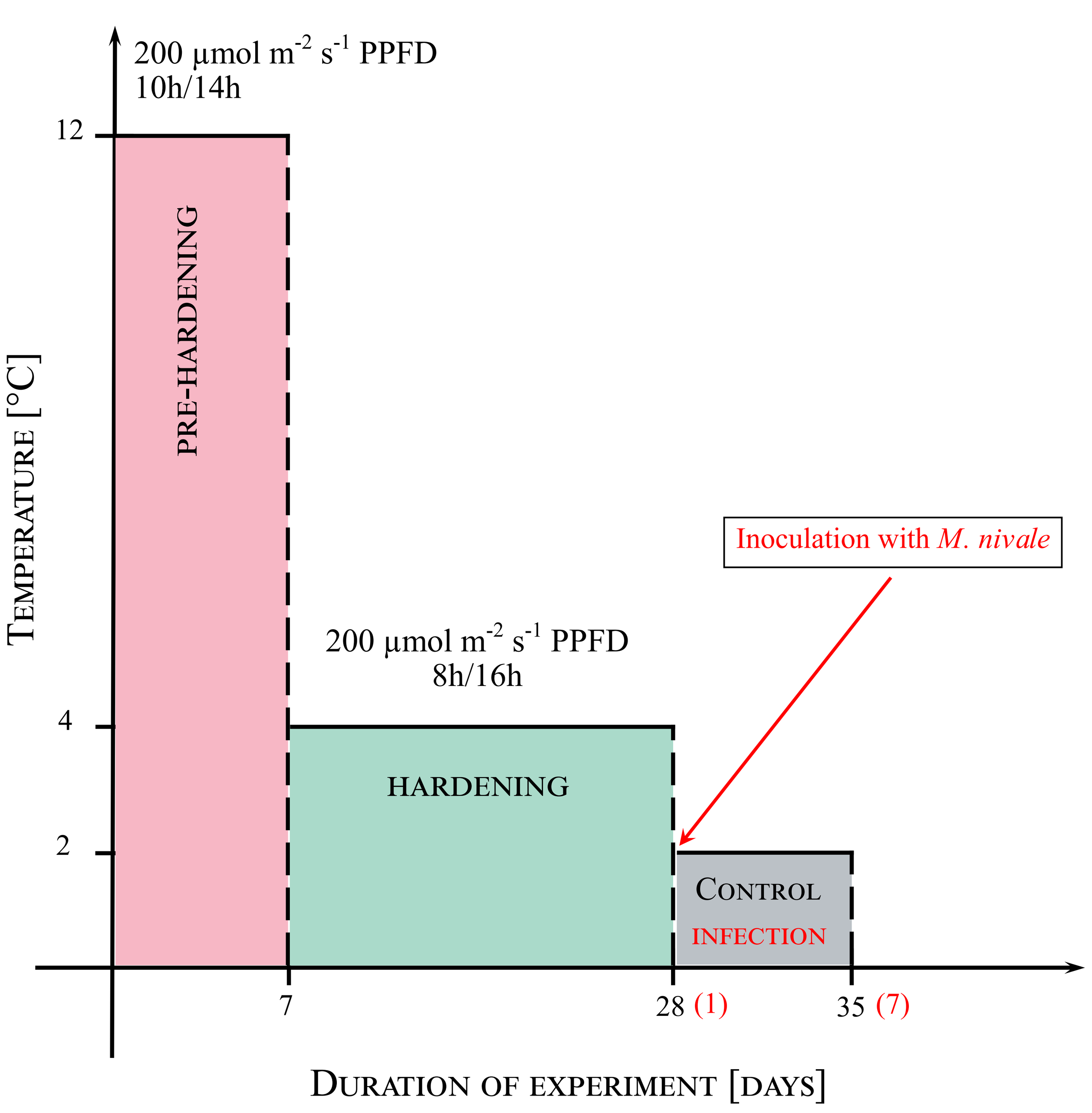

Fig. 1. A scheme demonstrating a workflow of the experiment.

RESULTS

The results of metabolites' profiling are shown in the Figure 2-4.

Fig. 2. A total soluble carbohydrates (TSC) content in leaves and crown tissues of *L. multiflorum/F. arundinacea* introgression forms after pre-hardening and hardening periods, and also on the first and seventh day of inoculation with *M. nivale*. Means of five replicates are shown. The bars marked with the same letter are not significantly different (Duncan's multiple range test, P<0.05).

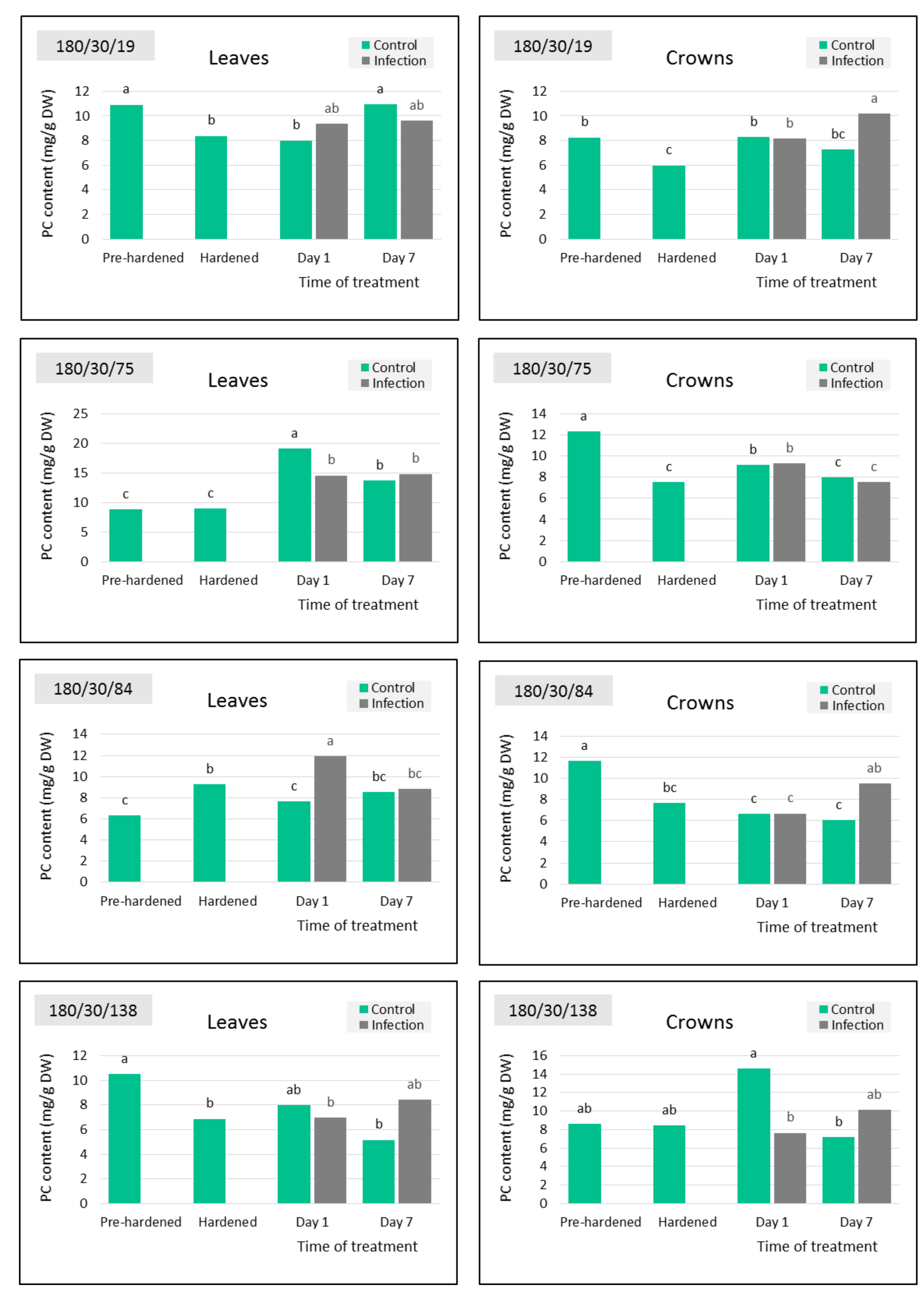

Fig. 3. A phenolic (PC) content in leaves and crown tissues of *L. multiflorum/F. arundinacea* introgression forms after pre-hardening and hardening periods, and also on the first and seventh day of inoculation with *M. nivale*. Means of five replicates are shown. The bars marked with the same letter are not significantly different (Duncan's multiple range test, P<0.05).

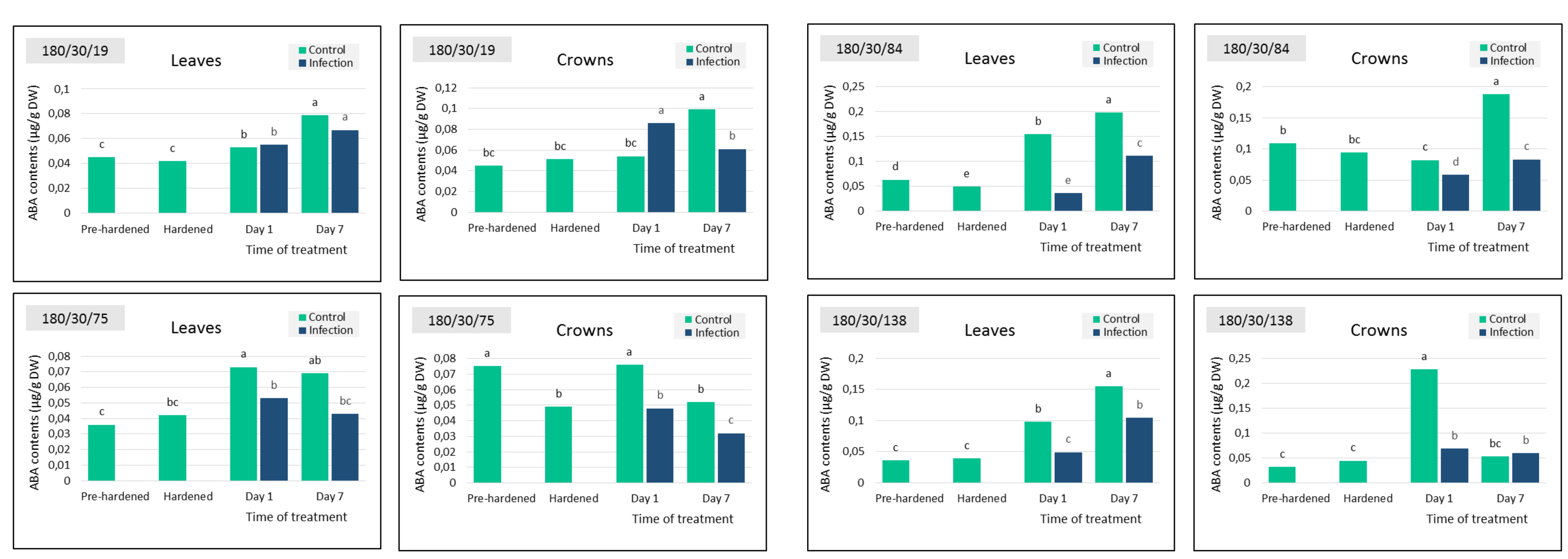

Fig. 4. An abscisic acid (ABA) content in leaves and crown tissues of *L. multiflorum/F. arundinacea* introgression forms after pre-hardening and hardening periods, and also on the first and seventh day of inoculation with *M. nivale*. Means of five replicates are shown. The bars marked with the same letter are not significantly different (Duncan's multiple range test, P<0.05).

CONCLUSIONS

As demonstrated earlier, carbohydrate components could play a significant role in the development of resistance to snow mould in forage grasses (Pociecha et al. 2013). Taking into account the total values for the group of two resistant forms and separately, for the group of two susceptible forms, the accumulation level of these primary metabolites after inoculation was much higher in the resistant individuals both in leaves and crown tissues, compared to more susceptible ones. A similar accumulation pattern was generally observed also for the PC content. The level of ABA was higher in the resistant introgression forms on the first day of inoculation and simultaneously much lower on the seventh day of inoculation in both organs, compared to the susceptible forms. The presented alterations in the analyzed metabolite profiles could be used as molecular indicators of resistance to *M. nivale* in the *Lolium-Festuca* grasses.

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