In search of alternative approaches to reduce Alternaria leaf blotch and fruit spots of apple: Testing interactions between slaked lime and sulphur lime

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Abstract

Alternaria leaf blotch and fruit spots of apple is a severe fungal disease, whose dynamic is still poorly understood and effective plant protection strategies are scares. Therefore, it is a critical task to a) understand the Alternaria dynamics, i.e. fungus-plant interactions, to b) develop alternative plant protection approaches. Here we present data of a field trail, where we tested the effect of slaked lime and sulphur lime on apple (`Gala´) leaf blotch and fruit spots. All treatments reduced leaf blotch but not fruit spots. The results revealed that positive interactions between slaked and sulphur lime do exist.

Keywords: Fungal disease, leaf necrosis, slaked lime, sulphur lime, Gala

Introduction

Alternaria leaf blotch and fruit spots have become a serious issue in the apple production of South Tyrol, but also worldwide in other growing areas (Park *et al.*, 1977; Rotondo *et al.*, 2012; Harteveld *et al.*, 2013). Particularly, the three varieties `Golden´, `Gala´ and `Pink Cripps´ are highly sensitive and in years with favourable climatic conditions, Alternaria can cause severe defoliation and thus economic losses. `Golden´ is the most sensitive variety for Alternaria, but also `Gala´ shows a substantial sensitivity against fruit attack, especially for an early infection during bloom. Beside the unpredictable epidemic behaviour of Alternaria, effective plant protection strategies are scarce in organic but even in integrated production systems. For that reasons the overall aims of our study are a) to understand possible interactions between Alternaria, site-specific factors and plant nutrition, and b) to identify alternative, plant protection strategies for both, organic and integrated production systems. In a subproject, we tested the efficacy of slaked lime and sulphur lime on Alternaria leaf blotch and fruit spots of organically cultivated `Gala´.

Material and Methods

The experimental treatments were: (1) control, (2) slaked lime (Calcce fiocco, Manica; 1,5 kg/hl), (3) lime sulphur (Polisenio; 1,5 kg/hl), (4) slaked lime + lime sulphur (1,5 kg/hl each). All treatments were tested with a randomized block design (n=4) in an organically managed `Gala´ orchard at Laimburg Research Centre, South Tyrol. The application was realized with a common field sprayer, from the pre-bloom period in March 2017 until the pre-harvest period in July 2017 (n=7). Additionally, the treatments (3) and (4) received standard scab treatments with lime sulphur (n=10). During the harvest period in July, 100 leaves per treatment*replicate*side and 70 fruits per treatment*replicate*side were evaluated for the relative frequency of infested leaves and fruits, respectively.

Data was analysed by means of F-statistics and subsequent post hoc tests (Tukey) both based on liner mixed-effect models (Pinheiro *et al.*, 2017). All data analysis was performed using R version 3.4.2 (2017).

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Results and Discussion

All treatments reduced significantly ($p<0.01$) the relative frequency of leaf blotch in `Gala´ and were statistically different from each other. The highest reduction of infested leaves showed the combined treatment of slaked lime and lime sulphur by about 75%, followed by sulphur lime with the second most reduction (60%). Mere slaked lime, having a pH of ~12.8, showed the lowest reduction by about 40%. However, this result might reflect also the different frequency of applications (7/17), but indicates on the other hand, that mere slaked lime has a high efficacy for leaf blotch, even though with ~60% less applications. But most important are the positive interactions between slaked and sulphur lime on leaf blotch which might represent a potential strategy for leaf blotch control for organically cultivated `Gala´.

By contrast, all treatments had no effect ($p=0.44$) on the fruit spots and were comparable to the control (overall mean: 4.7, sd: ±2.7; data not shown). Contrary to the variety `Golden´, where with increasing frequency of leaf blotch, fruit spots do increase, a correlation between leaf and fruit infestation was absent in our study. This different response of varieties, underlines the complexity of Alternaria and the need for variety-specific protection strategies. Moreover, an ongoing analysis indicates that the nutritional status of apple trees might play a potential role in the susceptibility for Alternaria leaf blotch (data not shown).

Finally, future research should address if the observed interactions between slaked and sulphur lime do exist under different conditions (years/sites) and are relevant for other (fungal) plant disease.

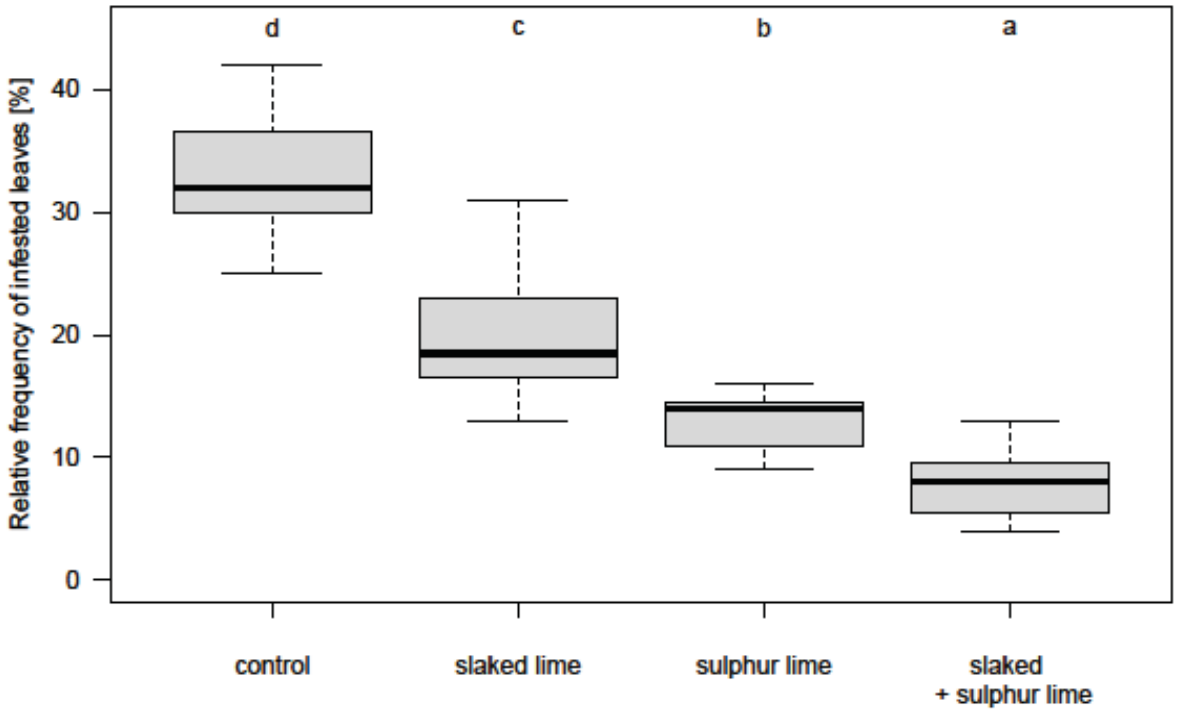

Figure 1: The relative frequency of Alternaria leaf blotch (n=4), depending on the treatment, for the apple variety **'Gala'**. Significant difference ($p<0.05$) between the treatments was tested by means of a linear mixed-effect model with a subsequent post hoc test (Tukey) and is indicated by a different letter.

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