Greenhouse-Experiments on control of *Venturia inaequalis* – First Results

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Abstract

Based on the encouraging results of the diploma thesis from Sibylle Späth in 2000 a series of experiments in the greenhouse followed in 2001 to test different extracts from medicinal plants against apple scab. The seedlings of the variety 'Golden Delicious' were infected artificially by spraying a suspension of conidia from scab infected leaves from the orchard. The plant extracts were compared with copper-hydroxid. A few extracts seem to be successful against apple-scab. In the future further experiments in the greeenhouse and in the orchard will follow to confirm the promising results and to find more information about side effects like phytotoxity, russeting or thinning.

Keywords

Malus domestica (Borkh.), Venturia inaequalis (Cooke), copper-alternatives, plant extracts, lime sulfur

Introduction

Copper is used in organic apple-growing before blossom mainly against apple scab and fire blight. Because of the danger, that copper-residues are increasing in the soil, the different associations of the organic agriculture agreed to set a limit of 3 kg Cu per ha and year. Conscious of the negative aspects of copper for the soil the longer-term aim must be to find effective alternatives for copper. In the past there were published lots of experiments with stone-meals (like Ulmasud and Mycosin), additives to sulphur, compost-extracts and different plant-strengthening preparations. Some success had been watched in years with a low infection-rate in the control. The best effects has lime sulfur, sprayed curatively close to the infection. The exact sprayings often have to be done during light rain or when the soil is still wet from rain. Lime sulfur has disadvantages, too: It tastes strongly after rotten eggs and the pH value is very high, so the user should protect himself. For the future the research should focus on alternatives to copper and lime sulfur, too.

Material and methods

Seedlings of apple cultivar 'Golden Delicious' were grown in a cold greenhouse (no additional heating). The control of powdery mildew was done by a conventional fungicide, which has no side-effects on apple-scab. Per treatment 3 x 5 seedlings were inoculated artificially. During the spring and summer 2001 four experiments were done with different plant extracts and combinations of components. Two of the experiments will be described in this article.

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The postulated effect of a treatment is characterised by the time between the sprayings and the artificial inoculation:

- Preventive = 4 to 5 hours until inoculation
- Curative = Minimum 15 hours **after inoculation**, differs from variant to variant

The different plant extracts were sprayed by a small hand-sprayer. Heavily scab-infected apple leaves from the orchard were used for the production of a conidia suspension with about 40 000 conidia/ml (experiment 1) or 55 000 conidia/ml (experiment 2). At the seedlings the age of the leaves was evaluated immediately before the treatments, the tip of the youngest grown out leaf was removed. The seedlings were sprayed with the different preparations and the leaves dried up. Then they were put into plastic bags and infected with the conidia suspension. At once the bags were closed densely, the leaves should have no contact to the side of the bags. At the day after the inoculation the bags were removed again and controlled, if there were still drops on the leaves.

After 3 to 4 weeks the first symptoms appeared. For each leaf the scab infection was classified from 0 to 4 (no severe infection). All lesions by scab cannot identified with the naked eye. For the evaluation of the germination of conidia all leaves, that were susceptible at the day of the inoculation, were removed. The conidia were shaken out with aqua dest. The number of conidia per ml was counted to judge, how active the fungus still is.

In experiment 1 the seedlings were inoculated in the late afternoon on May 10th 2001.

Table 1: Experiment 1 - preparations, concentrations and spraying strategy

Preparation	Concentration	Spraying strategy
control	–	–
Cu-hydroxid	0,1 % (w/v)	Preventive (-4 h)
Lime sulfur	2,0 % (v/v)	Curative (inoc. + 15 h)
AUSMA	0,2 % (v/v)	Curative (inoc. + 15 h, + 14 days)
F-08-1	0,4 % (v/v)	Curative (inoc. + 15 h)
F-08-2	0,4 % (v/v)	Curative (inoc. + 15 h, + 12 days)
F-EB	0,5 %(v/v)	Curative (inoc. + 15 h)
BioC	1,0 % (v/v)	Curative (inoc. + 15 h, + 12 days)
Pl-Ex 1-old (P1o)	2,0 % (v/v)	Preventive (-4 hours)
Pl-Ex 1-fresh (P1fr)	2,0 % (v/v)	Preventive (-4 hours)
Pl-Ex 2-fresh (P2fr)	2,0 % (v/v)	Preventive (-4 hours)

The spraying strategy of the preparations AUSMA, F-08-01, F-08-02, F-EB and Bio C based on the recommendation of the producer. Plant extract 1 was chosen after the interesting results of Späth (Diploma thesis in 2000). It was compared in two variants: an old one and a new produced extract. The question was, if the storage of about 6 months harmed the extract.

The aim of experiment 2 was to screen several medicinal plants on their effect on apple scab, of which fungistatic contents are known from the literature (Pahlow, 1993; Fischer, Krug 1997). The extracts were produced with simple methods depending on the preparation described for medicinal purpose, either by brewing or cooking either by alcoholic extraction. The herbal teas were cooked from dried drugs about two hours until spraying. To all spraying mixtures Vitanal sauer was added as wetting agent. **Over all preparations** the spraying strategy was **preventive**, the seedlings were sprayed in the early afternoon, the inoculation followed in the evening of June 6th 2001.

Table 2: Experiment 2 Preparations, active agents/drugs, concentrations

Preparations	Active agents/drugs	Concentration
Control	–	
Cuprozin	Cu-hydroxid	0,15 % (w/v)
Bellis perennis	Flores Bellidis	1,6 % (w/v)
Lysimachia nummulata	Herba Lysimachiae	1,2 % (w/v)
Galega offcinalis	Herba Galegae	1,6 % (w/v)
Stellaria media	Herba Stellariae Mediae	0,6 % (w/v)
Sambucua ebulus	Radix Ebuli	0,8 % (w/v)
Polypodium vulgare	Rhizoma Polypodii	4,0 % (w/v)
Dictamnus albus	Radix Dictamni	1,6 % (w/v)
Saponaria officinalis	Radix Saponariae alba	2,5 % (v/v) alcoh. extr.
Vitanal sauer	Wetting agent	0,1 % (v/v)

Except for *Saponaria officinalis* the concentrations are described as relation weight of dried drugs to necessary spraying volume.

Results and discussion

In experiment 1 the evaluation on scab on the leaves followed on June, 5th , in experiment on July, 2nd. The success of the artificial inoculation at the control plants was different, in the second trial the control was less severely infected. The reason for this phenomenon is not clear, so the wetting agent served as comparison for the plant extracts.

Table 3: Experiment 1 and 2 Preparations, scab infection on the leaves

Preparations Exp.1	Scab leaves	Preparations Exp.2	Scab leaves
Control	1,82	Control	1,30
Cuprozin	0,94	Cuprozin	0,86
Lime sulfur	1,14	*Bellis perennis (BP)*	1,06
AUSMA	2,07	*Lysimachia nummulata (LN)*	1,35
FU-08-1	1,86	*Galega offcinalis (GO)*	0,96
FU-08-2	1,75	*Stellaria media (SM)*	1,01
FU-EB	1,84	*Sambucua ebulus (SE)*	1,44
BioC	1,80	*Polypodium vulgare (PV)*	0,68
PI-Ex 1-old (P1o)	1,50	*Dictamnus albus (DA)*	1,51
PI-Ex 1-fresh (P1fr)	1,73	*Saponaria officinalis (SO)*	0,74
PI-Ex 2-fresh (P2fr)	1,92	Vitanal sauer (Vit)	1,26

The average of the scab on the leaves calculated like this: Sum of the value for infection for each leaf / sum of the number of leaves. The value˚0¤ means, that all leaves are free from scab.

As a further criterion for the influence of the sprayed preparations the conidia were shaken out from the infected leaves. There were watched some differences to the evaluation of scab by the naked eye.

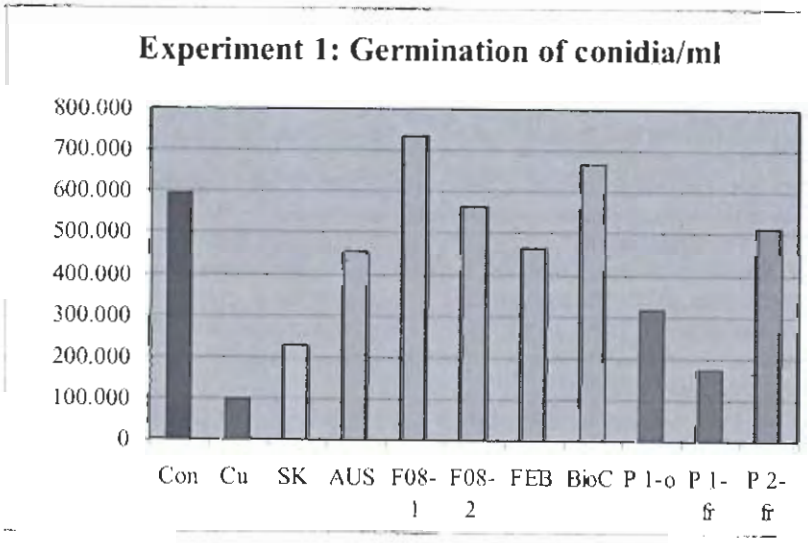

Diagram 1: Germination of Conidia/ml in experiment 1

Copper-hydroxid didn't suppress scab at all at the chosen concentration, even if the germination of conidia was the lowest of all preparations. Lime sulfur had been sprayed on the wet leaves about 15 hours after the inoculation, but the effect was not so strong. Plant extract 1 from fresh production was the best behind copper. No wetting agent had been used, so the active agents were probably not spread fine enough over the leaves.

Diagram 2: Germination of Conidia/ml in Experiment 2

The production of conidia in the control was not so high, some plant extracts increased the infection by scab. Preparations from *Polypodium vulgare and Saponaria officinalis* showed good effects on scab. Especially the last one is not able to suppress the first lesions, but the germination of conidia is reduced very strongly, this could be caused by the saponins, which are an essential content of that plants.

For the spring 2002 experiments are planned outside with potted seedlings under the conditions of natural ascospore-potential. The effects of the extracts on the blossom, the young fruit (russeting?) or on beneficial arthropods have to be proofed.

Literature Cited

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