# Recent results from field-experiments with yeast-extract to reduce the primary ascospore inoculum of *Venturia inaequalis*

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## Abstract

*The aim of this research project is the reduction of the primary ascospore inoculum of* Venturia inaequalis *by using a brewery yeast extract (Leiber GmbH, Bramsche, Germany). After leaf fall, the yeast extract was sprayed on apple scab infected leaves on the soil. The conditions for the yeast extract application and leaf litter decay by earthworms (*Lumbricus terrestris*) during winter were optimal when the soil had a temperature above 5 °C in 5 cm depth and a sufficient humidity. Significant effects of the yeast extracts on the amount of remaining leaves and reduction of ascospore potential in spring could be found in several field trials. The application with a 10% yeast extract showed a great efficacy and reduced ascospore discharge. In comparison to untreated control the acceleration of decay of scabbed leaves was several weeks in spring. Further factors can influence the leaf litter decay like time of leaf fall, apple cultivar, and weather conditions. The results suggest that treatment of leaf litter with a yeast extract can almost completely eliminate ascospore inoculum in spring. Therefore, yeast extract treatments could be an important phytosanitary method for apple scab control in organic fruit-growing.*


**Keywords:** *Venturia inaequalis*, apple scab, leaf litter, ascospore potential, organic fruit production

## Introduction

In March 2015 the research project "Development of a brewery yeast product to control apple scab in leaf litter" (FKZ 2814IP012) has been started, based on the results of BÖLN-Project FKZ BÖLN 2809OE103 (Kollar & Pfeiffer 2013; Rüdiger et al. 2012). The project is a cooperation of Julius-Kühn-Institute (JKI Dossenheim), LVWO Weinsberg and Leiber GmbH in Bramsche. The aim of this research project is the development of a marketable yeast extract for apple scab management. The dried brewer's yeast was tested also in a further study (Porsche 2015). One main effect of the extract is the reduction of leaf litter by earthworm activity (*Lumbricus terrestris*) and increased microbiological activity (Porsche et al. 2016). One purpose of this study was to optimize frequency and timing of leaf litter treatments to develop reliable application recommendations (number and timing) for the growers. Ten yeast extracts had been tested, which differ in grade of processing and content of bitterns from hop. Here the results of the best extract (regarding effect and price) will be presented.

## Material and Methods

Scab infected apple leaves from the cultivar \`Jonagold\` were collected from an organic orchard in Germany (Friedrichshafen). The leaves were dried and placed directly onto the soil or grass (tramline) in the experimental orchard in Heuchlingen of the State Research Institute for Viticulture & Pomiculture (LVWO) in Weinsberg. The leaves were exposed on

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3rd of November 2016 in a wooden frame covered with wire mesh (85 cm x 59 cm = 0.5 $m^2$, each 250 g dry weight (DW) leaves). A few hours before the treatment started, the yeast extract powder was dissolved in hot water. A small amount of foam stop preparation (Lebosol) was added to avoid strong foaming. Application dates and treatments are presented in Table 1. All yeast extract solutions were sprayed with a hand sprayer on top of the leaves (approximately 150 ml). The yeast extract treatments were performed up to three times between the end of November 2016 and the beginning of March 2017 (T1 = 30.11.16, T2 = 15.12.16 and T3 = 03.03.17).

At the beginning of the experiment, each depot was completely covered with apple scab infected leaves. The visual evaluation of remaining leave litter (%) was performed regularly. From each depot, 10 leaf samples were taken between March and June 2017 to determine the ascospore potential by using the water bath method (Kollar 1998). Data collected from weekly ascospore counts were combined for each treatment. Means were separated by oneway ANOVA and significance was assessed at $\alpha = 0.05$. The percentage of the remaining leaves in the depots on 06.04.17 was the base for the combined quantification of summarized ascospore potential in 2017.

Table 1: Yeast extract-treatments and frequencies for leaf litter applications on the soil and grass in winter 2016/2017, three replications per variant.

| **variant** | **description of variant** | **treatment (x)** | | |
|---|---|---|---|---|
| | | T1 = 30.11.16 | T2 = 15.12.16 | T3 = 03.03.17 |
| | SOIL (trial 1, variants 1-8) | | | |
| 1 | Untreated control (soil) | | | |
| 2 | Yeast extract *Leiber* 10% | x | | |
| 3 | Yeast extract *Leiber* 10% | | x | |
| 4 | Yeast extract *Leiber* 10% | | | x |
| 5 | Yeast extract *Leiber* 10% | x | x | |
| 6 | Yeast extract *Leiber* 10% | | x | x |
| 7 | Yeast extract *Leiber* 10% | x | | x |
| 8 | Yeast extract *Leiber* 10% | x | x | x |
| | GRASS (TRAMLINE, trial 2, variants 1-6) | | | |
| 1 | Untreated control (grass) | | | |
| 2 | Yeast extract *Leiber* 10% | x | | |
| 3 | Yeast extract *Leiber* 10% | | x | |
| 4 | Yeast extract *Leiber* 10% | x | x | |
| 5 | Yeast extract *Leiber* 10% | | x | x |
| 6 | Yeast extract *Leiber* 10% | x | | x |

## Results

In the mid of December 2016 approximately 90% of the annual leaf fall had occurred. In autumn and at this stage, the humidity of the soil was low. In the first weeks after treatment, there was almost no leaf litter decay (Fig. 1). In the last years before, the decay has started about middle of December. In 2017 it was limited by temperatures of the soil below 5°C and strong frost at end of January. In the first week of February, when soil temperature increased, the leaf litter decay progressed continuously.

All yeast extract variants (except for 0-0-T3) caused an improvement in leaf litter decay in comparison to the control. Within the variants deposited on soil (trial 1) the best reduction of leaves was achieved by the variant T1+0+T3 (Figure 1). The leaf litter decay was enhanced up to 30% compared to control. Three treatments had no better effect than two treatments.

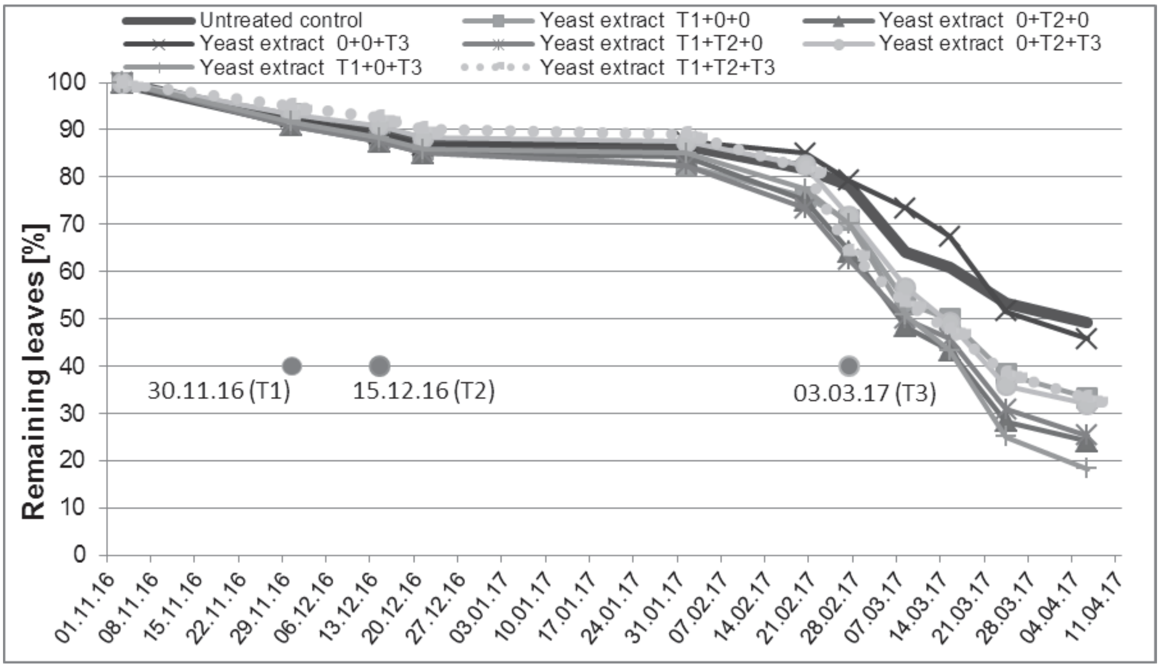


Figure 1: Decomposition rate of apple scab infected leaf litter on the soil due to earthworm activity. Leaf litter depots were treated on different dates (30.11.16/15.12.16/03.03.17, marked as grey point).

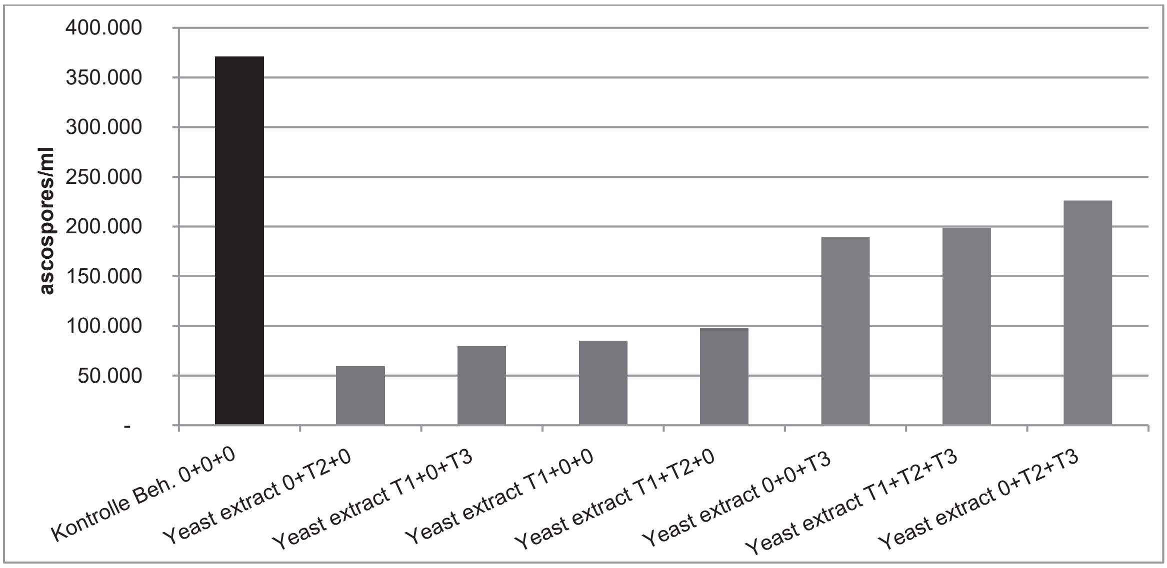


Figure 2: Summarized ascospore potential in the primary apple scab season 2017 (trial 1, leaf litter depots on the soil) 2017.

Statistical analyses were done for all dates, but because of the variability between the three replications, partly due to small differences in soil structure and due to the fact, that in many treated depots no leaves were left for collecting samples, no significances could be found in trial 1.

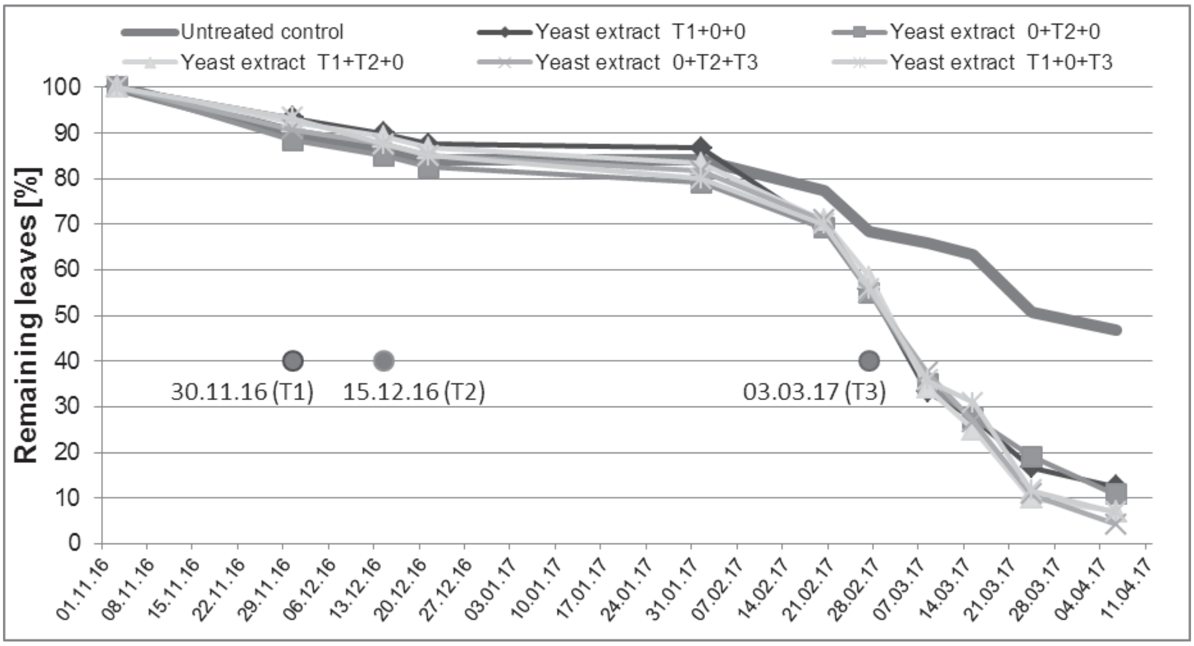


Figure 3: Decomposition rate of apple scab infected leaves (trial 2, leaf litter depots in grass, similar to tramline) due to earthworm activity. Leaf litter depots were treated on different dates (30.11.16, 15.12.16, 03.03.17, marked as grey point).

In the grass (tramline), leaf litter removal and decay by earthworm activity was higher in depots treated with a yeast extract compared with the untreated control. Only 4 up to 12% of the initial leaf material remained in the depots compared to 46% in the control (better efficacy than in depots on soil). No differences in leaf litter decay could be observed between one and two fold treated depots.

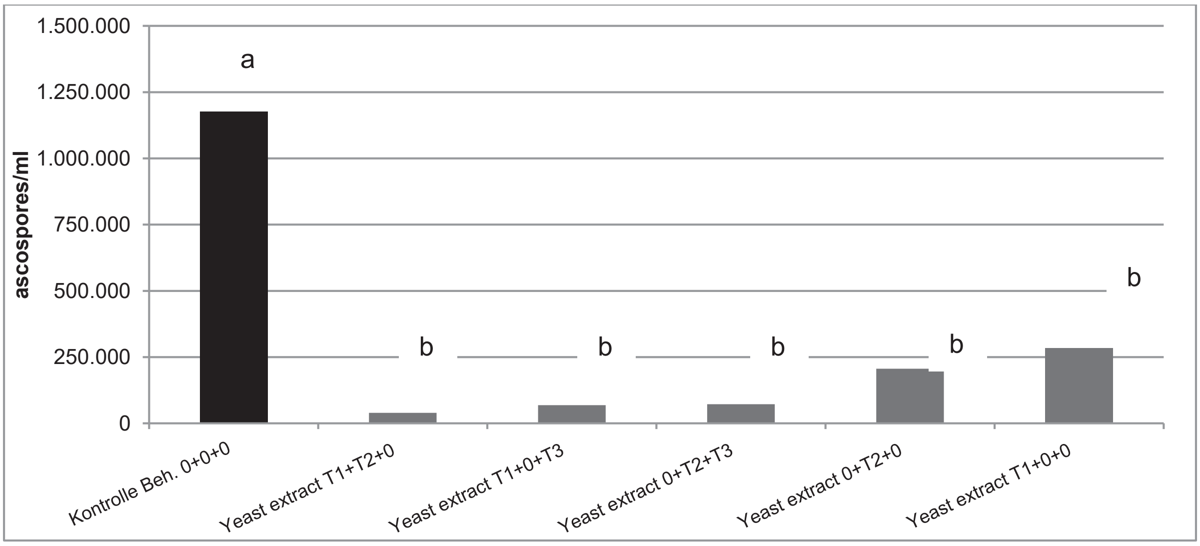


Figure 4: Summarized ascospore potential (trial 2, leaf litter depots on the grass /tramline) in the primary apple scab season 2017. Statistical analysis: ANOVA oneway, α = 0.05, tukey-test.

In the grass depots (trial 2, figure 4), the summarized ascospore potential in the control was 1.176.000 ascospores/ml. The most effective yeast extract treatment had a level of 39.700 ascospores/ml. In the depots on the soil (trial 1, figure 2) the control had a lower level of 372.000 ascospores/ml. The best yeast extract treatment had a level of 59.250 ascospores/ml (trial 1, on soil).

## Discussion

The present study demonstrated that treating leaf litter with a yeast extract resulted in a reduction of ascospore discharge in the following spring. The results are similar to those obtained by Rüdiger et al. 2012 and Porsche 2015. In spring 2016 (dry weather), first results indicated that the ascospore potential can be higher in leaves exposed on grass compared to leaves on soil (unpublished). In 2017, a comparison between different leaf litter treatments on soil and grass were performed. The ascospore potential was approximately three times higher than in leaves exposed on grass. Possibly, more dewdrops in the grass led to a better ascospore development. The cause of this effect should be investigated in further studies.

In 2016, the LVWO Weinsberg performed yeast extract treatments with standard plant protection equipment (e.g. special nozzles) in the orchard in Heuchlingen. In winter 2017/18 the experiments will be repeated. Different concentrations, dates and numbers of treatments will be tested. A powdery formulation will be compared with a liquid formulation of the yeast extract. In addition, the efficacy of applications on the foliage of the trees will be tested. The project will end in mid of August 2018.

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