

Results of an experiment on storage diseases at the apple variety Pinova

Pfeiffer Barbara¹

Abstract

Tema-Extrakt, a yeast preparation, FZB 24 (*Bacillus subtilis*) and a malt extract were proofed on their suitability for control of storage diseases in autumn 2000 in an organic orchard at Lake Konstanz. The preparations were sprayed three times before harvest on the apple variety 'Pinova'. In December 2000, February 2001 and at the end of March 2001 the decay through *Gloeosporium* was evaluated. At the end of March in the control only 12 % of the fruits were without or with only very weak symptoms. The best treatment were malt-extract (23%) and *Bacillus subtilis* (24 % in the lowest classes of disease). But the efficiency is too weak to advise this preparations for organic fruit growers. Attention should be payed in the orchards on the kind of growing of the trees, how long it lasts, until the trees drie up, and especially on the sources of infections on the wood.

Keywords

Apple, *Gloeosporium spp.*, *Bacillus subtilis*, *Equisetum*, malt-extract, yeast

Basic information about *Gloeosporium*, situation at Lake Konstanz

During the storage-period in winter 1999/2000 organic apple growers at the Lake Konstanz suffered heavy losses through *Gloeosporium spp.*, especially at the variety Pinova. In the past experiments on storage diseases in Weinsberg were done in 1989, 1992 and 1995. There the loss in the control had not been very high because of the young age of the trees.

Round Lake Konstanz both species of *Gloeosporium* (*G. alba* and *G. perennans*) can be watched. On the fruits appear round light or dark brown rotting parts. At high humidity of the air grey or yellow or light red spore cumuli can be seen. The infection itself can be set very early during the development of the apples: The fungus penetrates through wounds or lenticels, but the symptoms appear very late on storage, when the fruits reach a special stage of ripening.

The overwintering is possible on branches (as mycelium), dieing parts like on rests of apples in the trees (also fallen fruits on ground), stigmata of fallen leaves, wounds from cutting, on fallen leaves and on other host plants. *Gloeosporium malicorticis* causes damages on the bark, too, in that case copper is not efficient. In the past different connections were found between the colour or the constitution of the fruits and their susceptibility for *Gloeosporium*: Content of the sum of phenols (HULME, EDNEY 1960), benzoic acid (NOBLE, DRYSDALE 1983), Ca-nutrition (VERHOEFF 1974). The position within the tree seems to play a role, too (SCHULTE 1997).

¹ LVWO Weinsberg, Traubenplatz 5, D-74189 Weinsberg, Germany

SCHULTE (1997) postulated, that a combination of high humidity with long leaf-wetness encourages the infection. The susceptibility of the fruits is given through the whole summer and increases before harvest. On CA- or ULO-storage conditions the symptoms appear only later, but they are not suppressed at all.

Conception of the experiment 2000

Near Lake Konstanz in an orchard, which is grown after the rules of DEMETER, an experiment started in August 2000. The variety was 'Pinova' on woodstock MM 106, planted in 1982 (3,50 m x 1,40 m). The trees were very dense and about 3,50 m high. Each treatment was repeated three times, 7 trees per parcel. For the storage apples were picked from the 5 trees in the middle of each plot.

Table 1: Survey of the treatments

Number	Preparation	Concentration	Short description
1	control	-	Not treated, no water
2	Tema-Extract	5 % (vol./vol.)	Fa. Biofa, based on <i>Equisetum arvensis</i> + silica-acids
3	yeast	3 % (vol./vol.)	Selected by Fa. Biosystem
4	FZB 24	0,2 % (w./vol.)	Fa. Bayervital <i>Bacillus subtilis</i>
5	Malt extract	3 % (w./vol.)	Fa. Linco, extract from Demeter-barley-malt, very glutinous, has to be dissolved in warm water

Per tree 430 ml spraying mixture had been sprayed with a portable motorsprayer (Solo). The dates of spraying were 16.08.01 (sun shining, hot), 29.09.01 (70 % clouded, chilly) and 29.09.01 (warm lightly clouded, yeast not delivered). On 11.10.01 only the yeast parcels were sprayed (chilly, rain beginning afterwards). Because of the delayed postal transport the efficiency of the yeasts could have been influenced negatively.

FZB had been tested in the past against *Phytophthora cactorum*/strawberries and *Phytophthora infestans*/potatoes. Malt-extract was discussed to be successful against *Phytophthora*/potatoes. But after the vegetation period 2000 great disillusionment took place.

On 11.10.01 per parcel 125 apples (without large damages) were picked and put into wooden boxes in two layers to control the development of each apples during the storage period. The atmosphere was held on 3,5 C temperature air, 95-97 % relative humidity and normal conditions concerning O₂ and CO₂.

Evaluations during storage period

Before storage on October 26th to 28th the colour and the russetting was evaluated in four classes. Damages through hail or moths, scab, sooty blotch, dark

lenticels and beginning symptoms of *Gloeosporium* were registered. Extremely bad apples were removed. On December 18th/19th the increase of scab, sooty blotch, lenticel spot, *Gloeosporium* and further storage diseases was controlled and bad apples were removed again. The next evaluations in 2001 followed on February, 20th, the last on March 29th.

Results

Colour and Russetting

Still until the beginning of the actual storage-treatments the apples had been damaged by hail and were heavily russeted by the typical organic sprayings probably in the few weeks after blossom. The percentage of apples with more than 30 % russeted skin was about 65 % over all. The trees are very high and dense, so the percentage of bad coloured fruits was high (70-80 % of the fruit had < 50% red colour). The sprayings had nearly no influence on colour and russetting.

Lenticel-spots and *Gloeosporium*

The grade of infection by *Gloeosporium* was divided into 6 classes: L0 = without any spot, L1 = very small dark rims round the lenticels, L2 = a few small spots, L3 = 2-3 middle spots, L4 = few large spots, L5 = large rotting parts over the whole apple.

Other diseases appeared very seldom and could be watched after small wounds at the skin like nearby hail-stigmata, prints by stalks, hurts by nails of the wooden box.

In the following tables partly the evaluation-classes are summed up. L2 means for the customer, that he will get problems at shelf-life. Apples put into category L3, L4 or L5 cannot be sold at all. Apples with a *Gloeosporium*-infection taste bitter. Diagram 1 shows the development in the control of the percentage L0 and L1 from October 2000 to March 2001. 100 % are the number of picked apples in October. Already in October only 55 % of the apples had absolutely no symptoms of *Gloeosporium*. At the end of storage in March 2001 this class decreased to 0,8 %.

The differences between the treatments were not very high. The infection grade varied from repetition to repetition, so no significances could be proved.

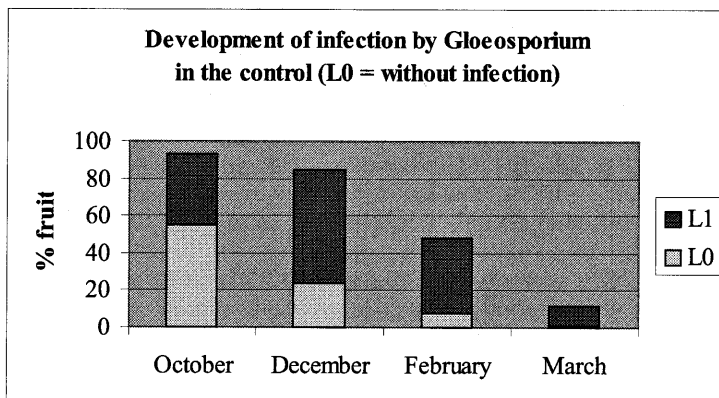


Diagram 1: Development of infection by *Gloeosporium* in the control (higher classes L2, L3, L4 and L5 were left out)

Table 2: % infected apples in December 2000

Treatment	L0	L1	L2+L3	L4
control	24,0	60,8	11,2	1,6
Tema-extract	25,3	65,3	6,5	0,3
yeast	36,4	54,3	5,1	1,6
Bac. Subtilis	40,7	51,1	6,1	0,5
Malt-extract	30,7	55,5	5,1	0,6

Table 2 shows the distribution in the single categories in December, when the first apples started to become less hard.

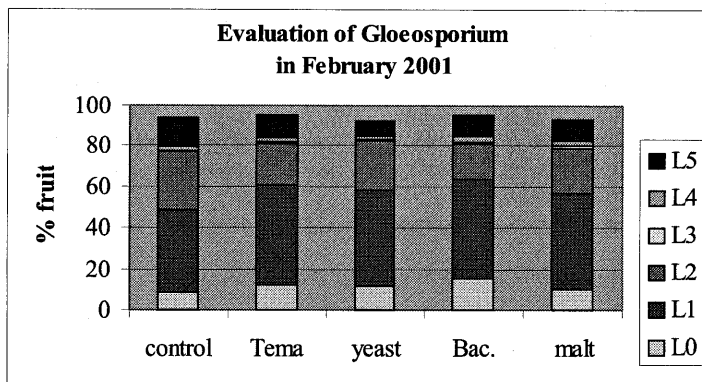


Diagram 2: Evaluation of *Gloeosporium* in February 2001

In diagram 2 the situation in February 2001 is described by stacking up the percentage of apples in the single classes. The difference to 100 % had been removed in October or December because of severe *Gloeosporium*-infection or other storage diseases.

At the end of storage season in March 2001 the treatments with FZB had the highest part of L0+L1 (5,1%+18,9 %), followed from malt-extract (3,6 % +19,1 %) and Tema-extract (3,6 % +15,3%), the control had only 0,8 % L0 and 11,2 % L1. Because the fruits had been strongly russeted, they were more susceptible for fading skin.

Comparing with the effect of warm-water-treatment (like Trierweiler and Schirmer examined in 2000) the described sprayings at the variety Pinova decreased the decay through *Gloeosporium* only weak.

Prospect for the future

Most likely the usual treatments in organic grown orchards are too weak to prevent such severe attacks by *Gloeosporium sp.* There could be a problem with residues on the apples, too. So hygienic measurements in the orchard should be used strictly, like removing of possible sources of infections and pruning with the goal to get less dense trees. A further important point is to pay attention to a good nutrition of the fruits with Calcium. Warm-water-treatments after harvest seem to have a good effect, but they are still in the testing phase, further cultivars should be tested for their suitability for this process.

Literature Cited

- Hulme, A. C.; Edney, K. L. (1960): Phenolic substances in the peel of Cox's Orange Pippin apples with reference to infection by *Gloeosporium perennans*. In: Pridham, J. B. (Ed.): Phenolics in plants in health and disease. Oxford, London, New York, Paris: Pergamon Press, 87-96.
- Noble, J. P., Drysdale, R. B. (1983): The role of benzoic acid and phenolic compounds in latency in fruits of two apple cultivars infected with *Pezizula malicorticis* or *Nectria galligena*. *Physiological Plant Pathology* 23, 207-216.
- Schirmer, H.; Trierweiler, B.; Tauscher, B. (2000): Heißwasserbehandlung eine Methode zur Reduzierung der Fruchtfäule an Bio-Äpfeln? *Obstbau* 11, 619-621.
- Schulte, E. (1997): Bitterfäule des Apfels Infektion, Infektionsbedingungen, Auftreten im Lager, Bekämpfung. Dissertation Universität Hannover, Fachbereich Gartenbau.
- Verhoeff, K. (1974): Latent infections by fungi. *Ann. Rev. Phytopath.* 12, 99-110.