# First observations on disease development of *Marssonina coronaria* on apple in Lake Constance area

A. Bohr[1], S. Buchleither[1], S. Späth[1] and U. Mayr[1]

**Abstract**

*The problem of early leaf fall on apple caused by* Marssonina coronaria *was approached by temporarily covering trees of the cultivar 'Topaz' with a membrane rain cover to inhibit the spread of conidiospores. Different time periods of coverage during the summer seasons of 2012-2014 were compared with regard to the resulting level of infestation at harvest time. A time frame from roughly mid June to the end of August was identified to be the most important period to decelerate the spread of the disease. The results of an initial trial with customary organic plant protection treatments in different periods in 2013 and the continuous recording of the disease development in 2012-2015 supported this finding.*

**Keywords:** *Marssonina coronaria,* early leaf fall*, Diplocarpon mali*

## Introduction

Early leaf fall caused by *Marssonina coronaria* was first observed at the KOB in 2011 on trees of the variety 'Topaz'. The symptomatic development of the fungus starts with brownish or black spots on the upper side of the leaf. Soon the spots grow together and the infested leaf turns chlorotic. Sometimes a snowflake-like pattern develops (cp. Hinrichs-Berger, 2011). Presumably depending on the weather conditions, leaves may fall as soon as two weeks after the first visible infestation. Damages of the fruit show as sunk-in blackish spots but are rarely observed up to now (Marschall *et. al.*, 2014). Up to date the long-term negative effect on the tree's ability to assimilate nutrients appears to be more precarious – highly infested trees can be almost bare as soon as three weeks before harvest. However, less is known about infection biology of *Marssonina coronaria* under western European climate conditions. Without deeper understanding of the fundamental infection parameters targeted plant protection treatments are not possible yet. In this context, first observations concerning disease development under the climatic conditions in Lake Constance area are presented in this paper.

## Material and Methods

Rain Cover

'Topaz' trees planted 2001 (for the 2012 trial) and 2003 (for the trials of 2013 and 2014) in an organically managed orchard at KOB were temporarily roofed with a transparent plastic foil using a common horticultural tunnel. Each treatment comprised 10 to 15 trees (no replications). The tunnel was open to the sides and thus did not prohibit wind circulation. Hence the system does not inhibit a possible contamination of ascospores. However, as it shelters the trees from rain, the spread of conidiospores can assumably be stopped or at least decelerated. Furthermore, infection development can assumably also be inhibited. Thus the design of the trial aims to constitute a situation that could theoretically be reproduced by the use of plant protection agents instead of a roof.

[1] Kompetenzzentrum Obstbau-Bodensee (KOB), Schuhmacherhof 6, D-88213 Ravensburg, Germany, bohr@kob-bavendorf.de

Degree of damage

The development of infestation was visually estimated using a 0-to-9-scale where 0 stand for 'no visible symptoms' and 9 for 'almost no leaves left on the tree'. The average infestation for every treatment is expressed mathematically as percent of maximum possible damage (P):

P = degree of damage in %

$P = \sum (n*v) / (9*N) *100$

N= overall number of trees

v = value 0,1,2,3,4,5,6,7,8,9

n = number of trees rated the respective value

Up to date this method to measure infestation by *Marssonina* seems to be the best available, but it has flaws. During the progress of infestation, more and more leaves fall off. If a tree is assessed after windy weather (which blew away many infested leaves), it might look healthy again. Particularly in the early stages of infestation, some leaves more or less hardly make a visual difference. The degree of damage P used below has thus to be interpreted with care – the author believes that a difference of around 10 percentage points should still be treated as an equal result.

Disease development

Disease development was recorded in the years 2012-2015 by weekly visual control of 120 untreated 'Topaz'-trees using described scale/method.

## Results

Monitoring of disease development

Figure 1 describes the progressive development of *Marssonina* symptoms over the summer seasons of 2012 to 2015 on *Topaz* at KOB.

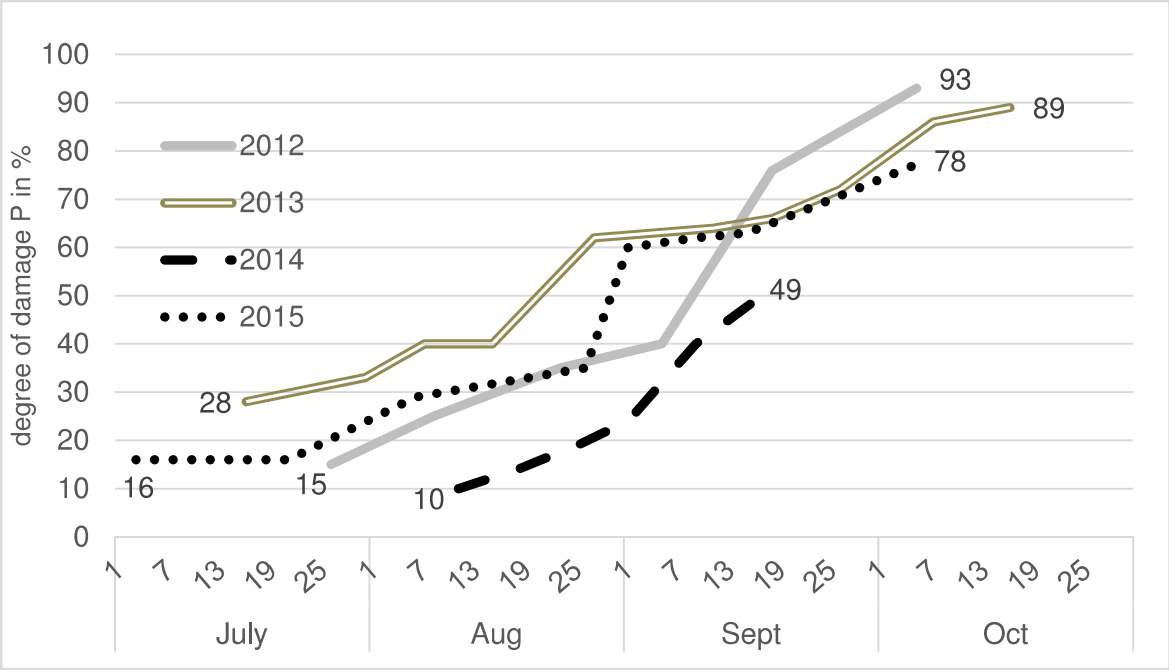


Figure 1: Development of disease symptoms 2012-2015. N=120. Cultivar 'Topaz'.

The earliest year so far was 2015 when 16 % damage was recorded by early July. In 2014, first symptoms developed much later and only reached 49 % by September 16th (data after Sept. 16th is missing for that year. In the same year though, the untreated control of the roofing trial described above reached 100 % damage).

Rain cover trials

Table 1 shows the treatments i.e. periods of coverage from 2012 to 2014 and the resulting degree of infestation. For each year, one treatment is highlighted in grey. This is the treatment which showed a comparatively good result with a relatively short period of time under roof. In 2012, treatments 3 and 4 have the same value, thus the time frame 18.6.-5.9 results as a combination of both. Comparing treatments 4 and 5 in 2012 it seems that early covering before June did not result in reduced infestation. Equally, covering only between May and end of July (treatment 2) was not sufficient. In 2013 and 2014, treatment 2 and treatment 3, covered between early/mid June and end of August / early September, were the most effective options. Comparing treatments 1 and 2 and also 5 and 6 in 2013, it becomes visible that extended covering from September 11th to October 7th did not lead to a reduction of infestation. This observation was reassured in 2014, where extended coverage in September did not lead to a better result (comparison of treatments 1 and 6 as well as treatments 3 and 5. The P-values of these treatments should be viewed as an equal result due to the flaws of the rating method mentioned above).

Table 1: Period under membrane roof and corresponding degree of damage in autumn (rated on 8.10.2012 / 7.10.2013 / 30.9.2014). Cultivar 'Topaz'. 10-15 trees per treatment (no replications).

| year | treatment | period under roof | degree of damage P (%) |
|---|---|---|---|
| 2012 | control | without roof | 65% |
| | 1 | 27.4. - 18.6. | 74% |
| | 2 | 27.4. - 26.7. | 63% |
| | 3 | 27.4. **- 5.9.** | 11% |
| | 4 | **18.6**. - 26.9. | 14% |
| | 5 | 4.4. - 26.9. | 11% |
| 2013 | control | without roof | 86% |
| | 1 | 19.06. - 07.10. | 19% |
| | 2 | 19.06. - 11.09. | 24% |
| | 3 | 19.07. - 07.10. | 56% |
| | 4 | 19.07. - 11.09. | 45% |
| | 5 | 15.08. - 07.10. | 69% |
| | 6 | 15.08. - 11.09. | 67% |
| 2014 | control | without roof | 100% |
| | 1 | 10.7.-27.8. | 48% |
| | 2 | 10.7.-12.8. | 61% |
| | 3 | 5.6.-27.8. | 34% |
| | 4 | 5.6.-10.7. | 84% |
| | 5 | 5.6.-29.9. | 24% |
| | 6 | 10.7.-29.9. | 58% |

Application of customary plant protection treatments

In 2013, the effect of customary organic plant protection treatments based on products containing copper, lime sulphur, sulphur and potassium carbonates on the infestation with *Marssonina* was tested additionally (Figure 2). Different time frames of application were chosen and the resulting damage was rated on Oct. 16th.

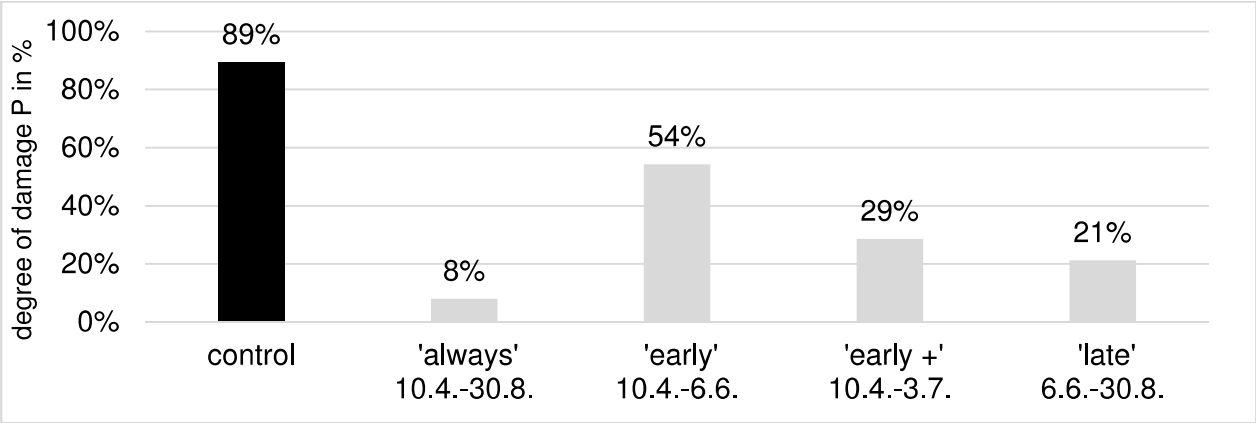


Figure 2: Effect of customary plant protection treatments applied in different time frames in 2013. Cultivar 'Topaz', planted 2003. Infestation rated on Oct. 16th. N=130 per treatment (no replications).

Besides intensive treatment 'always', the best effect was accomplished with the treatment 'late', when plant protection agents were applied during June, July and August. Least reduction of infestation compared with the untreated control resulted from the treatment 'early', where applications ended in early June and trees were left untreated after this date. The treatment 'early +' with additional applications during June reached an astonishingly good result, which demonstrates the importance of the June-applications in that year.

## Discussion

The monitoring of disease symptoms over the years reveals a fairly continuous growth pattern over the months of July, August and September. The date of first symptoms and the maximum degree of damage varies from year to year, assumingly depending on the weather conditions – a complex interrelation that cannot be discussed in this contribution. Some jumps in the graphs may also result from the rating scale which should be improved. From the roofing trials a time frame from early/mid June to the end of August / early September can be identified to be the most effective roofing period (again varying with the year and its specific weather conditions). To inhibit an excessive damage by *Marssonina* conidiospores, the concerned producer should consider this time frame the most relevant to apply plant protection agents.

These preliminary observations give a first impression of the seasonal course of disease development in Lake Constance area. Nevertheless, further experiments are necessary to be able to understand the complex infection biology of Marssonina coronaria in detail.

## References

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