Sooty blotch of apple: Efficacy of different application strategies

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Abstract

Sooty blotch causes heavy losses in Lake Constance organic apple production. In the last five years research has been done at the research station for fruit growing (Kompetenzzentrum Obstbau – Bodensee) on strategies to control Sooty blotch on organic grown pome fruit. Different control strategies with lime sulphur, coconut soap and potassium bicarbonate with different application rates, application times were tested in several trials on the cultivar 'Topaz'. Over the years the results show that lime sulphur has significant effects in controlling Sooty blotch. In a first trial potassium bicarbonate showed a promising efficacy against Sooty blotch. Concerning the right application times we need further investigations. The problem is that Sooty blotch is a disease complex caused by several fungi and it is likely that the fungi that are a part of the complex differ from area to area.

Keywords: Sooty blotch, application strategies, lime sulphur, coconut soap

Introduction

Sooty blotch causes heavy losses in Lake Constance organic apple production, especially in orchards with apple scab-resistant cultivars that are managed with low fungicide input (Buchleither & Späth 2007). This fact greatly reduces the practical benefits of scab-resistant cultivars, because the farmers have to treat these varieties against Sooty blotch as frequently as their standard varieties against apple scab. In comparison to apple scab, Sooty blotch is a disease complex caused by several fungi (Sutton & Williamson 2002). The biology of these fungi is not known, especially what time of summer this disease begins its fruit infections. Apart from experiments to determine when Sooty blotch occur by protecting susceptible fruits with bags at various times, winter treatments and different control strategies with lime sulphur, coconut soap and potassium bicarbonate with different application rates, application times were tested in several trials with the aim to reduce fungicide treatments.

Material and Methods

All experiments were carried out in the years 2003 to 2007 on the apple cultivar "Topaz" with three or four replications. The orchard was planted in 2001. Treatments were carried out with a tunnel sprayer or a hand-gun sprayer.

Incidence and severity were assessed using the following pattern: 0 = no symptoms, 1 = traces, 2 = until 10% of fruit surface, 3 = 10-25%, 4 = 25-50%, 5 = more than 50% of fruit surface.

Disease severity (p) is expressed as:

$$P = \Sigma\,(n*v)/(v-1)N*100$$

P: disease severity (%)
N: total number of fruits
v: evaluation number: 0,1,2,3, 4, 5
n: number of fruits of each evaluation number

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Trials assessments were made directly after harvest. For each treatment, at least 150 fruits maximum 1700 fruits, were randomly chosen for the assessment.

In 2003/2004 different management strategies were tested: a) starting with coconut soap treatments after a threshold value of wetness hours, b) application of coconut soap after a total number of wetness hours (Table 1). Another aim of the study was to verify whether the primary inoculum of Sooty Blotch can be reduced by winter treatments with lime sulphur, copperoxychloride or quick lime.

Table 1: Experimental setup 2003/2004

	Treatments*	**Application 2003 following**	**Number of treatments in 2003**	**Application 2004 following**	**Number of treatments in 2004**
A	Untreated		0		0
B	Coconut soap 8l/ha	Adviser recommondations	9	Adviser recommondations	9
C	Coconut soap 8l/ha	after 150 hours wetness	11	after 150 hours wetness	10
D	Coconut soap 8l/ha	after 200 hours wetness	10	after 250 hours wetness	8
E	Coconut soap 8l/ha	after 250 hours wetness	8	every 50 hours wetness	11
F	Coconut soap 8l/ha	every 50 hours wetness	8	every 100 hours wetness	6
G	Coconut soap 8l/ha	every 100 hours wetness	5	every 200 hours wetness	3
H	Lime sulphur 10l/ha	like B	9	like B	9
Winter treatments (end of February) with					
I	Lime sulphur 25 l/ha	combined with B	10	combined with B	10
K	Copperoxychloride 1kg/ha	combined with B	10	combined with B	10
L	Quick lime 50kg/ha**	combined with B	10	combined with B	10

*all applications with 500 l/ha, exceptionally ** quick lime with 800 l/ha

The value of the RIMpro Sooty blotch model as tool for timing fungicide sprays was tested in 2005 and 2006 (Table 2). The weather data to drive the model were collected from six weather stations located near the trial orchard. Fungicide treatments were made if the infection level was over 500 at least of three stations.

Table 2: Experimental setup 2005/2006

	Treatments	**Number of treatments in 2005**	**Number of treatments in 2006**
A	Untreated	0	0
B	Coconut soap 8l/ha, 500 l/ha	2	0
C	Coconut soap 8l/ha, 1000 l/ha	2	0
D	Lime sulphur 10l/ha, 500 l/ha	2	0

In 2007 the value of two models as tools for timing fungicide sprays to control Sooty blotch was tested: Mills and RIMpro (Table 3). Based on the experience in 2006 with RIMpro Sooty blotch model, the infection level for fungicide treatments was heavily reduced from 500 to 50. Concerning the Mills model, applications were made if the infection level was over 3,5.

Table 3: Experimental setup 2007

	Treatments*	Application following	Number of treatments
A	Untreated		0
B	Potassium bicarbonate (Armicarb) 5 kg/ha	RIMpro Sooty blotch	1
C	Lime sulphur 15l/ha	RIMpro Sooty blotch	1
D	Lime sulphur 15l/ha combined with a pretreatment at BBCH 72	RIMpro Sooty blotch	2
E	Potassium bicarbonate (Armicarb) 5 kg/ha	Mills	5
F	Lime sulphur 15l/ha	Mills	5

*all applications with 500 l/ha

Results and discussion

In the season 2003, Sooty blotch pressure was relatively low (disease severity in untreated control: p = 13,8 %) because of the very dry summer and the age of the orchard (planted in spring 2001). To increase infection pressure in 2004, branches of blackberry bushes were distributed two times (11.5 and 17.6) in the trial orchard. In contrast to 2003, Sooty blotch pressure 2004 was now relatively high in the untreated part of the orchard (p = 54,1 %). In the following years disease severity range from 60 to 90 % in untreated control.

Table 4: Results of the experimental setup 2003/2004

	Number of treatments in 2003	Number of fruits in 2003	Disease severity in 2003 (%)	Number of treatments in 2004	Number of fruits in 2004	Disease severity in 2004 (%)
A	0	344	13,8	0	1410	54,1
B	9	355	8,7	9	1180	44,2
C	11	319	9,3	10	987	42,5
D	10	343	9,4	8	1347	63,5
E	8	282	10,3	11	1100	27,6
F	8	292	11,0	6	944	35,1
G	5	256	10,8	3	1268	46,8
H	9	333	1,4	9	939	20,2
Winter treatments (end of February) combined with B						
I	10	403	9,37	10	1068	43,0
K	10	344	9,32	10	1051	44,5
L	10	421	14,9	10	1285	50,1

Both years show, that a winter treatment with lime sulphur, copperoxychloride, quicklime at high rate did not reduce the number of fruits infected by Sooty blotch. This results confirmed earlier work from Trapman et al. (2004). The conclusion will be, that either Sooty blotch inoculum hibernating on the stem and branches of the apple trees is only of less importance for the primary infection or that even intense treatments with the most effective fungicides available in organic farming are not effective enough to have an measurable influence on disease severity at harvest (Table 4). However the rates of lime sulphur and copperoxychloride applied as a winter treatment in one single spray would be much more effective by applying 3 to 8 well aimed applications during summer to control Sooty blotch.

The summer treatments with lime sulphur (H) reduced the disease incidence considerably in both years. The alternative program with coconut soap treatments during summer reduced the disease incidence slightly, but these effects are not significant (B). However in 2004 the efficacy of coconut soap treatments increased with the number of applications (B, E). A management strategy starting with coconut soap treatments after a threshold value of wetness hours or coconut soap treatments which have been applied after a total number of wetness hours showed no strong effect.

Table 5: Results of the experimental setup 2005

	Number of treatments in 2005	Number of fruits in 2005	Disease severity in 2005 (%)
A	0	1485	81,0
B	2	1540	71,6
C	2	1580	74,9
D	2	1550	70,7

In 2005 at harvest (October 10th) the disease incidence in the untreated plot was very high (81%, Table 5). First slightly visible symptoms were found on July 20th, the first "tear" was found on august 18 th. This infection was not recognized by the Sooty blotch RIMpro model. Only two treatments were applied according to the infection model (24.8/12.9), but there was no significant reduction of Sooty blotch incidence.
In 2006 the first visible symptoms were found two weeks later, but compared to 2005 the Sooty blotch RIMpro model never reached a infection level of 500, the threshold value for an application. In 2006 the disease severity was 70 % on average of all plots.

Observations in 2005 suggest that the first infection was not as severe for the model as in reality. The favourable weather conditions in late summer and also the infection potential that has grown over secondary cycles during summer were responsible for the rapid build up of symptoms in the last weeks before harvest. According to the strong disease build-up, the two treatments were not enough to control Sooty blotch. Whatever the reasons were, that the Sooty blotch RIMpro model didn't recognize any infection period in 2006, we concluded that the model, based on data of North America, is not simply transferable to Lake Constance weather conditions.

Table 6: Results of experimental setup 2007

	% of fruits of each evaluation number						Disease severity (%)	Number of fruits	Number of treatments
	0	**1**	**2**	**3**	**4**	**5**			
A	0,1	1,0	3,1	5,1	30,4	60,3	89,1	1641	0
B	0,9	4,3	10,6	14,1	38,5	31,7	76,0	1635	1
C	0,2	2,5	8,8	11,8	40,3	36,5	79,8	1692	1
D	0,3	2,7	8,8	13,1	42,0	33,1	78,6	1729	2
E	0,8	7,0	23,0	23,2	31,1	14,8	64,2	1667	5
F	0,7	4,9	17,0	21,0	41,0	15,4	68,6	1663	5

In 2007 we had the severest disease incidence in the untreated plot all over the years (89,1 %). The treatments B, C, D with one or two applications reduced the Sooty blotch incidence between 9 and 13 % compared to the untreated plot.

A pretreatment at T-stage of the fruits (BBCH 72) had no measurable effect on the disease level (Table 6). The treatments E, F with five applications reduced significantly the Sooty blotch incidence, 21 to 25 % compared to the untreated plot. Especially potassium bicarbonate (Armicarb) showed a promising efficacy against Sooty blotch.

But also in plots E, F the Sooty blotch pressure was too high and leaded to unacceptable high yield losses. These results suggest that in seasons with a very high Sooty Blotch pressure, much more than five treatments with lime sulphur or bicarbonate are necessary to expect a good result in Sooty blotch control. The results of management practices on Sooty blotch published by Main & Gurtz (1988) and Rosenberger et al. (1996) confirmed this assumption. In the future spray treatments to control sooty blotch need to be exactly timed with disease biology.

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