Marssonina coronaria - Fine tuning of direct regulation using acid clay

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Abstract
In quadrennial efficacy tests acid clay showed goods results in direct fungicidal regulation of Marssonina blotch of apple trees. This articles gives results of two-year-trials with acid clay in different application frequencies and timing and in combination with sulphur and solo.

Keywords: Apple blotch, Marssonina blotch, Apple leafspot, *Marssonina coronaria, Diplocarpon mali*

Introduction

In this contribution we present results from open field trials focussing on direct regulation of premature defoliation caused by *Marssonina coronaria ELLIS & J.J. DAVIS* (teleomorph *Diplocarpon mali Y. HARADA & SAWAMURA*). The trial sites are at Kompetenzzentrum Obstbau-Bodensee (KOB) and the variety 'Topaz' is used. Results for the year 2016 and 2017 have been presented already at Ecofruit and are now extended by the years 2018 and 2019, see Bohr et al. (2018). The results are divided into two trials. Trial A gives quadrennial results for common plant protection products and one test product (NEU 1143F). Trial B focuses on a more distinguished application of acid clay (product name 'Myco-Sin') in the years 2018 and 2019.

Material and Methods

Measurement of infestation

The degree of infestation was visually estimated using a 0-to-9-scale with 0 representing "no symptoms visible" and 9 "tree almost bare". The observed ratings then were converted straight proportionally into 'Degree of Damage P' (in %). Thus P = 100% represents maximum possible infestation. For a more detailed description see Bohr et al. (2018). The degree of damage was evaluated in middle/late autumn. The exact dates were Oct. 18th, 2016/ Sept. 27th, 2017/ Oct. 16th, 2018/ Oct. 7th, 2019.

Efficacy in % was calculated by comparing disease incidence with untreated control according to Abbott (1925).

Trial site description and randomization procedure

The research was carried out at an organically managed site at KOB using the variety 'Topaz' on rootstock M9 planted in 2003. The initial infestation with Marssonina blotch was recorded in autumn 2015 to avoid distortion of the test results by infestation in the precedent year. The orchard had a uniformly low degree of infestation, however. Thus, the trial was structured in randomized blocks with four repetitions in 2016. For 2017, the trial site was unequally infested with apple blotch due to the efficacy trial of the precedent year. Therefore, the blocks were randomized in a way that every product had two repetitions with rather low and two with rather high initial potential from the precedent year. In the years 2018 and 2019 the repetitions were randomized without regard to former infestation because in the years before no long-term effect was noted.

Product dosage and application details

The dosage of the tested products as well as the application frequencies and technique for each year are listed in tables 1 to 3. The product NEU 1143F is a test product of the company Neudorff which is not yet listed for general use. Its active ingredient is pelargonic acid.

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Table 1: Dosage of tested products, diluted in 500 l/ha water.

Year	Product	Dose/ha
Trial A		
2017 - 2019	Neudorff NEU 1143F	n.a.
2016 - 2019	Myco-Sin (acid clay)	10 kg
	Funguran progress (copper)	400 g
	Wettable Sulphur	2 - 5 kg (reduced under sunburn conditions)
	Curatio (lime sulphur)	12 l
Trial B		
2018 - 2019	Sulphur	4 kg
	Myco-Sin	10 kg
	Myco-Sin + Sulphur	10 kg + 4 kg
	Myco-Sin + Sulphur every 2nd week	10 kg + 4 kg
	Myco-Sin + Sulphur after extended periods of wetness	10 kg + 4 kg
2018	Myco-Sin low dosage	6,7 kg

Table 2: Application frequency in trials A and B. The application strategy in 2016 was “weekly regardless of weather forecast, but not directly during rainfall”. For 2017 to 2019 the strategy was “more or less weekly but with some days flexibility to apply rather preventive than curative”.

Year	Application frequency and strategy
2016	12 applications: 10.6./20.6./27.6./4.7./11.7./18.7./26.7./1.8./8.8./15.8./22.8./30.8.
2017	11 applications: 12.6./20.6./26.6./4.7./11.7./20.7./1.8./8.8./14.8./21.8./30.8.
2018	12 applications: 29.5./5.6./11.6./20.6./28.6./2.7./12.7./ 18.7./26.7./3.8./8.8./16.8. (only 6 applications for “Myco-Sin and sulphur every 2nd week”) (only 5 applications for “Myco-Sin and sulphur after extended periods of wetness
2019	9 applications: 18.6./28.6./5.7./11.7./19.7./26.7./1.8./8.8./15.8. (only 6 applications for “Myco-Sin and sulphur every 2nd week”) (only 5 applications for “Myco-Sin and sulphur after extended periods of wetness)

Table 3: Application technique 2016-2019 for both trial A and B.

Year	Sprayer type	Speed in km/h	Pressure in bar	Fan speed	Nozzles	Water volume/ha
2016	JOCO tunnel sprayer type 09G	6	9	high	Albuz orange	500
2017-2019	WANNER tailor-made for trials	5	6	adjusted to wind conditions	DG Teejet 80015VS green	500

Results

The results of trial A and B are provided in table 4 and figure 1. Within the four years of Trial A, two different levels of infestation could be distinguished. The untreated control reached a degree of damage of 73% and 76% in the first two years, but only 42% and 45% in the two

last years. The test product ‘NEU 1143F’ showed only a moderate effect in all three years. Compounds based on copper and wettable sulphur showed a higher efficacy in the last two years with a lower general level of infestation. The efficacy of lime sulphur varied between 67% and 89% over all four years. ‘Myco-Sin’ reached constantly high efficacies above 94%.

Table 4: Trial A. Degree of damage (P in %) by Marssonina blotch (2016-2019) after treatment with different compounds. Standard deviation (SD) of the population and efficacy (Abbott) in %. NEU 1143F was not tested in 2016.

Product	Year	P (in %)	± SD	Efficacy (%)
Untreated control	2016	73,1%	2,8%	
	2017	76,4%	1,4%	
	2018	42,1%	13,5%	
	2019	45,2%	10,4%	
NEU 1143F	2016	-	-	-
	2017	46,8%	8,6%	38,7%
	2018	18,2%	11,9%	56,8%
	2019	25,0%	10,7%	44,7%
Funguran progress (copper)	2016	7,2%	3,4%	90,1%
	2017	24,6%	7,5%	67,8%
	2018	0,7%	1,0%	98,3%
	2019	3,2%	2,4%	92,9%
Curatio (lime sulphur)	2016	9,8%	9,3%	86,6%
	2017	24,0%	3,9%	68,6%
	2018	4,7%	5,6%	88,9%
	2019	13,8%	5,3%	69,4%
Sulphur	2016	15,4%	7,7%	79,0%
	2017	24,9%	7,8%	67,4%
	2018	2,5%	2,0%	94,1%
	2019	5,5%	4,1%	87,9%
Myco-Sin (acid clay)	2016	4,4%	4,4%	94,0%
	2017	4,5%	1,3%	94,1%
	2018	0,6%	0,8%	98,6%
	2019	0,8%	0,8%	98,3%

In 2018 and 2019 more differentiated treatments with ‘Myco-Sin’ were added to further investigate the high efficacy of acid clay noted in 2016-2017, see figure 1. Efficacy is not displayed but is 88% or higher for each treatment. Thus, even with a reduced number of 5 to 6 applications the degree of damage was considerably reduced compared to the untreated control. The reduction of the standard recommended dosage of ‘Myco-Sin’ to two thirds (6.7 kg/ha) showed a high efficacy as well but was only tested in one year.

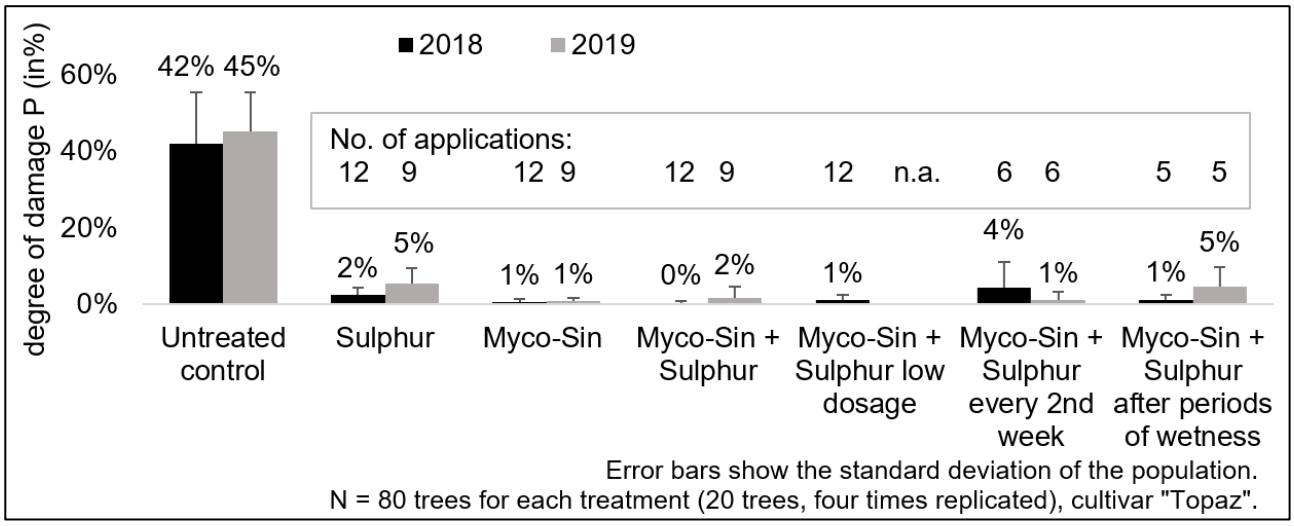

Figure 1: Trial B. Incidence of Marssonina blotch after different treatments based on acid clay 2018-2019. Low dosage of 'Myco-Sin' + Sulphur was only tested in 2018.

Discussion

Even in years with a high general infestation level (according to a high degree of damage in the untreated control), acid clay was the most effective substance to control Marssonina blotch under open-field conditions over four years of trial. The high efficacy of acid clay was described already by Gruber et al. (2014) and Kelderer et al. (2016) for the product 'Ulmasud' and by Rühmer (2016) for 'Myco-Sin'.

Based on the proven effectiveness of acid clay, the question of the lowest necessary application rate arises. Following our results in 2018 and 2019, a further reduction of either the dosage or the number of applications is possible, if disease pressure in the certain year or in the certain orchard, respectively, is comparatively low. All reduced treatments led to a possibly acceptable level of infestation. There is no generally accepted limit regarding a maximum degree of damage viewed as tolerable.

It remains uncertain, to what extend a reduction of fungicide input is possible in circumstances of high disease pressure.

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