

Biological control of American gooseberry mildew - cultivation systems and preventive applications

L. Brockamp¹

Abstract

In the years 2007-2009 different biocontrol agents like sodium bicarbonate, sulphur, fennel oil and potassium bicarbonate were proofed for their influence on reducing powdery mildew of gooseberry caused by *Sphaerotheca mors uvae*. The experiment also included a comparison between different training systems and locations. It took place on two organic fruit farms near Stuttgart, Germany, with the susceptible variety 'Tixia'. During the trial years the best results were reached with the following treatment: One or two sprout applications with sulphur and if required weekly, preventive spraying with a combination of fennel oil and sodium bicarbonate. *This project was granted by Bundesprogramm Ökologischer Landbau (BÖL, 06OE221). It included experiments about cultivation systems and examination of varieties at strawberries, cutting techniques at raspberries, plant protection at blackberries and weed control at blueberries and black currants. The part of weed control was carried out by OVB Jork (Germany).*

Keywords: Gooseberry, organic orchards, powdery mildew, preventive applications, cultivation systems

Introduction

American mildew of gooseberry is caused by the pathogen *Sphaerotheca mors-uvae*. The hibernation of the pathogen takes place at shoot tips inside infected buds. The spores are spread with wind and rain-water or dew. Optimal conditions for infection are temperatures around 18 °C and high humidity (VUKOVITS 1980), for example long time of aridity with dew formation in the morning and in the evening. Also wind protected locations combined with a compact crop support the presence of powdery mildew. Therefore only consistent hygienic measures, preventive applications and choice of cultivation system can guarantee a vigorous and healthy gooseberry crop. The influence of different biocontrol agents on the infestation of powdery mildew of black currants were proofed by BOOS and STRAUB (1996). Also there were successful experiences with different plant strengthening agents from the ecological viticulture and vegetable growing. In addition to the preventive applications there is a comparison between bush- and hedgerow planting as well as wind open- and wind protected site.

Material and Methods

From 2007 till 2008 the experiment took place at an organic fruit farm near Stuttgart with the variety 'Tixia'. The three year old plants were trained as bush with a distance of 0.80 m x 3.50 m. Three repetitions per variant were set up with seven equal plants per repetition. For evaluation five bushes in the mid were chosen. Application of biocontrol agents was done manually with a backpack sprayer, with a water flow rate of 500 l/ha. In 2009 the location changed. The gooseberry plants on the new organic fruit farm were five years old. They were trained as hedge with three branches combined with a yoke system. The distance was about 0,75 m x 3,00 m. The first treatment was done with a water flow rate of 500 l/ha. Caused by the development stage of plants it has been increased to 800

¹ Staatliche Lehr- und Versuchsanstalt für Wein- und Obstbau, Traubenplatz 5, 74189 Weinsberg, Germany

l/ha afterwards. In the harvest years 2007-2009 the yield, fruit size and fruit damage like mildew, sunburn or fruit cracking were evaluated. Furthermore there was a monitoring of powdery mildew at gooseberry leaves. In July 2007 and 2008 eight shoot tips per bush were evaluated into classes of infestation from one to five. One means "without infestation", three means "5-25 % infestation" and five means "> 50 % infestation". In 2009 the monitoring level was reduced into the grades "with infestation" and "without infestation". Table 1 shows the variants of plant protection from 2007 till 2009.

Table 1: Variants of plant protection 2007-2009

Variants 2007	Variants 2008	Variants 2009
Control	Control	Control
Sulphur (0,4 %)	Sulphur (0,4 %)	Potassium carbonate (Vigo, 1 %)
Whey powder (4 %)	Bio-S (Willow extract, thistle flour, 2 %)	Potassium bicarbonate (Salukarb, 0,5 %) + Wedding agent (Trifolio S-forte, 0,25 %)
Fennel oil (HF-Pilzvorsorge, 0,4 %) + Sodium bicarbonate (Steinhauers Mehltauschreck, 0,5 %)	Fennel oil (HF-Pilzvorsorge, 0,4 %) + Sodium bicarbonate (Steinhauers Mehltauschreck, 0,5 %)	Fennel oil (HF-Pilzvorsorge, 0,4 %) + Sodium bicarbonate (Steinhauers Mehltauschreck, 0,5 %)

Before starting the trial 2007 all plants, including the control, were sprayed three times with a combination of fennel oil and sodium bicarbonate. From May till June the trial agents were applied with an interval of seven to ten days four times in total. Caused by the results of 2007 the variant Whey powder was replaced with the agent Bio-S in 2008. Ten weekly applications could be realized in 2008. The spraying started at the beginning of April ending by mid of June. After six time use of sulphur, the variant was treated with fennel oil and sodium bicarbonate till the end of spraying. In 2009 sprout application was provided by the farm manager. At the first date 2 kg sulphur and 2 kg sodium bicarbonate (Steinhauers Mehltauschreck) and on the second date 2,5 kg sulphur and 2,5 kg potassium bicarbonate (Vitisan) were sprayed. The plants of control were treated by mistake. From the end of April till the end of May the trial agents could be sprayed with an interval of seven to ten days (four times in total).

Results

In the first trial year 2007 the different biocontrol agents couldn't satisfy caused by high pressure of mildew. None of them reached better results than the untreated control (table 3). The plant strengthening agent Whey powder wasn't followed up because over 50 % of fruits showed symptoms of mildew. In the year 2008 the tested agents had a moderate effect against powdery mildew at gooseberry fruits. The effect of reducing infestation at leaves wasn't sufficient. In relation to fruit infestation the combination of fennel oil and sodium bicarbonate showed the best results. It was given with an efficiency of 54 %, followed by Bio-S with 44 %. In 2009 the pressure of American gooseberry mildew was very low at the second location. Caused by the lack of fruit symptoms there was only an evaluation of leaf infestation. All agents only reached small to medium efficiencies between 30 and 50 %. The combination with fennel oil and sodium bicarbonate showed again the highest value (52 %). Table 2 shows the efficiency 2008 and 2009 at fruits and leaves influenced by different biocontrol agents.

Table 2: Efficiency (%) 2008 and 2009 of different biocontrol agents against mildew infestation

Treatment	Efficiency (%) Leaves		Efficiency (%) Fruits	
	2008	2009	2008	2009
Sulphur	25,2	-	25,2	-
Fennel oil + Sodium bicarbonate	53,7	51,5	53,7	-
Bio-S	43,6	-	43,6	-
Potassium carbonate	-	32,1	-	-
Potassium bicarbonate + Wedding agent	-	31,0	-	-

Caused by small fruit coverage density, high pressure of mildew from May to June and damage by hail the yield was very low in 2007 and 2008. It was given with 1,0 kg/bush in both years. The variant "fennel oil + sodium bicarbonate" reached the highest marketable yield (0,5 kg/bush). It included fruit sizes > 22 mm and > 20 mm. In 2008 an increasing of medium and small sized fruits could be observed. The most fruit symptoms of mildew showed the control and the variants with Whey powder and Bio-S (0,4 – 0,6 kg/bush). Treatment with fennel oil resulted into lowest mildew infection. Six time use of sulphur caused no phytotox damage at fruits and leaves during the trial years.

Table 3 and 4 show the yield of 'Tixia' in the years 2007 and 2008 divided into fruit sizes > 22 mm, 22-20 mm and < 20 mm, powdery mildew and fruit damage (sunburn, hail, fruit cracking).

Table 3: Yield of 'Tixia' 2007 influenced by different biocontrol agents (Tukey test for mildew, $\alpha = 0,05$)

Treatment	Yield 2007 (kg/bush)					
	> 22 mm	22-20 mm	< 20 mm	mildew	fruit losses	Σ
Untreated control	0,43	0,08	0,03	0,08 a	0,19	0,73
Sulphur	0,36	0,06	0,02	0,15 a	0,20	0,64
Fennel oil + Sodium bicarbonate	0,43	0,13	0,05	0,23 a	0,25	0,86
Whey powder	0,21	0,05	0,02	0,35 b	0,13	0,41

Table 4: Yield of 'Tixia' 2008 influenced by different biocontrol agents (Tukey test for mildew, $\alpha = 0,05$)

Treatment	Yield 2008 (kg/bush)					
	> 22 mm	22-20 mm	< 20 mm	mildew	fruit losses	Σ
Untreated control	0,08	0,07	0,01	0,62 a	0,02	0,80
Sulphur	0,17	0,15	0,04	0,42 a	0,03	0,81
Fennel oil + Sodium bicarbonate	0,24	0,26	0,14	0,29 b	0,04	0,97
Bio-S	0,20	0,19	0,10	0,55 a	0,04	1,08

Conclusions

The triennial experimental practice shows that only a hedgerow planting with three branches can be given as recommendation for the practical use. It results into a better aeration of crop and simplifies harvest by having a better overview about. Also consistent pruning in winter and removing of infected shoot tips in spring as well as an early sprout application reduce the infestation with powdery mildew.

At first one or two sprout treatments with sulphur (3-4 kg/ha) have to be apply. Afterwards there should be if required weekly preventive spraying with a combination of fennel oil (HF-Pilzvorsorge, 0,4 %) and sodium bicarbonate (Steinhauers Mehltauschreck, 0,5 %). Alternatively potassium bicarbonate (Vitisan, Salukarb, 0,5 %) combined with a wedding agent (HF-Pilzvorsorge, Trifolio S-forte, 0,25 %) can be use.

Pruning and early sprout application have to be carried out consequently to reach a low number of treatments.

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