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Application of acid clay against sooty blotch in organic apple cultivation in South Tyrol

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Abstract

In recent years, losses due to sooty mold fungi have increased massively in organic apple cultivation in South Tyrol. Until now, there was no large-scale practicable known way of regulating them in the field. In field trials in 2021 and 2022, various substances that can be used for organic apple cultivation were tested for their properties to regulate the pathogenic fungi. In analyses after harvest and after 3 months of storage, in cold storage, a product based on sulphuric acid clay achieved acceptable results.

Keywords: organic apple cultivation, sooty mold, sulphuric acid clay

Introduction

In the last decade, a steady increase in fruit damage due to sooty mold fungi has been observed in organic apple cultivation in South Tyrol. This mainly affects late-ripening varieties such as ‘Cripps Pink’, which are grown at low altitudes in the Adige Valley. In some cases, the tear-shaped, greyish-brownish fungal turfs, caused by different pathogens can already be seen on the fruit before harvesting, while in others the symptoms intensified, or only appeared during storage (Zanella *et al.*, 2023). In recent years, there has also been an increased incidence of this fungal disease in integrated cultivation (Rizzoli 2023). Since there is still relatively little reliable information available on the pathogen and its biology, but the problem in practice is now sometimes massive, the organic farming working group at the Laimburg Research Centre, has been conducting intensive field trials on the subject for years (Reyes Domínguez *et al.*, 2018). In previous trials, some agronomic measures like rain roofs (Boutry *et al.*, 2022) or post-harvest applications like brushing infested fruits (Kelderer *et al.*, 2020), have been identified which can help to increase the proportion of marketable fruit (Kelderer *et al.*, 2020). However, these possibilities are very poorly accepted by farmers and marketers due to high costs and increased organizational effort. After numerous unsuccessful spraying tests in the field, in which the effectiveness of different spraying agents was tested, promising results were gained for the first time in field trials in the years 2021 and 2022.

Material and methods

The field trials were carried out in 2021 and 2022 in several apple orchards located at the Research Center Laimburg, Auer, South Tyrol, Italy (coordinates 46°22'59''N 11°17'18''E, 222 m a.s.l., Ø annual rainfall 815 mm, Ø T 11.5°C, predominant soil texture: silty loamy sand). The trials were carried out in both years in the same orchard called Block 56, which is managed by the Laimburg farm of the Provincial Domain of South Tyrol. The trial site was managed in accordance with the guidelines for integrated fruit growing (www.agrios.it) until 31 June of each trial year. From the cut-off date onwards, plant protection was taken over by the Organic Cultivation Working Group and managed in accordance with the guidelines for organic cultivation in order to prevent falsification of the trial results.

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The trial site is planted with the variety 'Cripps Pink', the rootstock is M9. The trees are trained as a spindle, the planting distance is 3.15m x 1.1m. The orchard was planted in 1999, has a wire frame and is equipped with a hail net. All orchards are equipped with frost irrigation and drip irrigation.

All spraying treatments were carried out with a spraying device – specifically, a standard blower device (transverse current blower) from Waibl company (Waibl Diethart, 39012 Meran - Sinich BZ, Italy). The treatments were generally carried out in the morning hours.

The sprayer is fitted with CVI blue injector nozzles. The treatments were carried out in both test years with a water application rate of 15hl/ha. The travelling speed was 3.5 km/h at 1300 rpm engine speed. The spray pressure was 8.5 bar and the wing speed was set to position L (low).

A detailed list of the treatments tested in 2021 is shown in Table 1, those for 2022 in Table 2.

Table 1: Number of treatment, tested trial products, dose and number of applications of the trial in the year 2021.

Trial 2021					
Nr. T.	**Product**	**Active substance**	**Dose in**		**Number of applications**
			g/hl	**l/hl**	
1	Poltilia disperss	Copper	100	-	11
2	Silicosec	Diatomaceous earth	1000	-	11
3	Ulmasud	Sulphuric acid clay	1000	-	11
4	Ulmasud + Karma 85	Sulphuric acid clay + Potassium bicarbonate	1000 + 330	-	5 + 6
5	Ulmasud + Limesulphur	Sulphuric acid clay + Limesulphur	1000	0,8	5 + 6
6	Sugarplex Refelexo	Zinc	67	-	11
7	Sugarplex Refelexo + Bacillus Mix	Zinc + B.subtilis, B.licheniformis, B.amyloliquefaciens, B.megaterium	67 + 13,4	-	9 + 2
8	Bacillus Mix	B.subtilis, B.licheniformis,	13,4	-	11
9	Neu -1143 F	Iron pelargonate	-	2	11
10	Experimental product	Various microorganisms	-	3	11
11	Table vinegar	Acetic acid	-	10	11
12	Vacciplant	Laminarin	-	0,07	11
13	Untreated control	-	-	-	-

The 2021 trial consisted of 12 treatments + untreated control, while the 2022 trial consisted of 10 treatments + untreated control. Each treatment consisted of 4 replications in both trial years, with each replication consisting of 12 evaluation trees + 2 marginal trees. Promising products from the product groups, plant protection products, plant strengthening agents, basic substances and sprayable fertilizers were selected as test substances in the trials.

In 2021, the trial products of treatment 4 and 5 were applied alternately; in treatment 7, the product Sugarplex Refelexo was replaced by the product Bacillus Mix for the last 2 treatments.

Table 2: Number of treatment, tested trial products, registration status, dose and number of applications of the trial in the year 2022.

Trial 2022					
Nr. T.	**Product**	**Active substance**	**Dose in**		**Number of applications**
			g/hl	**l/hl**	
1	Flipper	Potassic soap	-	1	8
2	Trial product 1	Potassic soap	-	1	8
3	Trial product 2	Potassic soap	-	1	8
4	Trial product 3	Potassic soap	-	0,1	8
5	Origold	Boron	-	0,25	8
6	Silicosec	Diatomaceous earth	1000		8
7	Sunflower oil	Sunflower oil	-	0,7	8
8	Trial product 4	Sunflower oil + Ozone	-	0,7	8
9	Ulmasud	Sulphuric acid clay	1000	-	8
10	Optisyl	Iron + Silicium	100	-	8
11	Untreated control	-	-	-	-

The application time for both trial years was defined as "preventive every 10 days or after a precipitation event with more than 30 mm of rainfall". In 2021, treatments began on July 28th and a total of 11 treatments were carried out. The last treatment of the 2021 trial took place on November 13th. In 2022, the first treatment of a total of 8 treatments was carried out on July 23th, with the last treatment on November 5th. In both trial years, 2 trees were completely harvested per trial unit, with harvesting taking place on November 16th in 2021 and November 15th in 2022. Immediately after harvesting, the fruit was visually analyzed. The number of fruits infested with sooty mold fungi was determined visually. Before storage, fruit that posed a risk of rotting was sorted out. The fruit was then stored in the cold store at the Laimburg Research Centre at 2.5 °C and a humidity of 95%. The fruit from the 2021 trial was removed from storage on February 6th 2022 and the fruit from the 2022 trial year on February 13th 2023. A second visual evaluation was carried out immediately after removal from storage. Once again, the number of fruits infested with sooty mold fungi was recorded visually. The data was entered using electronic devices.

Statistics:

Data expressed in percentage were arcsine-transformed prior to the application of the ANOVA. Data normality was examined with the Shapiro–Wilk test, and homogeneity of variance was confirmed using Bartlett's test. A one-way ANOVA was performed and mean separation of the dependent variables obtained with the LSD Fisher's test ($p < 0.05$). All analyses were carried out in R v. 3.3.1. (R Development Core Team 2023).

Results

Table 3: Number of treatment, tested trial products, affected fruits in %, after harvest of the trial in the year 2021.

Affected fruits after harvest 2021 in %			
Nr. T.	**Product**	**Affected fruits in %**	**stat.**
1	Poltilia disperss	88,07	a
2	Silicosec	43,59	cd
3	Ulmasud	4,77	e
4	Ulmasud + Karma 85	8,38	e
5	Ulmasud + Limesulphur	12,10	e
6	Sugarplex Refelexo	69,31	ab
7	Sugarplex Refelexo + Bacillus Mix	36,58	d
8	Bacillus Mix	61,80	bcd
9	Neu -1143 F	66,23	bc
10	Experimental product	46,62	bcd
11	Table vinegar	46,43	bcd
12	Vacciplant	56,28	bcd
13	Untreated control	43,68	cd

The results of the evaluation of the infested fruit after the 2021 harvest show that all variants (3,4,5) in which the product based on sulphuric acid clay was used, recorded significantly fewer infested fruit.

Table 4: Number of treatment, tested trial products, affected fruits in %, after storage of the trial in the year 2021.

Affected fruits after storage 2021 in %			
Nr. T.	**Product**	**Affected fruits in %**	**stat.**
1	Poltilia disperss	66,88	a
2	Silicosec	67,98	a
3	Ulmasud	6,27	b
4	Ulmasud + Karma 85	16,06	b
5	Ulmasud + Limesulphur	11,24	b
6	Sugarplex Refelexo	78,40	a
7	Sugarplex Refelexo + Bacillus Mix	59,23	a
8	Bacillus Mix	63,60	a
9	Neu -1143 F	59,00	a
10	Experimental product	72,82	a
11	Table vinegar	66,36	a
12	Vacciplant	69,63	a
13	Untreated control	60,08	a

The evaluation after storage provides a similar picture to the evaluation of the fruit in autumn. Even after several months of storage, variants 3, 4 and 5, in which the product based on sulphuric acid clay was used, achieved significantly the best results. The increase in the percentage of infested fruit over the course of storage in individual variants can be attributed to the change in sample size due to the sorting out of fruit at risk of rotting.

Table 5: Number of treatment, tested trial products, affected fruits in %, after harvest of the trial in the year 2022.

Affected fruits after harvest 2022 in %			
Nr. T.	**Product**	**Affected fruits in %**	**stat.**
1	Flipper	82,66	ab
2	Trial product 1	80,85	ab
3	Trial product 2	78,16	ab
4	Trial product 3	79,99	ab
5	Origold	78,09	ab
6	Silicosec	83,40	ab
7	Sunflower oil	74,32	ab
8	Trial product 4	83,26	a
9	Ulmasud	30,14	c
10	Optisyl	67,46	ab
11	Untreated control	61,20	b

The autumn evaluation of the 2022 trial confirms the results of the previous year. The trial product based on sulphuric acid clay achieved significantly best result , even if the result of the previous year was not achieved.

Table 6: Number of treatment, tested trial products, affected fruits in % after storage of the trial in the year 2022.

Affected fruits after storage 2022 in %			
Nr. T.	**Product**	**Affected fruits in %**	**stat.**
1	Flipper	96,31	a
2	Trial product 1	91,54	a
3	Trial product 2	99,38	a
4	Trial product 3	99,52	a
5	Origold	99,10	a
6	Silicosec	93,76	a
7	Sunflower oil	98,21	a
8	Trial product 4	99,17	a
9	Ulmasud	58,75	b
10	Optisyl	98,45	a
11	Untreated control	92,87	a

The data from the evaluation after removal from storage in spring 2023 shows a similar picture to that in autumn. The variant that was treated with the product based on sulphuric acid clay achieved significantly the best result. However, the very good results from 2021 could not be achieved.

Summary and conclusion

In the trial years 2021 and 2022, substances were tested for their suitability for regulating sooty mold in organic apple cultivation in two agent test trials. In both trial years, the best result was achieved with a product based on sulphuric acid clay in an evaluation following the harvest as well as after approx. 3 months of storage. After many years of unsuccessful trials, the results of the 2021 and 2022 trials represent a glimmer of hope for organic fruit growers in South Tyrol. Although the very good result from 2021 could not be achieved in the 2022 trial, the product used, offers the possibility of limiting losses in addition to cleaning the fruit with a brush after removal from storage. Further trials should be carried out, to check whether it is possible to start the treatments later in the season and whether it is possible to reduce the number of treatments. It is questionable whether the result can also be applied globally, as the pathogens causing the damage can vary from growing region to growing region (Öttl & Rizzoli, 2022).

References

Boutry, C., Kelderer, M., Holtz, T., Baumgartner, F., Friedli, M. (2022). Testing the effect of a rainproof protection net on the apple production regarding disease and pest damages. Proceedings of the 20th International Conference on Organic Fruit-Growing: 101-106

Kelderer M., Casera C., Mora Vargas A. and Öttl S. (2020). Approaches how to reduce sooty mold on organically produced apples. Proceedings of the 19th International Conference on Organic Fruit Growing: 41-47

Öttl S. & Rizzolli W. (2022). Der Rußtau: Eine Einführung. Südtiroler Landwirt **76** (4): 41-42.

Reyes Domínguez Y., Gallmetzer A., Kelderer M., Kiem U. (2018). Epiphytische Pilze auf dem Apfel. Obstbau Weinbau - Fachmagazin des Südtiroler Beratungsringes **55**(5): 22-25

Rizzoli W. (2023) oral communication

Zanella A., Öttl S., Rizzolli W., Kelderer M. (2023). Epiphyten am Apfel: Rußtau und Co. Besseres Obst **68** (7): 12-15.