

Results from scab trials with Armicarb in the years 2006 and 2007

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Abstract

In organically cultivated orchards of the LVWO Weinsberg in the years 2006 and 2007 trials were carried out about new products and their efficacy against apple scab. In the year 2006 (variety 'Gala') Armicarb and BioPluss sprayed preventively during primary ascospore season could not convince, also not in combination with lime sulphur as stop-application. Armicarb showed at 'Gala' a tendency to increase russetting of the fruits. In the year 2007 (Variety 'Elstar') different combinations of wetting sulphur with yucca-saponin and stop-applications (lime sulphur, Armicarb) were tested with focus on the time immediately after blossom. The effect of Armicarb as stop-application was weaker than of lime sulphur at an infection-period with extreme high ascospore potential. The differences between the tested combinations were low. Wetting sulphur+yucca-saponin showed interesting tendencies in the year 2007, but should not be combined with lime sulphur as stop-application because of significantly increased reticular russetting of the apples.

Keywords: *Venturia inaequalis*, apple, potassium bicarbonate, yucca-saponin

Introduction

In the last few years the search for alternatives to copper as important plant protection agent against apple scab was going on at many institutes in lab and in field trials on organic cultivated orchards (Kollar&Pfeiffer, 2003 e.g.). Promising results were published about preparations based on potassium carbonate and additives like saponins (Tamm et al. 2006, Kelderer et al. 2006, Heijne et al. 2006). The way to a satisfactory plant protection strategy against apple scab including new preparations is long, because the products must be registered as plant protection agents and also interactions with other standard applications in organic cultivation should be assessed.

Material and Methods

In **experiment 1** different preparations were tested during primary ascospore-season 2006 with and without stop-applications with lime sulphur. The trial was carried out in an organically grown orchard, where in the past often scab-trials were done, so the infection potential was high. The trees of the variety 'Gala' were planted in spring 2002 with 3,5 m x 1,2 m distance. Two replications were set up, so that about 35 trees per treatment were sprayed (the exact number of trees changed a little bit depending from losses by *Nectria galligena* per row). At the beginning of growing season (19.03.06) the first application was done with 15 lime sulphur/ha over all trees of the plot to minimize infection risk from overwintering conidia on the wood. The treatments and the abbreviations used in the figures are described in table 1. Armicarb is a formulation of potassium bicarbonate and BioPluss consists of a combination of 60 plant extracts and micronutrients. On the trees of untreated control the first symptoms of scab on the leaves were found still on May 5th, shortly before full blossom.

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Table 1: Dosages of preventive and stop-applications (2 m high canopy) during primary ascospore season 2006 - variety 'Gala'

Treatment	Abbreviation	Treatment preventive*	Stop-application**
1	Con	untreated control	
2	Cu+NS+SK (copper only before blossom)	copper 400 g a.i./ha + wetting sulphur 3 kg/ha	Lime Sulphur 15 l/ha
3	Arm	Armcarb 5 kg/ha	
4	Arm+SK	Armcarb 5 kg/ha	Lime Sulphur 15 l/ha
5	BP	BioPluss 3 l/ha	
6	BP+SK	BioPluss 3 l/ha	Lime Sulphur 15 l/ha

* Data of applications before blossom: 07.04., 13.04., 21.04., 24.04. (only copper in Treatment 2 because of spraying of rape-seed-oil against spider-mites on the same day)

* Data of applications after blossom: 05.05., 08.05. (treatment 2: only 2 kg NS), 12.05., 15.05.

** Stop-applications with lime sulphur: only 27.04. and 14.05.

The following data were evaluated in this experiment: On May 16th 2006 scab infections on leaves of rosettes of blossom-clusters were divided in 4 classes (S0 = without lesions, S1 = 1-2 small lesions, S2 = middle infection, S3 = severe infection). For each replication 25 rosettes were assessed. Clear result of this evaluation was, that both preparations (Armcarb and BioPluss), even in combination with stop-application with lime sulphur, were too weak to protect the leaves in a sufficient way during primary ascospore season. So the trial was stopped at middle of May, afterwards the whole plot was sprayed with the same strategy based on wetting sulphur up to middle of August.

Scab lesions on the apples were evaluated provisionally on July 3rd and directly after harvest (about 200 apples per treatment) in a similar way as infections of the leaves. Russetting of the fruits was divided in 4 classes: B1 = without russetting, B2 = < 10 %, B3 = 10-30 %, B4 = >30 % russetted skin. Apples of the class B3 can still be sold in organic fruit growing.

Main topic of **experiment 2** was to find an optimal plant protection strategy against apple scab round blooming period and in the weeks after blossom, when the young fruits are still very susceptible for russetting. The trial was carried out in 2007 at organically grown apple trees of the variety 'Elstar' (with interstem 'Summerred'), planted in spring 2003 at 3,5 m x 1,2 m distance. Each treatment was replicated 3 times, per replication at least 10 trees were chosen, depending from losses of trees in the row. There were some indications to a better efficacy of Armcarb when used as stop-application or as curative spraying than as preventive spraying, so the design of the trial changed.

In spring 2007 the first two applications were the same over all trees of the plot: 16.03. 15 l/ha lime sulphur, 29.03. 500 g copper (active ingredient) + 3 kg wetting sulphur/ha. From 25.03. to 04.05. nearly no rain fell (except for 0,2 mm on 04.04.07). The weather in April was very warm and dry, humidity of air was low, humidity of the soil decreased only at the end of the month, so the development of the plants accelerated heavily. On April 19th the apple trees of the variety 'Elstar' were in full blossom, that was very early in comparison to other years.

Other preparations were sprayed on 05.04. (Para Sommer) and on 11.04. (Neemazal + Dipel ES), the dispensers for confusion of codling moths were distributed on 23.04. In expectation of rainfall the trial started with different treatments on 03.05., when blooming time had ended. The potential of ascospores had increased during the last weeks extremely, so with the first rainfall in May severe infections were forecasted.

Table 2: Dosages of preventive and stop-applications (2 m high canopy), beginning on May 3rd 2007 - variety 'Elstar'

Abbreviation	Treatment preventive	Addition	Stop-application (only May 8 th 2007)
Con	untreated control		
NS+SK	wetting sulphur 2-3 kg/ha		Lime Sulphur 20 l/ha
NS+YS	wetting sulphur 2-3 kg/ha	Yucca-saponin 7,5 l/ha	in this treatment only 2 kg wetting sulphur
NS+YS+SK	wetting sulphur 2-3 kg/ha	Yucca-saponin 7,5 l/ha	Lime Sulphur 20 l/ha
NS+YS+Arm	wetting sulphur 2-3 kg/ha	Yucca-saponin 7,5 l/ha	Armcarb 5 kg/ha
NS+Arm	wetting sulphur 2-3 kg/ha		Armcarb 5 kg/ha

The dates of applications were: 03.05., 07.05., 08.05. (stop-application), 10.05., 14.05. (only 2 kg wetting sulphur), 27.05., 30.05., 12.06., 21.06. (in short intervals without rain, severe damage of the tunnel sprayer the day before), 29.06., 08.07. (2,5 kg wetting sulphur). The residues of that application could be seen for a long time.

The evaluations were done in the same way as in experiment 1. On July 19th/20th 2007 the scab infections on leaves of long branches were assessed, for each replication 25 branches were determined. The apples were harvested at four days: 17.08., 20.08., 24.08. and 29.08. because of great differences in ripening between the treatments. Scab lesions on the apples were evaluated directly after harvest (about 900-1000 apples per treatment) in a similar way as infections on the leaves. For the russetting of the fruits 4 classes were formed: B1 = without russetting, B2 = < 10 %, B3 = 10-30 %, B4 = >30 % russetted skin. Samples of each treatment are still in storage for further assessments of storage diseases.

Results and discussion - experiment 1

Figure 1 shows the result of the evaluation of infection of the leaves on May 16th 2006. The standard-treatment (altogether 1600 g copper a. i. per ha, in combination with stop-applications with lime sulphur) had a good effect on scab in early spring. The combination of the other preparations with lime-sulphur improved the efficacy. Armcarb and BioPlus used only in a preventive schedule were not convincing. So at that point the trial was stopped to avoid heavy secondary infections in the orchard.

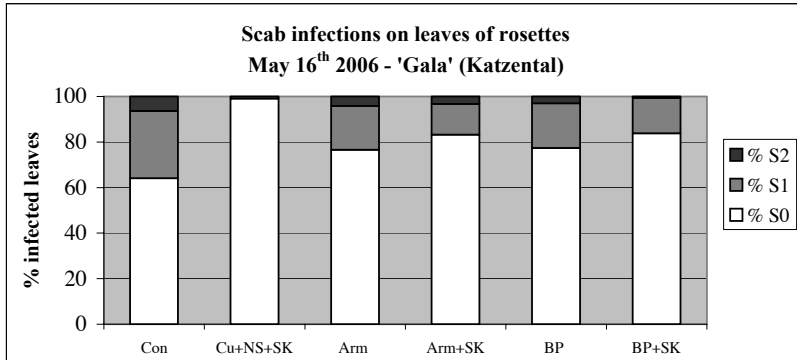


Figure 1: % leaves of rosettes in different classes of scab infection on May 16th 2006, S0 = without lesions, S1 = 1-2 small lesions, S2 = middle infection

A provisional evaluation about scab on the apples followed on July 3rd, the results were similar to the infection of the leaves of rosettes and to the assessments after harvest, which are described in table 3. In the untreated control nearly 95 % of the fruits were heavily infected by apple scab at harvest. The percentage of fruits without scab or with only 1-2 small lesions was too low in the treatments with Armicarb or BioPlus in comparison to the standard treatment.

Table 3: % scab-infected fruits of the variety 'Gala' at harvest 2006 (S0 = without lesions) *

Treatment	% S0	% S1	% S2	% S3
Con	0,0 a	0,9 a	4,5 ab	94,6 c
Cu+NS+SK	73,4 b	22,3 b	2,6 a	1,7 a
Arm	6,6 a	20,8 b	10,2 bc	62,4 bc
Arm+SK	11,6 a	32,4 b	13,0 cd	43,1 bc
BP	9,0 a	21,7 b	21,1 d	48,2 bc
BP+SK	13,2 ab	38,6 b	13,2 cd	35,0 ab

* different treatments only until middle of May, tukey-test, $\alpha = 0,05$

Table 4: % fruits in 4 classes of russetting (B1 = without russetting), variety 'Gala' 2006*

Treatment	% B1 + % B2	% B3	% B4
Con	98,7	1,3 a	0
Cu+NS+SK	96,1	3,9 a	0
Arm	65,3	31,8 c	2,9
Arm+SK	69,4	26,9 c	3,7
BP	80,7	18,1 bc	1,2
BP+SK	91,8	7,5 ab	0,7

* tukey-test, $\alpha = 0,05$

The treatments partly were sprayed in a period, when russetting of the apples can increase. Within the classes B1, B2 and B4 no significant differences were found, but Armicarb showed significantly more apples with 10-30 % russetted skin (B3) than the other preparations, so this preparation seems to be not suitable for use directly after blossom. BioPluss had also some risk of increasing russetting at the variety 'Gala'. Maybe there were interactions with other treatments like oil, too.

Results - experiment 2

Because of the long period of dry weather in April 2007 many of the leaves had no symptoms of apple scab at all, as it is shown in figure 2. The stop-application with Armicarb was not as effective as that with lime sulphur. The first tendency was, that the combination of wetting sulphur+yucca saponin seemed to have a comparable effect to scab as wetting sulphur + stop application with lime sulphur under the conditions in May 2007. The application on July 8th expecting further rain after period of rain and high humidity of the air caused heavy damages by sunburst (about 10 % of the total yield), when temperature rose up to extremes of 35 °C in the middle of July.

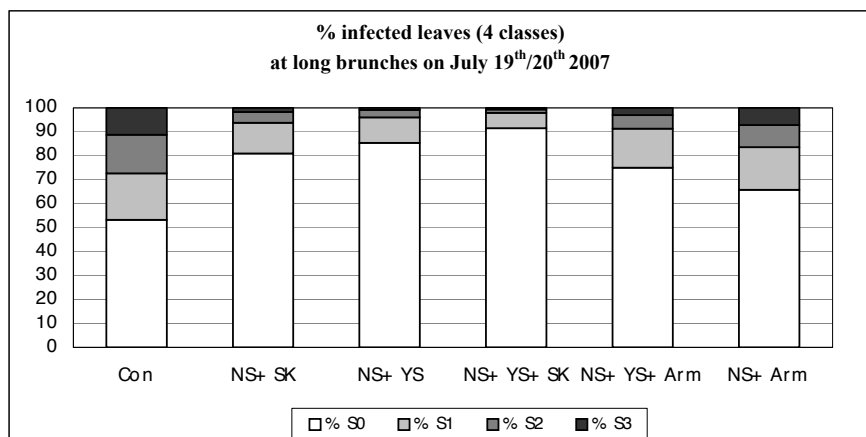


Figure 2: % leaves of rosettes in different classes of scab infection on July 19th/20th 2007, S0 = without lesions, S1 = 1-2 small lesions, S2 = middle infection, S3 = severe infection

Table 5: % fruits in 4 classes of russetting (B1 = 0 % russetting) and scab infections, variety 'Elstar' 2007*

Treatment	B1**	B2	B3	B4**	S0	S1	S2**	S3**
Con	2,5	80,5 b	16,1 a	0,9	66,9 a	31,1 a	2,0	0
NS+SK	0,5	76,8 b	22,6 a	0	97,9 b	1,9 b	0	0,1
NS+YS	0,2	74,1 b	25,6 a	0,1	98,0 b	2,0 b	0,1	0
NS+YS+SK	0	38,0 a	62,0 b	0	92,5 b	7,5 b	0	0
NS+YS+Arm	0,3	85,8 b	13,9 a	0	94,5 b	5,4 b	0	0,1
NS+Arm	0,9	83,7 a	15,0 a	0,4	92,4 b	7,4 b	0,1	0,1

*tukey-test, $\alpha = 0,05$, ** no significances found

Armicarb used as stop-application caused less russetting than in the year before, when it was sprayed in a preventive schedule at the variety 'Gala'. This first data showed an increasing of russetting by the combination wetting sulphur + yucca-saponin with stop-application lime sulphur.

Discussion

There seems to be some effect of Armicarb when used as stop-application against scab. Respecting other results, that will be presented during conference, the new trials in spring and summer 2008 should be designed. One important question is, if Armicarb can be used as stop-application or curative spraying under cold weather conditions in spring, too, in a period when other treatments against insects or spider-mites are usual. Combinations of wetting sulphur and yucca-saponin should be tested in other concentrations and at further varieties to get more data about risk of russetting.

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