

Results from thinning experiments in 2002 and 2003

Ergebnisse aus Ausdünnungsversuchen in den Jahren 2002 und 2003

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Abstract

In 2002 an experiment about thinning blossoms of the apple variety 'Pinova' lime sulfur (in 2002 45 % thinning) and sodium salt (21 % thinning) showed good effects, the number of blossom-clusters in 2003 was very high in the lime sulfur parcels. Results from extracts of *Hericium erinaceum* in 2003 have to be replicated again, the number of applications must be increased.

Keywords: Apple, organic fruit-growing, thinning of blossoms, lime sulfur, sodium salt, potassium chloride

Introduction:

An important goal of organic fruit-growers is the regulation of yield to avoid alternate bearing, which is typical for some varieties like 'Elstar' or 'GoldRush'. Other varieties like 'Gala', 'Rubinette' or 'Pinova' tend to bear too much and too small fruits. Too heavy fruit setting also has negative effects on the inner quality and on the initiation of flower buds for the next season. In the past good effects were produced by the application of lime sulfur, this treatment was used as a standard. The effect of lime sulfur was not the same every year, depending from the weather conditions. Some satisfactory thinning effects were achieved in 2001 by the application of sodium salt (see **literature cited**).

Material and Methods:

During the master education at the LVWO Weinsberg M. Englert (2002) made an experiment about blossom thinning with different agents for the ecological fruit-growing. The trial took place on the fruit experimental station Heuchlingen near to Heilbronn in a conventionally managed orchard with very homogeneous trees of the variety 'Pinova'. The trees were planted in 1994 (distance 3,50 m x 1m) and were about 2,50 m high. Per treatment 10 trees with a high number of blossom clusters were chosen. The number of clusters on the whole tree was counted. In the **season 2002 (experiment 1)** the complete rows were sprayed with a Joco-tunnel-sprayer with 1000 l per ha water amount. Basing on the results of Ruess and Pfeiffer (2002) for sodium salt and potassium chloride an amount of 10 kg salt per ha was chosen. The treatments are listed in **table 1**. In the figures the following abbreviations will be used: B= beginning blossom (BBCH 61), F= full blossom (BBCH 65).

Table 1: Thinning treatments during blossom 2002 at variety 'Pinova' (**experiment 1**)

Treatment 2002	per ha	first treatment	second treatment
Control (Con)		untreated	untreated
Sodium salt (KS)	10 kg/ha	beginning blossom	
Sodium salt (KS)	10 kg/ha	beginning blossom	full blossom
Sodium salt (KS)	10 kg/ha		full blossom
Potassium chloride (KCl)	10 kg/ha	beginning blossom	full blossom
Lime sulfur (SK)	30 l/ha		full blossom
Thinning by hand (H)		June 28 th 2002 thinning of bad fruit qualities (not for breaking alternate bearing)	

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The first time the agents were applied in the morning of April 18th 2002, the sky was clouded, temperature of air was only 7 to 10 °C, the relative humidity of air was high with 85 to 90 %. Leave moisture was low. The second treatment followed on April 22nd at lunchtime. It was warm (20 °C) and sunny, relative air humidity was low at 42 %, the sky was only a little bit cloudy.

The weather during blossom 2002 was mainly cold and wet, some blossoms had been damaged by cold temperatures in early spring, so the fruit-setting was not so high. The fruit setting was evaluated twice (before June-fall and at harvest), the number of apples per tree was counted. The thinning effect (in %) for lime sulfur e.g. was calculated in comparison to control: **$(1 - (\text{apples per 100 clusters lime sulfur} / \text{apples per 100 clusters control})) * 100$** . A negative value means, that the fruit setting was higher than in control.

At harvest each tree was picked separately for the calibration of size and colour with an AWETA-sorting-machine. Size was classified in 5 mm grades, colour in 5 classes. A randomised sample of 100 fruits per treatment was evaluated on russetting (4 classes) to get an estimation of russetting potential of the thinning application.

The influence on the blossom 2003 was investigated twice: In January 2003 a mixed sample of 75 buds per treatment (one twig per tree was removed) was analysed under microscope, the buds were divided in leaf- and blossom-buds. In April 2003 the number of blossom clusters per tree was counted again.

In **spring 2003** the following thinning experiment (**experiment 2**) was started, some of the treatments were tested on their thinning effect because they seemed to be interesting for protection of apple scab. Only one application was done in the morning of April 23rd at full blossom (BBCH 65), the weather was a bit foggy with dew on the leaves, temperature was about 7 to 10 °C, relative humidity of air was 96 to 100 %. The agents were sprayed with portable sprayer (420 ml per tree). As treatments were chosen with the amounts per ha: Control (untreated), Quillaja-Saponin 7,5 kg, Quillaja-saponin + sulfur (7,5 kg / 2 kg), Lime sulfur (30 l), sodium salt (8 and 10 kg), Agromil (2,5 kg), an extract of Asian mushroom (10 kg extract from *Hericium erinaceum*) and sunflower-oil (26 l, formulated with 4 l RIMULGAN). Sodium salt 10 kg was part of the conventional trial, sprayed with Joco-tunnel-sprayer. All evaluations were done in the same kind as in experiment 1.

Results experiment 1 (2002):

Per tree between 200 and 246 clusters were counted, the average over the whole trial was 228. **Figure 1** shows the thinning effect of the treatments during blossom, the values are calculated from the number of apples per cluster on May 15th 2002. With lime sulfur application during full blossom a thinning effect of about 45 % was achieved, this was nearly too strong. Comparing only the sodium salt treatments the second treatment at full blossom had more efficiency than that at the beginning of flowering, one reason could be the cold weather during the first treatment. The thinning effect of the second treatment was about 22 %. The two spraying of potassium chloride caused about 32 % thinning effect.

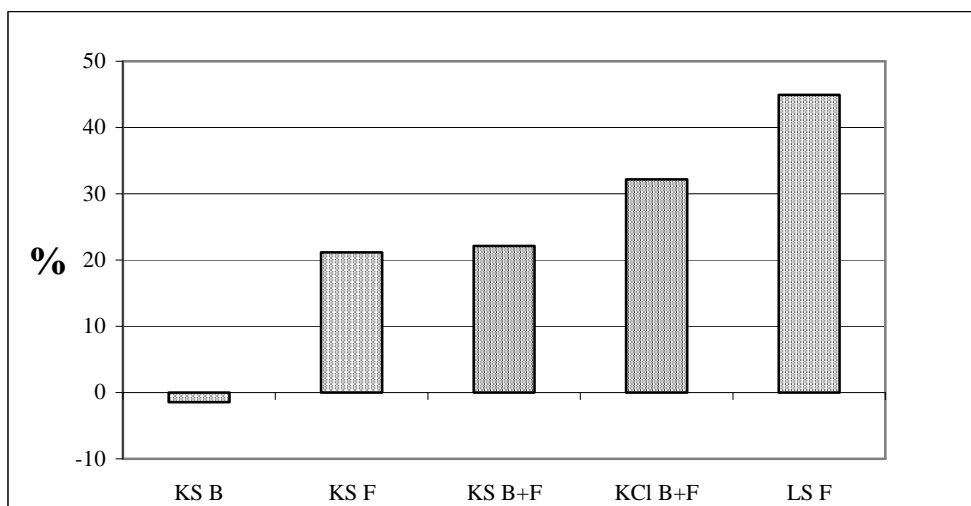


Figure 1: % thinning effect of KS=sodium salt, KCl=potassium chloride, LS=lime sulfur

Dates from harvest 2002 are summarized in **table 2**, all values are the average from 10 separately evaluated trees. In the last column the fruit-setting per cluster at harvest is listed.

Table 2: Yield per tree (kg), average fruit weight (g) and fruit setting at harvest (apples per blossom cluster) at 'Pinova' 2002

Treatment (date)	kg/tree	Fruitweight (g)	Apples per cluster at harvest
Control	15,07	125	0,60
Sodium Salt (B)*	23,35	158	0,60
Sodium Salt (F)*	18,06	143	0,53
Sodium Salt (B+F)*	19,86	150	0,59
Potassium chloride (B+F)*	18,83	148	0,45
Lime sulfur (F)*	17,82	168	0,46
Thinning by hand	14,88	170	0,41

* B=begin of blossom, F=full blossom

There were some fluctuations between the different treatments at the yield per tree (15 kg per tree in control versus 23 kg in sodium salt (B)). In the control the average weight per apple was very low, because the most apples had a size between 65 and 75 mm. By thinning by hand quite a few apples were removed from the trees because of lacks in quality (size, less colour). So weight per apple was very high with 170 g, but the yield per tree with about 15 kg was as low as in control. The time for picking the apples was reduced clearly. The best relation between yield per tree and fruit weight was seen at lime sulfur treatment. In **figure 2** the distribution of the yield (as kg/tree) in the different classes of size is compared.

In all treatments a shifting towards higher diameter of the apples could be watched, the most clearly at lime sulfur and thinning by hand, between these two variants was nearly no difference. Principally the russetting of the apples was low, fruits in the categories 3 (10-30 % russeted skin) and 4 (> 30 % russeted skin) were watched seldom. Between the treatments nearly no differences were seen. Finally the results about blossom 2003 are listed in **table 3**.

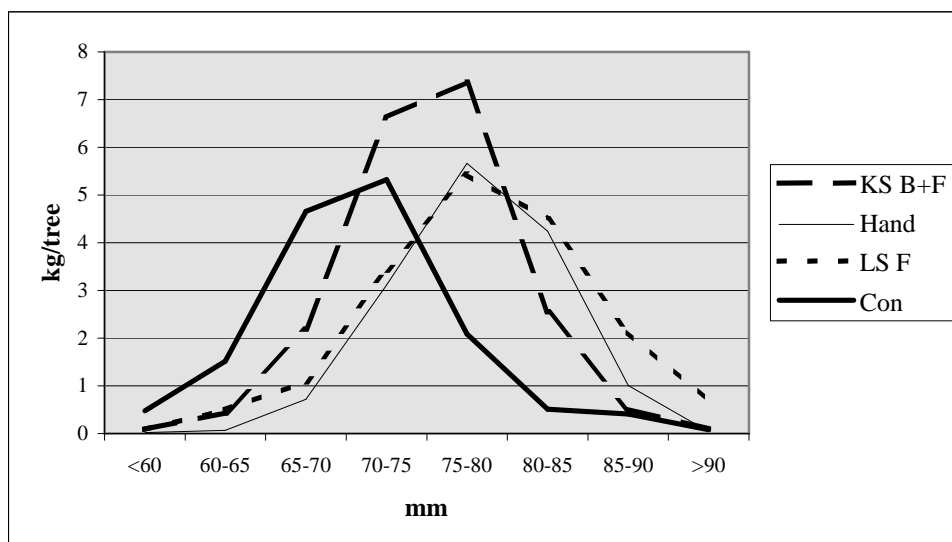


Figure 2: kg/tree in classes < 60 mm up to > 90 mm, comparison of control (Con), lime sulfur (SK F), sodium salt (KS B+F) and thinning by hand (Hand)

Table 3: % leaf- and flower buds January 2003 before pruning, blossom cluster/tree April 2003

Treatment April 2002	% leaf-buds Jan. 2003	% weak flower buds Jan. 2003	% strong flower buds Jan. 2003	blossom-clusters/tree April 2003
Control	28,0	58,7	13,3	213
Sodium Salt (B)*	18,7	61,3	20,0	179
Sodium Salt (F)*	18,7	54,6	26,7	219
Sodium Salt (B+F)*	9,3	49,3	41,3	198
Potassium chloride (B+F)*	6,7	41,3	52,0	220
Lime sulfur (F)*	2,7	54,6	42,7	306
Thinning by hand	2,7	54,7	42,6	215

* B=begin of blossom, F=full blossom

A high percentage of strong flower-buds was counted under the microscope in the treatments sodium salt (B+F), potassium chloride (B+F), lime sulfur (F) and thinning by hand. In the control the lowest percentage of flower-buds was evaluated. These results could be confirmed with the counting of blossom-clusters in April 2003. Lime sulfur had the most blossom clusters with 306 clusters per tree. On the other side in the control only 213 clusters per tree were counted.

Results experiment 2 (2003):

In the season 2003 there were some cold nights in April, so about 70 % of the flowers had been damaged before blossom. Only small differences were watched between the treatments, the yield per tree was homogeneous, the weight of the fruit fluctuated weakly. Altogether the average fruit weight was very low because of 2 weeks extremely hot and dry weather in August 2003. None of the treatments increased the russetting of the fruits severely. The results are listed in **table 4**. The percentage of leaf- and flower-buds will be counted in February 2003, the number of clusters/tree in April 2003.

Table 4: Flower-clusters/tree, fruit-setting before june-fall (apples per flower cluster), yield (kg/tree), average fruit weight (g) and fruit-setting at harvest, variety 'Pinova' 2003

Treatment	Clusters/tree	Fruit-setting before june-fall	kg/tree	Weight/apple g	Fruit-setting at harvest
Control	333	0,80	21,68	87	0,75
<i>Quillaja</i> -saponin	223	1,07	22,64	99	1,05
<i>Quillaja</i> -Saponin + sulphur	240	0,89	21,04	96	0,94
Lime sulfur	256	0,85	23,87	98	0,96
Sodium salt 0,8%	243	0,84	20,21	88	0,96
Sodium salt 1,0 %*	334	0,87	29,29	91	1,01
AGROMIL	245	0,96	20,40	85	1,01
<i>Hericium erinaceum</i>	238	0,94	23,09	98	1,01
Sunflower oil	231	0,95	22,08	97	1,03

* for comparison from conventional trial

The highest percentage of well coloured apples with diameter between 65 and 90 mm were evaluated at the treatments with lime sulfur, sunflower-oil and the Asiatic mushroom *Hericium erinaceum*.

Discussion:

In 2002 the use of sodium salt with 10 kg/ha at full blossom showed good effects, it was nearly as effective as lime sulfur (30l/ha), when it was applicated during warm weather. In the following season lime sulfur had the highest setting of flower buds. The results could not be affirmed in 2003, but it seemed to be a specific situation in 2003 because of the dry spring and dry summer. In conventional thinning trials in Southern Germany the effects were low, too. Some thinning effects were caused by an extract from *Hericium erinaceum*, these results have to be replicated the next years, the number of treatments should be increased. In Germany it is necessary to achieve a registration of some agents for thinning blossoms in ecological apple production.

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