

Comparison of different thinning measures for organic grown apples (cultivar 'Pinova')

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Abstract

Organic fruit growers have to deal with more difficulties in regulating the crop load because of higher yield variation (alternation) and higher production costs. Thinning by hand is a usual technique in organic apple orchards but needs a lot of work and time. Chemical-synthetic thinning agents or plant hormones for crop regulation are not allowed. One part of the research project "Increasing of crop safety and optimizing of crop loading of organic grown pome fruit" (2806OE197, "Bundesprogramm Ökologischer Landbau", 04/2009-12/2011) is a comparison of different thinning measures for apple trees: thinning with the rope thinner, lime sulphur, additional pruning and the effect of different dosages of the foliar fertilizer Wuxal Aminoplant. Tested sites are located at Ahrweiler, Jork and Weinsberg. Selected trial results of the apple cultivar 'Pinova' from 2009 are described.

Keywords: thinning, apples, organic, rope thinner, lime sulphur

Introduction

To obtain a high fruit quality and regular yields crop load regulation measures are necessary. Organic fruit growers have to deal with more difficulties with regard to regulating the crop load because of higher yield variation (alternation) and higher production costs. In spring 2009, a research project (FuE 2806OE197) was started, funded by the "Bundesprogramm Ökologischer Landbau" (04/2009-12/2011). The aim is, to prove different possibilities for securing yield and optimizing crop loading in organic grown apples and pears. The project is a cooperation between the research facilities LVWO Weinsberg, DLR Rheinpfalz and ÖON Jork. Only the results of the trials in 2009 with the apple cultivar 'Pinova' at Ahrweiler and Weinsberg are described here.

Material and Methods

Trial 1 was carried out on an organic apple orchard at the fruit experimental station of LVWO Weinsberg. 'Pinova' trees have been planted in spring 2003 (10 trees per treatment, each tree was counted as replication). In spring 2009 flower set (blossom clusters/ tree) was counted. Different thinning methods were compared (table 1): thinning by hand, Darwin rope thinner, lime sulphur, additional pruning and foliar fertilizer Wuxal Aminoplant. Additional pruning was done to reduce the number of blossom buds. Therefore single branches and parts of the trees with lots of spurs were removed, similar as it was done in former experiments at the cultivar 'Elstar' (Eis *et al.*, 2008). Lime sulphur was carried out with a hand-gun and a tunnel sprayer. The rope device was used at three different flower stages. After blossom for the treatments with the rope device the blossom clusters were counted divided into 'complete cluster removed', 'only blossom removed, rosette leaves still on the branches' and '1 to 6 blossoms/cluster left'.

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On June 8th and 10th all trees were thinned by hand (except of control) and time has been stopped. Fruits were harvested on three picking dates: 19.09.09, 24.09.09 and 1./2.10.09. Statistical analysis were carried out with ANOVA (Tukey-tests, $\alpha=0.05$).

Table 1: Thinning treatments at Weinsberg (trial 1).

treatment	application/ dosage	date
untreated control		
thinning by hand		
rope thinner BBCH 57	200 U/min, 8 km/h	17.04.09 (pink bud stage)
rope thinner BBCH 59	220 U/min, 8 km/h	20.04.09 (flowers forming a hollow ball)
rope thinner BBCH 65	220 U/min, 8 km/h	22.04.09 (full blossom)
lime sulphur	3 x 30 l/ha + 1,5 l Bioblatt-Mehltaumittel (Sojalecithin) /ha	21.04.09, 23.04.09, 24.04.09
additional pruning		16.04.09
foliar fertilizer	Wuxal Amino plant, 15 l/ha	13.05.09

Trial 2 at Ahrweiler was on-farm placed in an organic orchard within two rows of 'Pinova'. For details about treatments and date see table 2. Thinning by hand was compared with thinning with lime sulphur, as well as with mechanical thinning by the Darwin rope thinner. The testing variants have been repeated four times with seven to nine trees per testing plot respectively. Five trees per plot have been evaluated (in total 20 trees per variant). After treatment the trees have been adjusted to an average amount of 100 to 110 apples per tree (thinning by hand and lime sulphur: on May 26th, rope thinner: on June 17th). Fruits were harvested on four picking dates: 25.09.09, 01.10.09, 09.10.09 and 20.10.09.

Table 2: Thinning treatments at Ahrweiler (trial 2)

treatment	application/ dosage	date
thinning by hand		
rope thinner BBCH 59	200U/min, 8 km/h	21.04.09
rope thinner BBCH 65	200U/min, 8 km/h	23.04.09
lime sulphur	3 x 15 l/ha and meter crown height	22.04.09, 23.04.09, 27.04.09

Results

At Weinsberg flower set has been counted before blossom. Also the relation to the stem diameter was calculated. These data should be taken into account of the interpretation of time necessary for thinning (table 3). Especially with the rope thinner BBCH 57, notable less time was needed for thinning by hand. The rope device at the BBCH stage 59 needed a bit more time, because the trees had more blossoms. Using the rope device at the pink bud stage and when the most flowers forming a hollow ball, a higher percentage of blossom clusters with more than 4 flowers left were counted on the tree. Whereas using the rope thinner when first flowers are open, leads to the result, that more blossom clusters with less than 4 flowers remain on the tree.

Despite of a high number of flowers and an average time for thinning by hand, the treatment with lime sulphur had significantly less fruits on the trees (table 3 and 5) compared to the treatments rope thinner (BBCH 57 and 59), thinning by hand and the control. The reason is probably the strong thinning effect of lime sulphur in combination with an overdose of the Bioblatt-Mehltaumittel by mistake at the first application. Thinning by hand needed more time than with additional use of the rope device or lime sulphur. For the treatment additional pruning a lot of time was needed for thinning by hand, but these trees also had a high number of flowers. Additional about 12 h/ha were needed for the extra pruning.

Table 3: Blossom clusters/tree and blossom cluster/stem diameter and time for thinning by hand (h/ha) for different treatments at 'Pinova' trees (Weinsberg 2009, Tukey-test $\alpha=0.05$).

treatment	blossom clusters/tree	blossom cluster/ stem diameter	time for thinning by hand (h/ha)
untreated control	287	6.83	0
thinning by hand	256	6.03	125 bcd
rope thinner BBCH 57	250	5.87	87 a
rope thinner BBCH 59	285	6.41	106 abc
rope thinner BBCH 65	228	5.38	92 ab
lime sulphur	286	5.98	113 abc
additional pruning	299	6.12	140 cd
foliar fertilizer	245	5.71	149 d

The trees in the testing plots treated with lime sulphur and rope thinner at Ahrweiler have been thinned by hand after the treatment to an amount of 100-110 apples per tree. The working time for thinning by hand has been calculated under presumption that removing one apple per tree needs one hour per ha (2500 trees/ha). Considering this the time saving because of mechanical thinning and lime sulphur was computed (table 4). In the mechanical thinned plots more than 50 % less apples has to be removed by hand after treatment than in the plots with only hand thinning and the time saving was about 250 h/ha. The time saving for the lime sulphur treated plots was 68 h/ha. At harvest there were hardly differences regarding to the average yield per tree (number and kg per tree). The average fruit weight was lower in the hand thinned trees, but generally was high.

Table 4: Calculation of time saving for hand thinning after treatment in comparison to only hand thinning ('Pinova', Ahrweiler 2009).

treatment	average amount of apples removed by hand	apples removed by hand (%)	time saving in comparison to thinning by hand (h/ha)*
thinning by hand	448	100 %	
rope thinner BBCH 59	197	56.1 % less	252
rope thinner BBCH 65	209	53.5 % less	240
lime sulphur	380	15.2 % less	68

*Presumption: thinning one apple per tree needs one hour per ha (2500 trees/ha).

Table 5 shows the yield data for Weinsberg and Ahrweiler. At Weinsberg, using the rope thinner on the first two flowering stages showed with about 23 kg/tree the highest yield. Regarding the total yield per tree, the treatment lime sulphur with only 14 kg/tree was significantly different to all other treatments. With about the same yield, the first two rope thinner treatments (BBCH 57 and 59) achieved a significantly higher fruit weight than the control. The treatment thinning by hand had with 146 the largest number of apples per tree (except of untreated control) and therefore a smaller fruit weight. The untreated control had about twice the number of fruits per tree than the other treatments but with 94 g only a very small fruit weight. Despite the same number of fruits per tree, the treatment foliar fertilizer had over two kilo less on the trees compared to the rope thinner BBCH 65, and just a little higher fruit weight than the treatment thinning by hand.

Table 5: Total yield, number of fruits/tree and average fruit weight (g) for different treatments at Weinsberg and Ahrweiler, 'Pinova' 2009 (Tukey-test $\alpha=0.05$).

Treatment	Weinsberg			Ahrweiler		
	yield (kg/tree)	fruit/tree	fruit weight (g)	yield (kg/tree)	fruit/tree	fruit weight (g)
untreated control	23.75 c	254 c	99 a	-	-	-
thinning by hand	21.41 bc	146 b	147 b	20.4	106	186
rope thinner BBCH 57	22.60 bc	130 b	174 c	-	-	-
rope thinner BBCH 59	22.94 c	136 b	171 c	21.9	106	193
rope thinner BBCH 65	20.17 bc	115 ab	175 c	22.1	106	198
lime sulphur	13.98 a	81 a	175 c	20.4	100	196
additional pruning	19.20 bc	113 ab	170 bc	-	-	-
foliar fertilizer	17.88 b	115 ab	154 bc	-	-	-

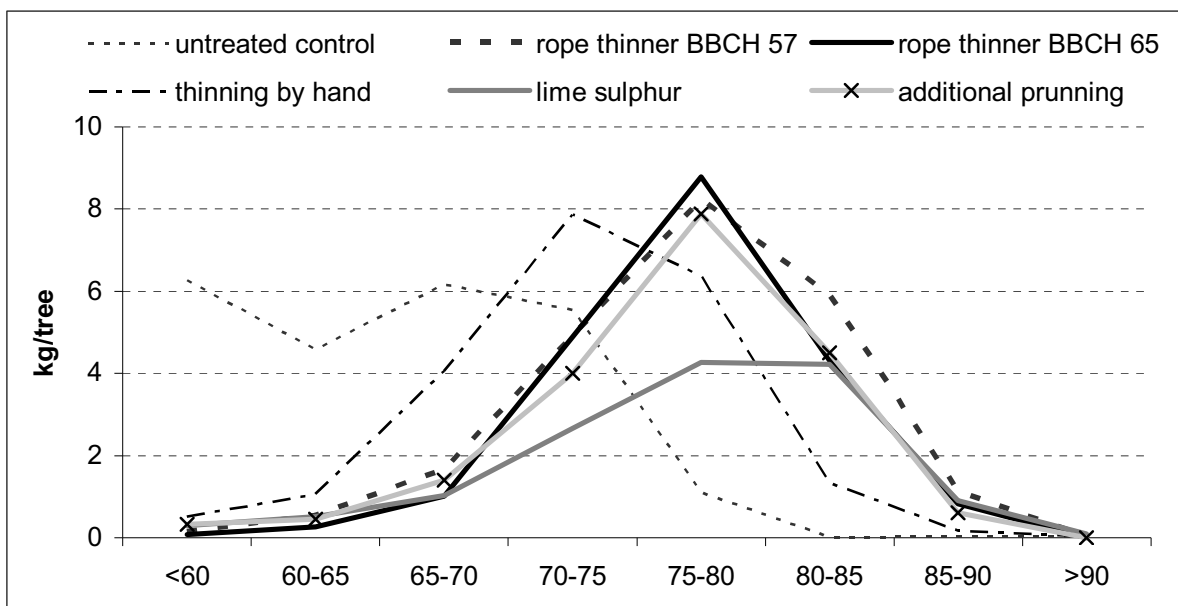


Figure 1: Yield (kg/tree) and size of 'Pinova' apples at Weinsberg, 2009.

Figures 1 and 2 show the size of 'Pinova' apples at Weinsberg and Ahrweiler. Size grading at Ahrweiler was similar at all four treatments with the highest peak in size 75-80. But trees thinned with the rope thinner had more larger fruits. At Weinsberg, the treatments with the rope device and 'additional pruning' had their highest peak in size 75-80. Fruit size of the treatment 'Thinning by hand' was a bit smaller. Many fruits of the 'control' were very small and not as good coloured as the other ones.

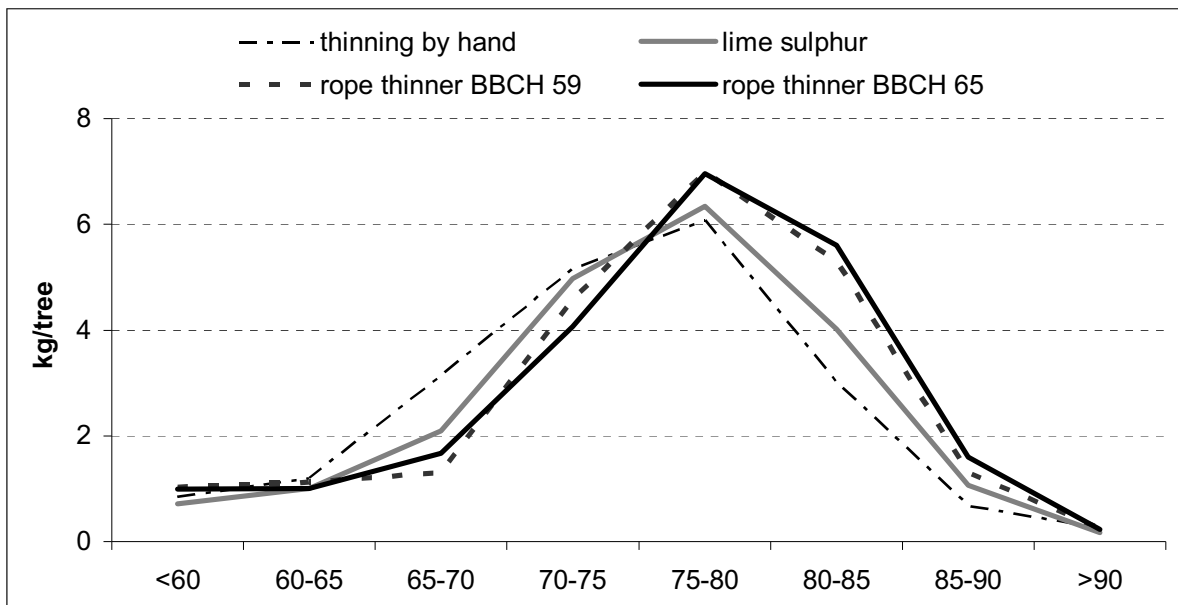


Figure 2: Yield (kg/tree) and size of 'Pinova' apples at Ahrweiler, 2009.

Looking at figure 3 (Weinsberg), the treatment leaf fertilizer had the highest proportion of red coloured fruits, followed by the rope thinner BBCH 65 and additional pruning, while the control had a high number of not sufficient coloured fruits. Although the treatment lime sulphur had a lower yield, the percentage of well coloured fruits was high. At Ahrweiler (figure 4) fruits of the treatment lime sulphur had the highest proportion of red coloured fruits.

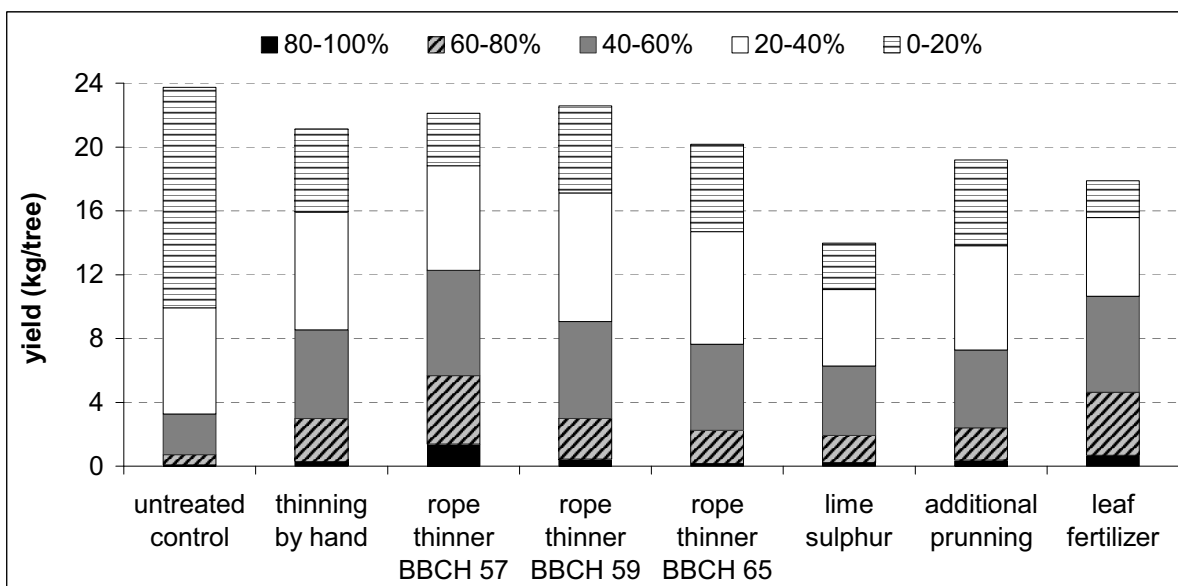


Figure 3: Yield (kg/tree) and colour of 'Pinova' apples using a five-step colour scale (0-20%, 20-40%, 40-60%, 60-80%, 80-100%), Weinsberg 2009.

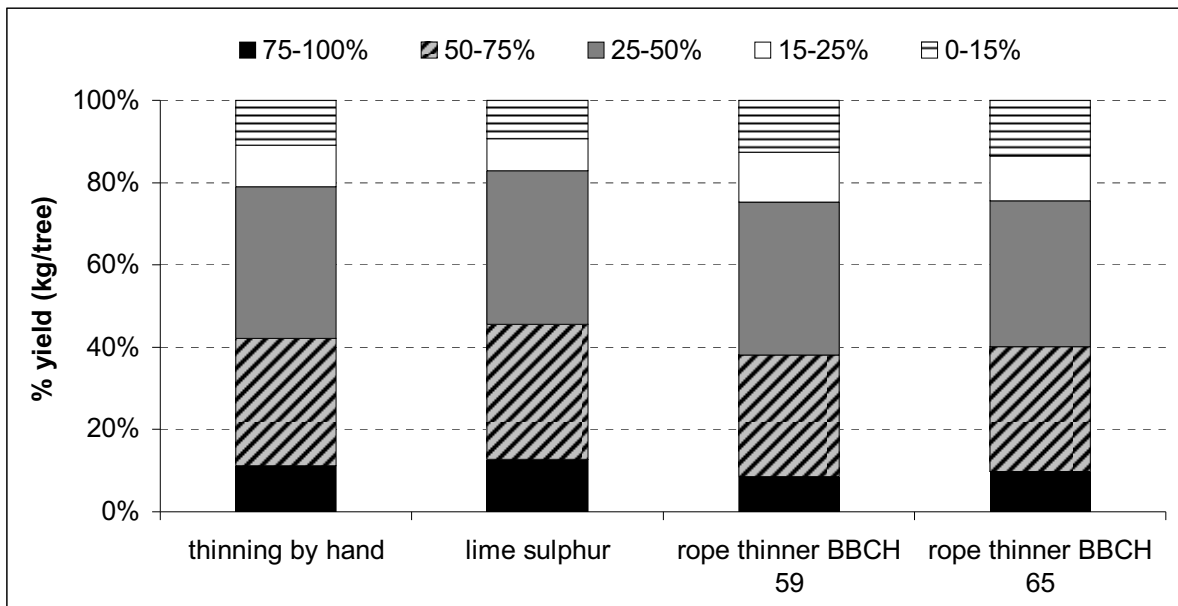


Figure 4: Percentage and colour of 'Pinova' apples (kg/tree) using a five-step colour scale (0-15%, 15-25%, 25-50%, 50-75%, 75-100%), Ahrweiler 2009.

Discussion and Outlook

Summarizing the first year results for 'Pinova' apples, the treatment with the rope thinner (new types of ropes) showed good results in 2009, regarding the total yield, colour and fruit size as well as the time for thinning by hand. Using lime sulphur also saved time for thinning by hand. In Ahrweiler fruits treated with lime sulphur had a higher proportion of red coloured fruits than the treatments with the rope device. Total yield of lime sulphur was here at the same level like the treatment thinning by hand.

Unpublished results with the rope thinner at organic grown cultivars 'Topaz' and 'GoldRush' in Weinsberg had the effect, that the trees, where the rope thinner was used in 2008, in spring 2009 had a low number of blossom-clusters/tree (comparable to hand thinning alone), while the level was higher for the treatments with Armicarb or lime sulphur. This winter also tree growth reaction of the rope thinner will be measured (number and length of one-year-old branches) and possible changes in habit evaluated. In order to assess the thinning potential and the treatment influence on biannual bearing, counting the number of blossom clusters/tree in spring 2010 will show further reactions of the trees.

A comparison of different thinning strategies for organic apple production in Switzerland have shown, that the best method was a combination of rope thinner (old type of ropes) and N-Vinasse, regarding the fruit set reduction and a high flower bud set next year (Weibel *et al.*, 2008). In the following season additionally a combination of the rope device and lime sulphur or of a leaf fertilizer like Aminoplant should be proved at 'Pinova' trees, too.

References

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