

## Blossom thinning and pre-harvest defoliation with air in SQ 159 - Natyra® apples

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### Abstract

*Natyra® - SQ159 is a scab-resistant apple variety with high potential for organic cultivation, but it requires specific management due to slow growth, alternate bearing and late harvest. This study evaluated mechanical blossom thinning and pre-harvest defoliation with air. Trials were conducted on M9 rootstock trees with weak to moderate vigour. Mechanical thinning was tested using the BMV machine (rotating wires) and the Vimas defoliation machine with air, while pre-harvest defoliation was examined using the Vimas and OLMi defoliation machines shortly before harvest. Key parameters included rotor speed, hydraulic pulses, air pressure and driving speed. Results showed that optimised thinning reduced the number of flowers, decreased hand-thinning labour, and increased average fruit weight. Pre-harvest defoliation enhanced first-pick proportions and improved fruit colour, especially in weaker growing trees. Excessive pulses or high driving speeds caused leaf damage, highlighting the need for precise machine settings. Targeted mechanical thinning and defoliation thus provide an effective approach to improving fruit quality and colour in Natyra® - SQ159, though settings must be adapted for tree vigour, flower density and machine type.*

**Keywords:** Natyra®, SQ159, blossom thinning and pre-harvest defoliation with air

### Introduction

Natyra® - SQ159 is an apple with firmness at harvest around 8 kg/cm<sup>2</sup> and the sugar content goes up to 14 °Brix. An important advantage is its scab resistance (*Rvi6*), which gives this variety great potential for organic cultivation. For this reason, several organic growers have invested in new plantings of Natyra® - SQ159 in recent years. However, unlike several other currently grown varieties, we have found that Natyra® - SQ159 requires a different cultivation approach: (1) the trees grow slowly, thinning is necessary to avoid alternate bearing, and (2) harvest time is late, so achieving good and early coloration is essential. Trials with blossom thinning and defoliation with air indicate that growers can make remarkable progress in this area.

### Material and Methods

Trials were conducted at two different timepoints during the season to improve the quality of Natyra® - SQ159. The trials were carried out in Natyra® - SQ159 orchards owned by organic growers. All trees were grafted onto M9 rootstock and had weak to moderate growth vigour.

#### (I) Mechanical flower thinning with wires AND (II) Mechanical flower thinning by flower blowing

A trial was set up in 2021 using the BMV thinning (Figure 1) machine, which has two rotors equipped with plastic wires to knock off flowers. Both rotors can run at different speeds. In 2023 and 2024, additional trials were set up using the Vimas defoliation machine with air (Figure 2) to evaluate whether it was possible to blow away some flowers. For both application, trials were carried out between the beginning of flowering and full flowering to

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minimize leaf damage. The impact on manual thinning labour, the effect on production and return bloom were monitored. The trials were setup as demonstration trials (without repetitions) on bigger plots of at least 30 trees were the observations and counting's were done on 10 trees with homogeneous amount of flower buds.

### (III) Colour improvement

For the second part of the study, the OLM1 (Figure 3) and Vimas defoliation machine with air was used shortly before harvest to improve fruit coloration. Particular attention was paid to adjusting air pressure and driving speed. The airflow needed to remove sufficient leaves without damaging the fruit. The effects on colour, proportion of first-pick fruit, and overall fruit quality were monitored. The trials were setup as demonstration trials (without repetitions) on bigger plots of at least 30 trees. The production and the colouring was determined on these 30 trees.



Figure 1: BMV thinning



Figure 2: Vimas defoliator



Figure 3: OLM1 defoliator

## **Results**

### (I) Mechanical flower thinning with wires

Before the trial was set up, for each treatment 10 trees were given a flowering score between 1 (no flower buds) and 9 (very many flower buds). Only trees with high amount of flower buds were included in the observations. Three different rotation speeds were tested, with a difference between the lower and upper rotor. The driving speed was 8 km/hour. In June, the labour required for hand thinning was recorded and converted to labour per hectare. During the harvest in October, yield and complete sorting were determined (Table 1).

Table 1: Mechanical flower thinning on Natyra® - SQ159 with rotating wires on the BMV machine in 2021.

	Treatment	Object		Flowering Rate (1-9)	Hand Thinning (hours/ha)	Kg/tree	Mean fruit weight (g)
		Rotation speed upper rotor (rpm)	Rotation speed lower rotor (rpm)				
1	Control	-	-	7.4	99	11.1	151
2	Light thinning	180	250	7.9	92	10.5	161
3	Moderate thinning	200	250	7.2	72	9.8	155
4	Strong Thinning	220	250	7.5	69	8.8	163

The higher the rotation speed, the stronger the thinning effect. Additionally, the presence of a table system at the bottom of the tree makes it difficult to drive deep enough into the canopy and the wire of the table system can get caught around the machine. At a speed of 180 rpm, only slight thinning occurred and the reduction in hand thinning work was small. From 200 rpm onwards, the labour required in summer decreased, but the impact on fruit size remained limited because the trees had also a low growing level. Return bloom in the plots with moderate to strong mechanical thinning was better compared to control and light mechanical thinning.

### (II) Mechanical flower thinning by flower blowing

In 2023 and 2024, two trials were conducted during flowering period using the Vimas defoliation machine to remove flowers. In 2023, variations were made in air pressure, number of hydraulic pulses and driving speed (Table 2). The machine is not high enough to work over the total length of the trees, so the results for production and fruit size are the results for the production up to a height of 2.5 m.

Table 2: Various settings of flower blowing on Natyra® - SQ159 in 2023.

	Pressure (bar)	Driving speed (km/h)	Hydraulic pulse	Total tree				Up to a height of 2.5 m	
				Flower buds / tree	Fruits / tree harvest	Fruits / 100 clusters	Thinning (%)	Kg/ tree	Mean fruit weight (g)
1	Control	-	-	165	137	83	-	14.7	152
2	0.59	1.2	18	162	94	58	30	12.3	175
3	0.59	1.7	15	138	98	71	15	11.0	168
4	0.59	1.7	20	145	107	74	11	12.2	159
5	0.50	1.7	15	141	99	70	15	12.0	167

Thinning occurred in all tested treatments, ranging from 10 to 30%. Hand thinning during summer was not necessary. As a result, the average fruit weight was 10 to 20 grams higher. The proportion of apples smaller than 70 mm decreased from 4.5 kg/tree for the untreated trees to <2 kg/tree for the different treatments for all treated objects. Furthermore, during the winter of 2023-2024, it quickly became clear that the trees in the control plot were in an alternate bearing year, while the treated trees had developed sufficient flower buds for 2024 (evaluation in 2024).

A high number of pulses caused a lot of leaf damage, which is undesirable. With respect to the number of pulses, a setting of 17 appears to offer a good balance between thinning intensity and leaf damage. Regarding air pressure, little thinning occurred at 0.50 bar; at least 0.55 bar is required to achieve a noticeable effect.

In 2024, the number of hydraulic pulses was consistently kept at 17 while and pressure and driving speed were varied again. There was no clear line between 0.55 and 0.59 bar. In terms of driving speed, this takes time. When driving at 2 km/h or faster, no thinning occurred. At 1.2 km/h, the thinning was slightly too strong. The optimal driving speed appears to be between 1.5 and 1.7 km/h.

### (III) Improving colour of Natyra® - SQ159

In 2021, a trial was conducted with the OLM1 defoliation machine. Three weeks before the expected harvest date, two different treatments (different driving speed) were applied on 30 trees with both weak and moderate growth levels. The proportion of fruit harvested during the first and second pickings was then determined (Figure 4).

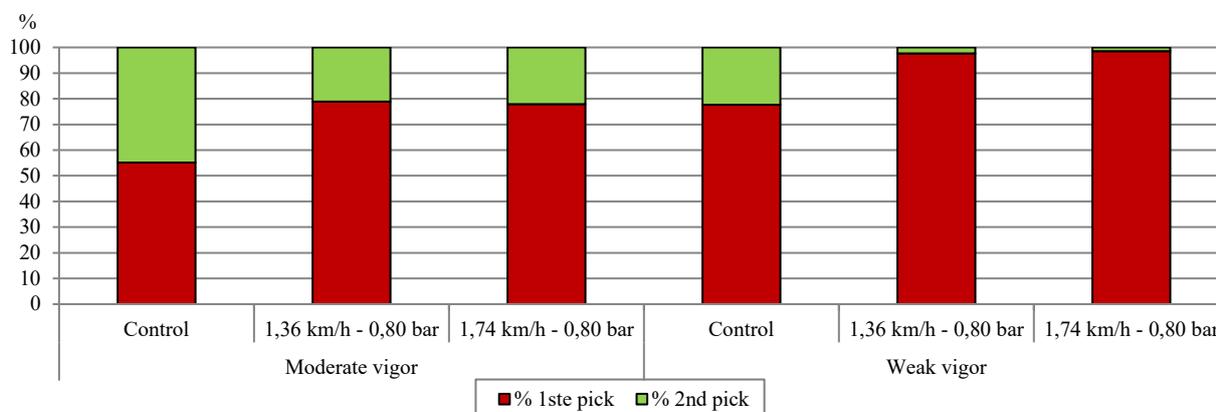


Figure 4: Distribution across different harvest times of Natyra® - SQ159 after lead defoliation in 2021.

Natyra® - SQ159 responds very strongly to partial defoliation shortly before harvest (Figure 4). In weak-growing trees, the entire crop could even be harvested in a single picking. In stronger-growing trees, the proportion of fruit harvested during the first picking increased by at least 20%. When the OLM1 defoliation machine operates at a pressure of 0.8 bar, a considerable amount of foliage is removed, indicating that very high pressure is not required for this variety. This helps limit the risk of fruit damage. Defoliation carried out so close to harvest had no effect on firmness or sugar content and only minimal on bruising or cracking.

## **Discussion**

### Blossom thinning

The timing of blossom thinning is critical. The earlier in the season that excess flowers or young fruits are removed, the greater the beneficial effects on fruit size, the reduction of hand-thinning labour and the formation of flower buds for the following season. In years with a high number of flower buds, thinning flowers with air during the flowering period can be a valuable first step. It should be noted that the results presented here are specific to the Vimas defoliation machine with air. Adjustments such as pressure, driving speed and rotational speed can vary between different models and will also depend on the number of flower buds present. Indicative tests on other varieties have shown that flower bud formation does not proceed equally smoothly across all varieties, and therefore thinning strategies may need to be adapted accordingly.

### Defoliation for colouring

Similarly, the results regarding defoliation to improve fruit colour are specific to the Vimas defoliation machine with air. As with blossom thinning, the optimal settings for pressure, driving speed, and rotational speed differ between machine models. Furthermore, the effectiveness of defoliation on colour enhancement varies between varieties: while Natyra® - SQ159 shows a strong response, other varieties may exhibit more limited improvements.

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