

Strategic irrigation against apple scab (*Venturia inaequalis*)

M. Korsgaard¹

Abstract

In Denmark there are several organic orchards, that do not spray at all, and they seek non-spraying methods to prevent apple scab. In this pilot trial, irrigation with water at strategic moments was tested to prevent scab-infection.

In April-June 2011 in five organic orchards we irrigated the orchard floor, to force the ascospores to be released. We irrigated with at least 0.2 mm of water in dry periods, at least 12 hours before rain forecast. The idea was to empty the stock of ascospores during dry spells, so they would dry out without infecting the leaves. To find the best strategic times for irrigation, we used the local weather forecast and the scab-warning programme Rimpro based on data from climate stations located in the orchards.

In this first year of trial we experienced difficulties in spreading the water evenly. A water wagon turned out to work better than sprinklers. We found, that the irrigation did result in ascospore-release, but the effect on the scab-attack was not significant. We also experienced, that the fruit growers found this way of preventing scab very interesting and easy to carry out. The pilot-trial was financed by "Fonden for Oekologisk Jordbrug" and in 2011 it was conducted by the organic advisory-service. It is continued in 2012 and 2013 at the University of Copenhagen.

Keywords: *Venturia inaequalis*, non-spraying, prevention, organic apple production.

Introduction

Apple scab is often causing serious losses in apples, especially if springtime is humid and in susceptible varieties.

In 2008 and 2009 the apple scab was not a problem in Denmark. This was due to dry weather during spring and early summer, and the fact, that dry spells got interrupted by short showers of rain.

These rain showers released the overwintering ascospores. But the showers were short and the leaves dried rapidly, hence the spores never got humidity enough to infect the leaves. They simply dried out.

The two seasons with none or very low level of scab-infections gave the idea of utilizing the climate by irrigating at strategic moments. Such a scab preventing method would be helpful to the Danish organic fruit growers, who produce unsprayed apples, and could also reduce the number of scab-sprays in sprayed orchards.

Material and Methods

In five organic apple orchards we established an irrigation system to irrigate the orchard floor. We simulated short showers of rain during dry spells from beginning of April till the beginning of June.

The growers decided themselves when to irrigate. Their decision was supported by the local weather forecast combined with the scab warning-system Rimpro, based on data from their own climate station.

¹ M. Korsgaard, AGRECO, University of Copenhagen, Denmark. mkor@life.ku.dk

The irrigation was turned on in situations, when Rimpro showed that many ascospores were ripe, and the weather was dry, and rain was forecasted later than within 12 hours.

The growers irrigated with at least 0.2 mm water, which is 0.2 l/m².

Three of the hosts put up sprinklers to irrigate the orchard floor. Two of the hosts created a water wagon.

The trials were conducted in 6 rows of apples. In the orchards with sprinklers, we irrigated every other plot of 15m row.

In the two orchards with water wagon the 6 rows were either irrigated or not irrigated.

The degree of scab attack on the leaves and on the apples got registered in July on 5 trees in the middle of every plot. The infection level on the apples got registered again in September, right before harvest.

The release of ascospores got registered in a spore trap in April, to see if the ascospores did react to the irrigation.

The five hosts irrigated against scab from 4 till 12 times during April and May, see table 1.

The differences reflect the different climatic situations in the five orchards and their slightly different strategies of irrigation. Some of the hosts choose to irrigate once a week during dry spells to empty the stock of ascospores combined with irrigation the day before rain forecast. Other hosts choose only to irrigate the day before rain forecast.

Table 1: Description of five trials with irrigation against apple scab.

Host No.	Location	Varieties and age of trees	Other types of scab control	Irrigation method	Number of irrigations in 2011	Dates of irrigations
1	Slangerup, Nord-sjælland	'Aroma', 20 years	Biodynamic preparations	Water wagon	4	11/4, 25/4, 29/4, 7/5
2	Kyse, Syd-sjælland	'Holsteiner Cox', 3 years	None	Sprinklers	12	4/4, 11/4, 15/4, 18/4, 26/4, 31/4, 2/5, 10/5, 12/5, 21/5, 31/5, 5/6, 6/6
3	Regstrup, Vest-sjælland	'Aroma', 5 years	None	Sprinklers	9	11/4, 18/4, 25/4, 28/4, 2/5, 8/5, 10/5, 21/5, 5/6
4	Otterup, Nordfyn	'Gravenstein', 11 years	Sulfur-sprays	Sprinklers	7	7/4, 10/4, 11/4, 18/4, 25/4, 1/5, 9/5
5	Harndrup, Midtfyn	'Elishof', 15 years	Sulfur-sprays	Water wagon (from old sprayer)	7 (x 2 each time)	14/4, 17/4, 30/4, 2/5, 14/5, 21/5, 5/6

Results

There was less than 1% scab in orchard no. 4 and 5. These orchards had a very dry spring, and in both of the orchards sulphur sprays were also used to control scab.

In orchards no. 1-3, 39 - 74 % of the apples had spots in September. The spots were caused by both scab and an undefined "spot" disease.

In orchard 2 and 3 there was a tendency to a small, but positive effect of the irrigation, but the level of scab rose very fast in July and August, while the weather turned extremely wet (Figure 1 and 2).

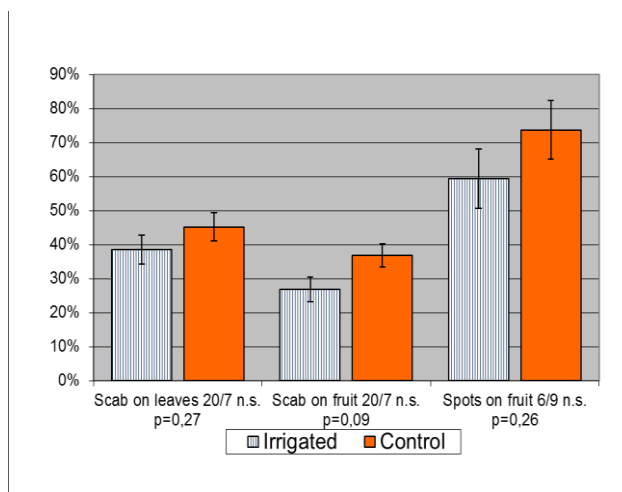


Figure 1: Effect of strategic irrigation on apple scab 2011. Orchard no. 2. Variety: Holsteiner Cox

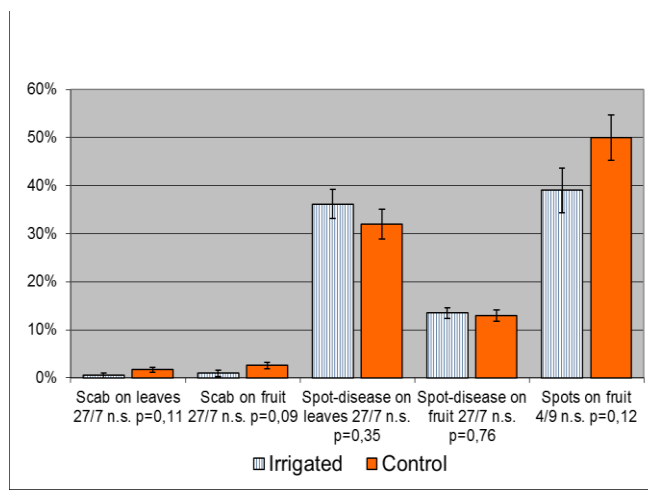


Figure 2: Effect of strategic irrigation on apple scab and "spot"-disease 2011. Orchard no. 3. Variety: Red Aroma

In orchard 1 the water wagon was top sprinkling, so the whole tree got wet. That gave a tendency to a slightly negative effect of the irrigation, when monitored in July, but in September, there was no difference between irrigated and non-irrigated plots.

The irrigation of the orchard floor did result in ascospore-release, this was confirmed by counting ascospores in a spore trap.

Another result of the trial was the gaining of technical experiences on the irrigation equipment; see the evaluation in table 2.

The quality of the weather forecast is important for this method. We found, that in some cases the Norwegian weather forecast (www.yr.no) service is more accurate, than the Danish (www.dmi.dk).

We also experienced, that the growers found it very interesting to conduct the experiment and to decide when to irrigate. All five hosts would like to use the method in general, if we find the right "recipe".

Table 2: Evaluation of the equipment for irrigation against apple scab

Equipment	Description	Advantages	Disadvantages
Water wagon, rebuilt manure spreader	The manure spreader was mounted with a pump and shortened, to be able to turn in the rows.	It has a large water tank, and needs not to be filled often. It spreads the water over several rows, which is faster.	The irrigation is wetting the trees, which requires a longer dry period after the treatment. The chance of good moments for scab-irrigation are reduced.
Water wagon, rebuilt mist sprayer.	1000 l mist sprayer, where the compressor was removed and a bar with sprinklers*) was mounted in front. The pump was geared up.	Evenly distribution of the water on the orchard floor without "shadow" effect from the trunks. The trees does not get wet at all. Fairly cheap to rebuild.	The treatment takes time. The water tank is small and needs to be filled often. The long treatment time diminishes the chances of optimal irrigation moments.
Sprinklers hanging in the rows, underneath the branches.	A hose is hung up app. 0,5 m above ground in the tree rows. Microsprinklers**) was mounted between every 2.-3. tree.	Easy, you just turn on the water for 3-10 minutes (depending on the water pressure). The short treatment time gives better chances of optimal irrigation moments.	The trunks are shadowing the irrigation, leaving dry spots. The water pressure was too low to cover the orchard floor. Hanging branches are in risk of being irrigated.

*) The sprinklers are Hardi Round nozzles no. 1553-40, 10 l/min at 2 bars.

***) Micro sprinklers no. 022201 from Dansk Vandingssteknik.

Discussion

The strategic irrigation against apple scab did actually provoke the ascospores to be released. But the method has to be improved to gain a satisfactory effect.

The limitations of the method got clear in 2011: If scab is not completely prevented at midsummer, a following wet summer will result in a too heavy scab attack on the fruit.

It is also a question how much impact conidiospores from neighbouring areas are having on the late scab attack.

It is important to find a technical design, which works fast and easy and covers the whole orchard floor. We will work on improving the technical design in 2012 and also work with higher amounts of water.

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