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Conference pears; work on system changes to enable better scab control in organic orchards in the Netherlands

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Abstract

Scab control in Conference pears is the bottleneck in organic growing. A group of growers, advisers and researchers in the Netherlands is working on new approaches to organic pear growing. Central to this approach is a reliable and good scab control. Changes in the system of cultivation are sought which will enable this scab control with less fungicide. This has become even more urgent since copper was banned as a fungicide in the Netherlands. First results from trials on vigour control show that there is potency for system changes that will enable a better scab control in organic growing. Scab incidence was reduced in three trials with 34, 58 and 82% respectively. The project, in which also other cultivation measures are being tested, will be continued.

Keywords: Conference pears, scab, *Venturia pirina*, vigour control, system approach.

Introduction

The demand for organic pears in North-western Europe is high compared to the limited production. In spite of the good market perspective there are very few pear growers in the Netherlands who dare convert to organic production. The most prominent reason for this is their fear of scab (*Venturia pirina*). And indeed it is the experience of those who are growing organically that it is very hard to control this important disease. This is even more so since Copper based products were banned as fungicides in the Netherlands.

Since 2005 a group of 6 growers have formed an intensive study group that tries to find new ways to make organic pear growing more stable. This group participates in a research project carried out by the Louis Bolk Institute and funded by the Dutch Ministry of Agriculture. In a series of on-farm trials various measures are tested that can contribute to a system of growing that enables the grower to keep the scab pressure low without using large amounts of copper.

The results from these trials are combined with observations by growers, advisers and researchers in an ongoing discussion during fieldtrips and meetings. Thus far this work has made the group aware that the epidemiology of pear scab clearly differs from that of apple scab and that we need more knowledge to come to a new and more stable system of growing Conference pears. Of the cultivation measures tested, vigour control has shown to be a useful measure to help control scab.

In this article preliminary results of two trials on vigour control are presented together with more casual observations, questions and hypotheses.

Material and Methods

Trial 1, started spring 2006.

Conference on Quince C rootstock, planted 1995, V-system 3,4 x 1,2 m, young fertile clay soil. Block trial with 4 replications, 8 trees per field. The standard spraying program was applied in both treatments.

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Stem notching was carried out with chainsaw, pre-bloom, from two sides; only in 2005. Root pruning was carried out under 45 degree angle, almost undercutting the tree. In 2005: one side pre-bloom, the other side in July. In 2006: both sides pre-bloom.

Scab incidence and severity on the fruit were measured indoors after harvesting separately per tree. Scab was scored in 4 categories: 0= no scab; 1= < 10 small lesions or 0,5 cm² (=very little scab); 3= 10-30 small lesions or 0,5-1 cm² (= clearly visible but still marketable); 4= > 30 small lesions or >1 cm² (=no longer marketable as good quality)

Scab on shoots was counted on year-old twigs cut in late winter.

The reduction in shoot growth was not measured exactly but judged visually by the group.

Trial 2, started spring 2007.

Conference on Quince C rootstock, planted 1991, slender spindle 3,25 x 1,4 m, Light clay on sand. Block trial with 4 replications, 8 trees per field. The standard spraying program was applied in all treatments.

Stem notching was carried out with chainsaw, pre-bloom, from two sides. Root pruning was carried out under 90 degree angle, 40 cm from the stem. Scab incidence and severity on the fruit were measured as in trial 1.

Trial 3, 2006-2007

On-farm trial sprayed by the growers. Full-grown Conference on QC. On location 1 without replications, on location 2 in four replications. Fields several rows wide and around 20 trees long with observations made on trees in the middle. Scab was determined as in trial 1.

Results

Trial 1.

Soon after conversion a heavy scab pressure developed in this orchard. With hindsight the grower, from his conventional experience knowing Conference as being not very susceptible to scab, has underestimated scab and maybe underestimated the spray products used in organic growing (at that period low dosages of copper). At the start of the trial this high pressure shows itself in almost all year-old twigs having scab. Combined with the knowledge that incidence on the fruit in 2005 was also very high we may assume that also the ascospore dose from overwintering leaves was high. Leaf degradation in this orchard was relatively bad. Vigour was judged by growers as high. The owner wanted to cut the stems from 2 opposite sides about halfway with 30 cm between cuts. We created extra vigour control by combining this with root pruning. The aim was to suppress shoot growth drastically with to enable better scab control. Because of the severity of the scab problem and the fact that the overall vigour was clearly too high it was unacceptable for the grower to leaf part of the trees untreated. The question addressed here is not if vigour control has to be applied but how much vigour control is needed to bring scab under control again.

In the first season in mid July the vigour control was clearly visible. Shoots at the top stopped growing earlier and the tree was visibly more open. Considering the drastic measures taken this effect was rather mild. Weather in summer was very dry which made scab control relatively easy.

Surprisingly there was a clear effect on both scab incidence and severity at the fruit. Most of the scab found comprised of small lesions. Root pruning reduced the number of scabbed fruits with 58%. Scab incidence on the new wood was very low overall, but still showing a clear effect of the treatment.

Table 1: Trial 1: Twig scab at start of trial and after one year.

	March, 2006 (start of trial)		March, 2007	
	lesions/m	incidence	lesions/m	incidence
1. trunk notching	51	94%	0,8	10%
2. trunk notching + root pruning	46	92%	0,2	6%

Table 2. Trial 1: Fruit scab incidence.

	Harvest 2006		Harvest 2007	
	total incidence	category 1 incidence	total incidence	category 1 incidence
1. trunk notching	19 %	16 %	11 %	10 %
2. trunk notching + root pruning	8 %	7 %	2 %	2 %

Table 3. Trial 1: Mean production and fruit weight.

	Harvest 2006			Harvest 2007		
	kg/tree	number of fruit/tree	mean fruitweight (g)	kg/tree	number of fruit/tree	mean fruitweight (g)
1. trunk notching	28.6	256	112	20.9	171	123
2. trunk notching + root pruning	28.7	265	111	21.7	194	113

In the second season we can assume that we started with a lower scab pressure than the year before. Again we carried out root pruning and again we saw the same effect on vigour. This year the summer was very wet.

Scab incidence on the fruit was lower than in 2006 but again the effect of vigour control was marked. Root pruning reduced the number of scab fruits with 82%. Scab incidence on the shoots has not been measured yet.

Production in both years was roughly the same for both treatments (65 and 52 ton/ha). The average fruit weight was below optimum in both years. In 2006 no hand thinning was carried out to see the effect of the root pruning on fruit set and June drop. In 2006 the orchard had a severe infestation with pear suckers (*Psylla piri*) which led to suboptimal fruit growth. The impression of the group is that this level of growth control does not have to lead to suboptimal fruit size if hand thinning is carried out properly as has been done in the rest of the orchard.

Trial 2.

This orchard has been organic from planting and has gradually developed a high scab pressure which fluctuates from year to year. Leaf degradation is good and vigour medium. Apart from scab, canker (*Nectria galligena*) and dying of mixed buds (*Alternaria? Pseudomonas?*) pose problems in this orchard. After the good results with trial 1 a second trial was started here to check the effect on scab under different conditions and see whether vigour control also has an effect on canker and dying mixed buds.

Because this location is vulnerable to drought and sweet water is scarce, root pruning is considered risky by the grower. Therefore different vigour control measures are compared. Due to wet conditions in summer, all treatments had a weed cover on the tree strip during summer which minimizes the difference between treatments 1 and 4.

Table 4. Trial 2. Percentage of the fruit in different scab categories.

	cat 0	cat 1	cat 2	cat 3	Total incidence
1. untreated	33 b	51 b	13 a	3 a	67 %
2. root pruning	57 a	34 a	8 a	1 a	43 %
3. trunk notching	40 b	47 b	10 a	3 a	60 %
4. grasscover treestrip	35 b	51 b	11 a	3 a	65 %

Table 5. Trial 2. Average production per tree and mean fruit weight.

	kg/ tree	mean fruit weight (g)
1. untreated	10.1	181
2. root pruning	10.5	163
3. trunk notching	11.2	173
4. grasscover treestrip	11.0	168

In July the effect of vigour control was visible but the differences between treatments and between individual plots were not very clear. As in Trial 1. the effect on scab incidence and severity was surprisingly clear for the root pruning treatment. The reduction of scab incidence from 67 to 43 % comprises an effect of 34%.

Due to the dying of many mixed buds the production was low with around 23 ton/ha. The effect of root pruning on fruit size was no problem under these circumstances.

Trial 3.

Aim of this trial was to determine when it is possible to stop spraying so as to save sprays and reduce residue on the fruit. Trials on some farms and in some years gave sometimes incomprehensible results. The trials presented here show a picture that fits the general observations made by the growers.

Table 4 Trial 3. Scab incidence on fruit and twigs after ending spraying at different dates.

	Location 1	Location 2		fruit	
	fruit	fruit	twigs		
	2006	2006	2006	2007	
	incidence	incidence	incidence	severity lesions / m	
1. stop spraying at July 1.	1.6 %	76 %	41 %	12	44 %
2. stop spraying at Sept. 1.	0.4 %	28 %	22 %	2	26 %

Location 1 is an orchard where scab has been kept under control since conversion and the pressure is very low. Location 2 is typical for many organic orchards where spraying is done till right before harvest to keep the fruit reasonably "scab-free". The majority of the fruits show just a few lesions. Ending spraying at July 1 leads to a sharp increase of scab incidence. The summer infections lead to small lesions and mainly a rise in the percentage category 1 fruit.

Because pears with just a few small lesions are still marketable some growers may ignore this. The amount of twig scab shows the same trend though and thereby ignoring late summer infections may lead to a further build up of the scab pressure in an orchard.

Discussion

Some 15 years back, controlling scab on organic Conference pears was not really a problem. Since then it has become very hard to keep scab off the fruit and the twigs. As the results of trial 3 show, it is necessary to keep the fruit covered with fungicides almost until harvest time. These results strengthen the impression that the fruit of Conference pears stays very susceptible throughout the summer. In this pears are different from apples where the susceptibility of the fruit is lower in summer and offers the chance to minimize spraying once you have come (almost) clean through the primary season. With pears summer sprays are needed to prevent fruit scab.

Another reason for a tight schedule in summer is the prevention of twig scab. The amount of twig scab is a critical factor in the epidemiology of pear scab. Once an orchard develops more than a little twig scab it becomes very hard to keep the epidemic under control. Already pre-bloom the constant spread of conidiospores from the twig lesions sets in. This may lead to very early infections of the fruit. In fact the fruitlets may be infected already before bloom, at the stage when the buds are opening and the individual flowers are still tightly together. Our hypotheses is that during heavy rainfall spores are washed in and then have optimal condition to germinate on tissue of which we can assume that it is not well covered with fungicides. An experiment to test this hypothesis failed two years in a row because of dry weather conditions during the critical period.

These early fruit infections become visible shortly after bloom. At this moment we seldom find scab at the leaves. With ascospore discharge almost finished these early lesions on the fruit may for a short period be an important source of conidiospores, next to lesions on year-old twigs which were not cut away during winter pruning.

In 2006 we labelled these infected fruitlets to find out how long they last on the tree and observe the development of the lesions. We found that within 4 weeks 50% of the infected fruitlets had aborted, after 8 weeks 20% were left and at harvest less than 5 %. While lesions at fruitlets of 15-20 mm in cross section are sporulating very actively, this seems to diminish rapidly. Our hypothesis is that these early lesions on fruit can be an important motor in the scab epidemic, just after bloom when ascospore discharge is at its end.

To keep scab under control we think the following conditions must be met, which may be reached by certain measures:

Condition	Measures
Low ascospore pressure in spring	Leaf shredding, degradation enhancing sprays, antagonistic fungi?
Low conidiospore pressure in spring	Pruning away infected twigs, high dosage limesulphur sprays at bud break.
Preventing early fruit infections	???
An open canopy and timely cessation of shoot growth	Sufficient crop load: vigour control measures

The most important factor determining this year's scab epidemic is the successfulness of last years prevention programme. A build-up of pressure must be prevented. Of the different measures that can be thought of vigour control is one that can have far reaching consequences, both positive and negative. On the positive side we hope that a more open canopy will positively affect the microclimate inside the tree and enable better coverage when spraying. Vigour control leads to an earlier cessation of shoot growth which may shorten the period in which susceptible tissue is available in the form of young leaves and shoots. On the negative side we may have diminished fruit size and thereby income loss. The general idea amongst pear growers is that pear trees need to be rather vigorous to be productive. Training and pruning are aimed at concentrating this growth at the end of branches. Finding the balance between fruit size and vegetative growth is an important task.

From trials 1 and 2 we can conclude that vigour control can contribute substantially to controlling scab. We were surprised that relatively minor differences in growth level can lead to such big differences in scab incidence and severity. Not only does this measure lead to less scab on the fruit but more important we have the impression it is an important tool to bring scab under control again once it has gotten out of hand as can be seen in the example of trial 1. In this trial, which is still being continued we are now going to supplement the vigour control measure by a different pruning strategy to make the trees even more open. Of course other measures should also be applied here to bring scab under control again.

A question of the long term is whether the current planting systems are really suited for organic growing. Maybe other tree shapes and according planting systems offer better opportunities to combine good scab control with the desired productivity and fruit quality.

Currently a lot is awaited from new spray products based on potassium bicarbonate for instance Armicarb. In an extensive on farm trial in 2006 we found that during summer this product worked reasonably well provided the scab pressure was low (unpublished results). If European organic growers want to diminish their use of copper by switching to other products all other conditions must be met to keep scab pressure low.

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