

**CONTROL OF APPLE SCAB, ACCORDING TO COMPUTER "RIMPRO" PROGRAM
(YEARS 2011-2012)**

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Abstract

Apple scab (Venturia inaequalis) is the most dangerous fungal disease that affects apple culture. Damages caused each year in apple production are extremely large. Although every year there are marked major advances in methods of control of this disease often they are carried empirically and with high cost in yield. RIMpro prognosis computer program (Relative Infection Measure program), is one of most efficient models to perform chemical treatments against apple scab at the right time. This program gives sufficient and convincing data about primary infections (ascospores) and secondary infections (conidia). At the same time the program is a good model for any other damaging disease of apple culture but also for harmful diseases affecting other agricultural crop.

Keywords: apple scab, prognosis, RIMpro, electronic weather station.

1. INTRODUCTION

RIMpro (Relative Infection Measure program), is one of the simulation models for the biology of main pests and diseases in fruits, created by Marc Trapman, the Netherlands (www.biofruitadvies.nl)

Apple scab disease, to be fully controlled requires extensive knowledge, both in terms of combating time, as well as the types of fungicides effective against the disease. There are computer programs (software) such as APPLESCAB (Blaise, 1987), (Duket, 1989), VENTEMTM (Butt, 1992), RIMpro (Trapman, 1994), and WELTE (Aalbers, 1998), whose main purpose is to optimize the use of fungicides in the proper time. Computer models estimate the severity of apple scab infection, depending on the cultivar resistance, weather changes and information received for pathogen.

RIMpro program is one of the programs that make it possible to identify the most dangerous time for primary infections (Ascospores) and for secondary infections (Conidia).

The RIMpro program provides information for the ascospores release and may be useful in determining the time of severe infections during primary infection. (R. Rancane, Eihe M., L. Vilka. 2010).

In Denmark in 2008, 2009, 2010, there were performed for primary infections, 19 preventive treatments with fungicides. While through the RIMpro program, are performed 3-4 curative treatments or 79% fewer treatments. (Hanne Lindhard Pedersen, Birgit Jensen, Lisa Munk, Marianne Bengtsson, Marc Trapman).

The program RIMpro gives automatically the forecast of events that will occur and on this base determines the protective measures. The protection strategy is based on preventive measures. These measures are based and not calendar. The program facilitates decision-making work for chemical treatments.

With this method cannot be monitored the peritheces maturing but there are caught just ascospores in the air

by ascospore's captor. Through graphs that are automatically given in the computer, are presented moments of risk exposure, by apple scab for primary infections as well as for secondary infections. Through the notification system, farmers are notified to start treatment with fungicides.

2. MATERIALS AND METHODS

RIMpro program is installed and implemented by specialists of the Research Institute of Organic Agriculture in Switzerland (FiBL) through Korça SNV to support farmers who grow apples culture. Electronic meteorological station is installed in an apple farm in Dvoran village in Korça in April 2011.

This station sends the data automatically in the office computer where the program gives the prognosis of possible predictions for the first ascospores apparition or data about secondary infections. These data can be drawn by each apple grower or agricultural specialist via the website: www.bioaktuel.ch

RIMpro program has two main elements:

1. Electronic weather station (Fig. 1.3)
2. Programming of disease.

The climate data are provided automatically by orchard on the office computer which is specific for this program. The electronic station records and sends in the office the following information

1. The air temperature
2. The soil temperature
3. The amount of rainfall
4. The air humidity
5. The solar radiation
6. The apple's leaf moisture (Fig. 2)
7. The capture time of winter ascospores by ascospore's captor

This station also contains a mechanism called ascospore's captor (Fig. 3). This captor is placed in orchards in a place surrounded by wire mesh with height 1 m and surface 1.2 m x 1 m. On the ground, within the wire are put in autumn, leaves infected by apple scab.

Through the air suction provided by ascospores captor, it catches even the mature ascospores from leaves that are set on the ground and fixed in a scalable film tape (coil) in the time separation set in the camera (Fig. 3). This film tape can be issued at any moment and can be observed under a microscope if the first mature ascospores of apple scab are caught.

At the same time through the film can be issued the number of caught ascospores. The installed program on the computer performs the calculation of climate (temperature, humidity, etc.) with the biology of this disease. Through graphs given automatically in the computer, are presented moments of exposure by apple scab risk (Graph 1, 2, 3). Through the notification system, farmers are announced to start the treatment with fungicides.



Fig. 1. Electronic weather station



Fig. 2. Gauge of the leaves' moisture



Fig. 3. Ascospore's captor



Fig. 4. Coil of the ascospore's captor

To compare the tactile degree of apple from apple scab at different times, orchard of 1 ha was divided into two parts with 0.5 hectares each. In one part were performed routine chemical treatments, while in the other one, treatments were performed according Rimpro program that predicts the time of treatment (Table 1).

Chemical preparations were the same in each case. Analyses were performed on the leaves and fruits to account the tactile degree. For three varieties: Golden Delicious, Paragold and Starking were labelled 10 trees for each of them. While for each tree were analyzed 10 fruits and 10 leaves. So for each variety were analyzed 100 fruits and 100 leaves.

2.1. ASSESMENT OF THE TACTILE DEGREE BY APPLE SCAB

At the beginning of August when the probability of the leaves or fruits to get infected from apple scab is very low, at 10 labelled apple trees, for each variety, there are analyzed 10 leaves and fruits each = 100 fruits and 100 leaves in total. The tactile degree indicates the percentage of leaves or fruits affected in 100 leaves or 100 fruits analyzed (Table 3 and Graph 4).

3. The tactile degree will be calculated through the formula:

$$P = n \times 100 / N$$

Where: P = degree of tactile

n = number of leaves or fruits affected by apple scab

N = the total number of leaves or fruits analyzed for each variant. (Hasani M).

3. RESULTS AND DISCUSSION

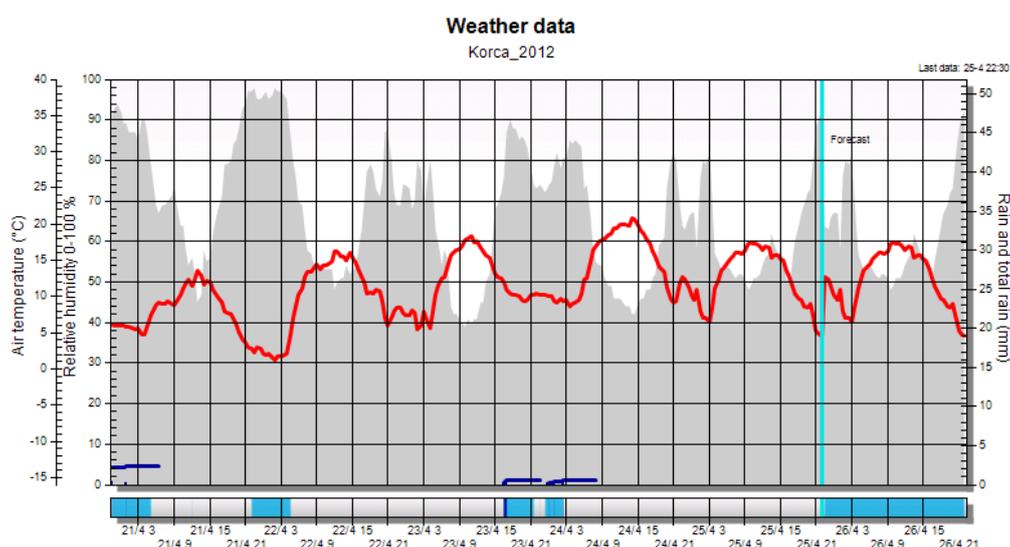
Table 1. The dates of chemical treatments and fungicides used (Years 2011-2012)

TREATMENTS ACCORDING TO RIMPRO			ROUTINE TREATMENTS			
Nr	Dates of treatment		Fungicides used	Dates of treatment		Fungicides used
	2011	2012		2011	2012	
1	21. 4	27.4	Captan + Sulphur	10.3	09.3	Copper sulphate
2	27. 4	30.4	Penconazole	25.3	20.3	Copper hydroxide
3	06. 5	08.5	Cyprodinil + Metiram	10.4	12.4	Dodine
4	13. 5	16.5	Captan + Carbendazim	22.4	21.4	Captan + Sulphur
5	17. 5	18.5	Trifloxystrobin + Metiram	29.4	27.4	Penconazole
6	20. 5	28.5	Kresoxym methyl	04.5	04.5	Cyprodinil + Metiram
7	29. 5	30.5	Trifloxystrobin + Propineb	11.5	12.5	Captan + Carbendazim
8	05. 6	6.6	Hexaconazole + Captan	20.5	19.5	Trifloxystrobin + Poliram
9	12. 6	11.6	Difenoconazole	27.5	26.5	Kresoxym methyl
10	20. 6	24.6	Dithianon	02.6	01.6	Trifloxystrobin + Propineb
11	-		-	09.6	08.6	Hexaconazole + Captan
12	-		-	13.6	15.6	Difenoconazole
13	-		-	18.6	22.6	Dithianon

The temperatures and rainfall plentiful in the period 1 April to 30 June have been very favourable for the development of apple scab (Table 2).

Table 2. The Data of average temperatures and three monthly rainfalls.

Years	Months	The average monthly temperature (°C)	Monthly rainfall (mm)	Number of days with rain
2011	April	8.73	80.7	13
	May	12.3	148	14
	June	21.7	80	4
2012	April	8.3	124.3	11
	May	13.5	144.6	10
	June	18.5	34.1	3



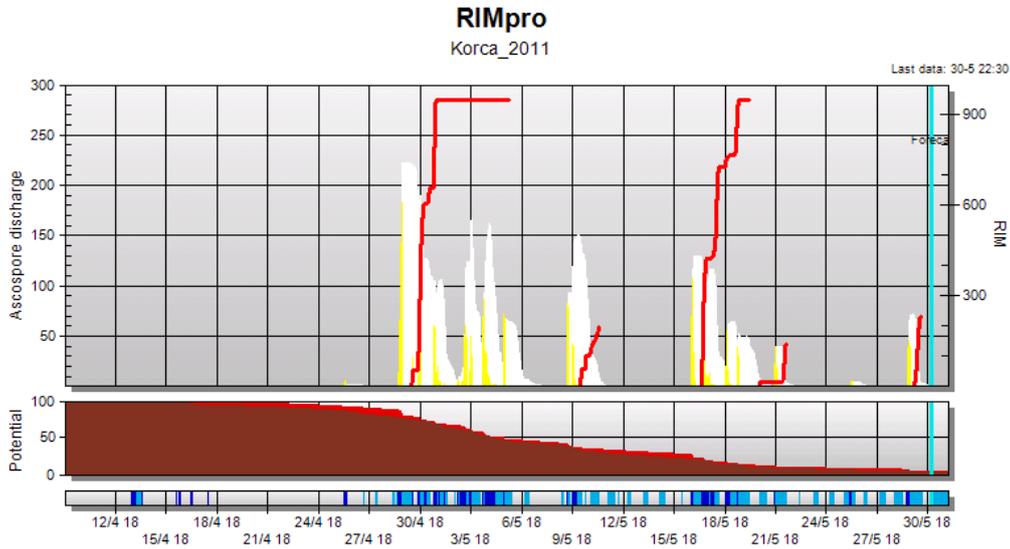
Graph 1. The data on the weather according to days (2011-2012)

The red line expresses the daily temperatures in Celsius degrees.

The blue navy line  expresses the amount of rainfall in mm.

The gray color  expresses the relative air humidity in %.

The blue light color  expresses the duration of moisture on the leaves.



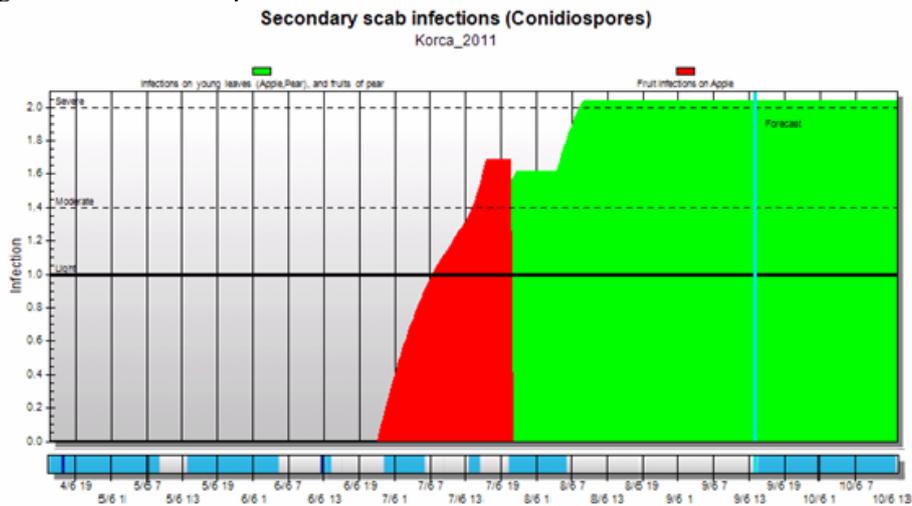
Graph 2. The data on ascospores maturing and the risk of infection (2011-2012)

The yellow color  expresses the number of released ascospores.

The white color  expresses continuity of release time and released ascospores number.

The red line  expresses the degree of risk by ascospores.

The blue light color  expresses the duration of moisture on the leaves.



Graph 3. The dates on the risk of secondary infections

The green color  expresses the degree of risk from apple scab in leaves.

The red color  expresses the degree of risk from apple scab in fruits.

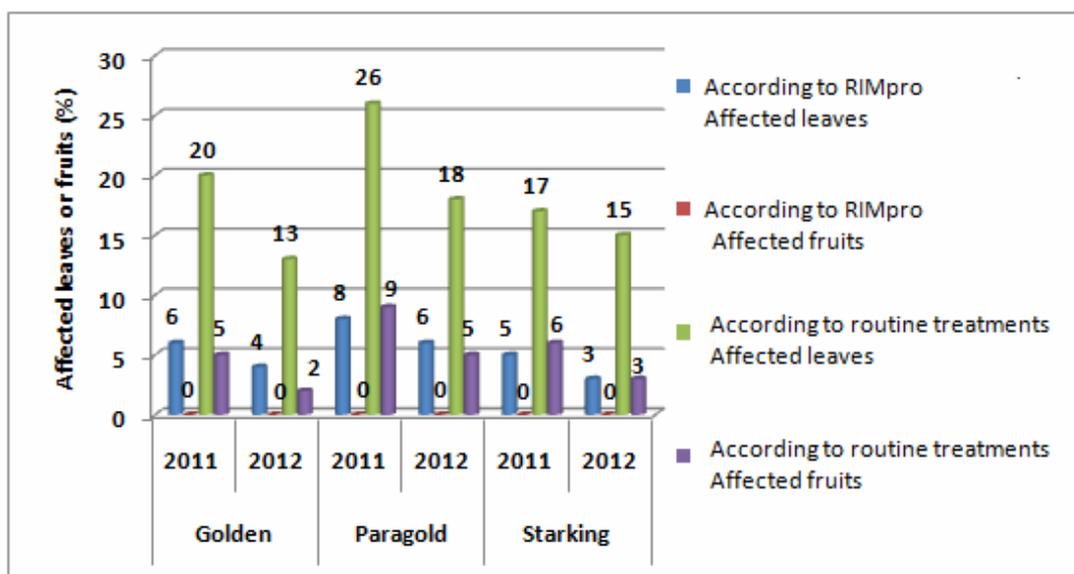
The horizontal black line in the middle of the graph  expresses low degree of risk (Koeffic 1.0).

The interrupted middle black line  expresses middle level of risk (K 1.4).

The interrupted upper black line  expresses high level of risk (K2).

Table 3. The data on the degree of infection of the leaves and fruits by apple scab (Years 2011-2012)

Nr	Cultivars	Leaves or fruits analyzed	According to RIMpro				According to routine treatments			
			Affected leaves %		Affected fruits %		Affected leaves %		Affected fruits %	
			2011	2012	2011	2012	2011	2012	2011	2012
1	Golden	100	6	4	0	0	20	13	5	2
2	Paragold	100	8	6	0	0	26	18	9	5
3	Starking	100	5	3	0	0	17	15	6	3



Graph. 4. The rate of infection of the leaves and fruits by apple scab

Table 4. The data on the stages of the development of apple scab and climate for RIMpro method

Years	The first ascospores	Completely emptying of the pseudotheceas		Date of occurrence of the first conidia
		Dates	Numbers of days	
2011	26.04	16.06	51	07.05
2012	26.04	17.06	52	06.05

P.S. The number of rainy days and amount of rain fall (in mm) includes the time from the moment of the first ascospores' release to 30 June.

4. CONCLUSIONS

This method is very simple for farmers, it is only needed a computer and internet access.

Through graphs and ascospores' captors, it is shown that first ascospores appeared on april 26, 2011 and april 26, 2012.

Full release of ascospores ended on June 16, 2011 and June 17, 2012. This period lasted 51-52 days.

On april 27, 2011 and 27, 2012 was conducted the chemical treatment to prevent primary infection of ascospores.

The second treatment was conducted later when the incubation period finished and the first conidia of apple scab appeared. Other treatments were carried out on the basis of prognosis according RIMpro program.

Rising temperatures and rainfall, greatly increased risk of infection on the leaves, especially during the period May 29 to June 7, because they didn't permit the accomplishment of chemical treatments.

Chemical treatments according to the RIMpro program made possible that none of fruits didn't get infected from apple scab, while in routine treatments that number was high. According to the RIMpro program, are carried out 4-5 less treatments than in routine treatments.

The number of leaves affected by apple scab, according to RIMpro program was 3-4 times lower than in routine treatments.

Farmers need to be informed with details of the program RIMpro especially after April 20. Once in the graphic appears the yellow color, or film tape shows the first ascospores, there should be performed treatments before and after each rainfall.

When graph 3 gives the level of risk of secondary infection (conidia) in fruits or leaves, on the black line (coef.1.0 = 15 mm rain), chemical treatments should be performed.

After 30 June, when apple fruits reach the size of a walnut fruit, they are resistant to infection by apple scab, so attention should be focused on new leaves.

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