Potato and Onion Disease Models

1. Potato Late Blight *Phytophtora infestans*: Due to the emends importance of this disease there are numerous different simulation models for Late Blight. We decided to implement three of the most common for potato. SMITH Periods is widely used in the United Kingdom to point out Late Blight infection periods. The Pytophtora Negative Prognosis following SCHRÖDTER and ULLRICH is well experienced in the germane speaking Europe. FRY Phytophtora Units are a relatively new solution practically used within the NegFRY Model in Denmark.

2. Potato Early Blight *Alternaria alternata* and related diseases: TomCast has been developed for early blight and other moisture related non Phytophtora diseases in Michigan state University

3. Onion Downy Mildew *Perosnospra destructor* sporulation is evaluated by the DownCast Model by Hilldebrand and Sutton

4. Onion *Botrytis Squamosa* sporualtion conditions are evaluated by the IPI model

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Potato Late Blight *Phytophtora infestans* Smith Periods

Definition: Two consecutive days with minimum temperature of 10 °C and 10 hours of relative humidity higher than 90% on the first day and 11 hours of relative humidity higher than 90% on the second day is a **Smith Period**.
If the criteria for the fist day is fulfilled and the second day reaches 10 hours of relative humidity higher than 90% this indicates that 90% of the Smith period or **Near Smith**.

Biological Basis: *Phytophtora infestans* can grow if temperature is lower than 10°C. But sporulation will be nearly nothing at this temperatures. Therfore it needs a moist period with temperatures higher than 10°C to get a reasonable sporulation. Infection of *Phytophtora infestans* needs free mositure. In longer periods of high relative humidity free mositure eihter by rain or by dew is very much probable.

Result: Smith periods or near Smith periods are pointing out periods where the climate is very favourable for the disease. The model points out periods with a very high risk of this disease.

Experiences: This is an empirical model showing very good results in UK where it is used as a negative prognosis too. As long it is to cold for 2 moist days with temperature always higher than 10°C no spray is needed. This is only valid where temperature increase during spring is very steady (Ocean Climate).

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Potato Late Blight *Phytophtora infestans* SCHRÖDTER and ULLRICH Negative Prognosis

This model uses measurements of temperature, relative humidity, and rainfall to predict when late blight (*Phytophthora infestans*) epidemics are not likely to occur. It has been used in Germany to predict the timing of the first treatment. Daily and accumulated risk values over a week are calculated starting at crop emergence. Negative Prognosis can´t be used in areas with permanent cropping of potatoes, areas with no winter.

Functionality: First the negative prognosis value increases with time. Duration of moist periods and temperatures favouring pathogen development are fastening the increase of the Negative Prognosis Value. A moist period is defined as hours with more than 90% relative humidity, leaf wetness or more than 0.1 mm of rain. The model differentiates between moist periods with4 h duration and with 10 h duration.

Thresholds: The model gives two thresholds: A value of 150 indicates the date when we can suspect a disease incidence of 0.1% in a year with average to high inoculum pressure. A value of 270 indicates the date when we can suspect a disease incidence of 1% in a year with average to high inoculum pressure. In years with average inoculum pressure 150 would be the value to start to spray. In a year with low inoculum pressure 270 would be the value we start to spray. Inoculum pressure is influenced by the last year disease occurrence in the seed producing area.

Potato Late Blight *Phytophtora infestans* SCHRÖDTER and ULLRICH Negative Prognosis Estimation of Emergence

The Negative prognosis Model does only make sense in areas with winter. To avoid the needs to input the emergance date into the model the METOS software assesses the erarliest possible date for potato emergence by simple temperature rules.

No temperature below 6°C within last 96 hours => Emergence possible calculation can start

No temperature higher than 8°C within last 96 hours => Emergence impossible calculation is set back to 0 again

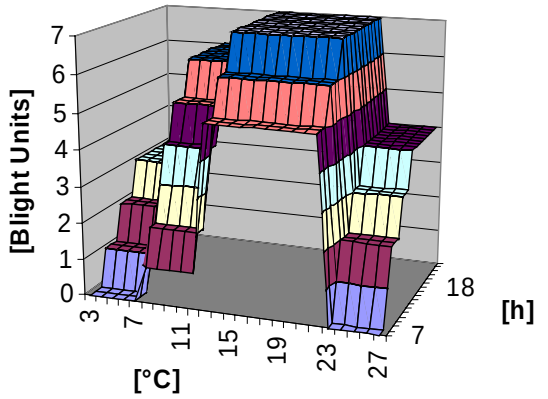
This rules might be to early for late potato growing. But we descided to use them for both because: There are many areas with mixed growing of early potato and late potato and the impact of the early weeks into the model are very low.

Potato Late Blight *Phytophtora infestans* Fry Blight Units

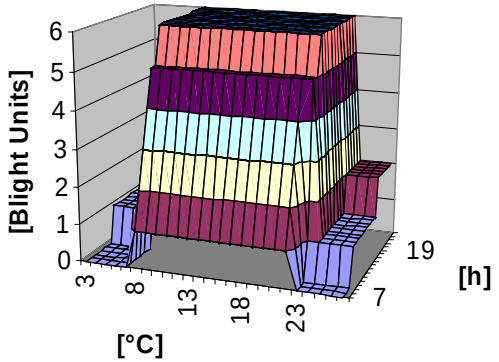
The Infection Model

... uses relative humidity higher than 90% or Leaf wetness to estimate moist periods. Depending on the duration of moist periods and the temperature during this period Blight Units for susceptible, moderate susceptible and moderate resistant cultivars are estimated following the graphs beside.

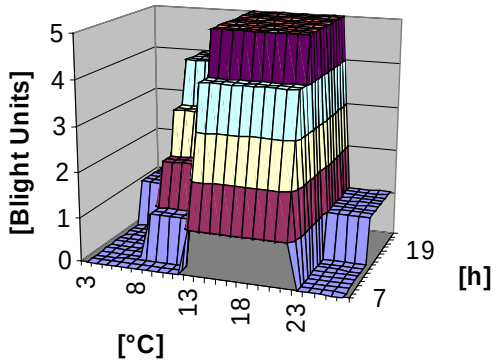
Temperature and Duration of Moist Period leading to Blight Unit for susceptible cultivars



Temperature and Duration of Moist Period leading to Blight Unit for moderate susceptible cultivars



Temperature and Duration of Moist Period leading to Blight Unit for moderate resistant cultivars



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Potato Late Blight *Phytophtora infestans* Fry Blight Units
The Spray Interval Estimation Model

... uses the result of the daily calculations from the infection model described at the slide before. With different thresholds for susceptible, moderate susceptible and moderate resistant cultivars the model helps to decide if a spray is needed or not.

A spray is indicated if:

the last spray is longer than 6 days away

and

the accumulated blight Units are exceeding:

30 for susceptible varieties

35 for moderate susceptible varieties

40 for moderate resistant varieties

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Potato Late Blight *Phytophtora infestans* Data Presentation in µMETOS

- µMETOS presents the results of Smith Periods as one asterix if Near Smith is fulfilled and as two asterix if Smith is fulfilled. In the same screen SCHRÖDTER and ULLRICH Negative Prognosis value is shown from 0 to 400.
- FRY Phytophtora Units for susceptible, moderate susceptible and moderate resistent are shown in a separate screen.
- There is a third screen to accumulate FRY Blight Units over a selectable interval.

Phytophtora
Smith Period, Moist hours, Negative P
M-DD HH Sm Mh nPr

Label

5-12 07		9	130
5-12 08	*	10	130

M-DD HH Sm Mh nPr
M-DD HH Sm Mh nPr

1th Screen

Acc. FRY Units
Rain, susc. m susc, m resistant
Rain Sus Msu Mre

Label

5-12 - 5-19

30.4	17	13	9

Rain Sus Msu Mre

3rd Screen

FRY Phytophtora Units
susc. m susc, m resistant
M-DD HH sc ms mr

Label

5-12 07	2	1	0
5-12 08	3	2	0

M-DD HH sc ms mr
M-DD HH sc ms mr

2nd Screen

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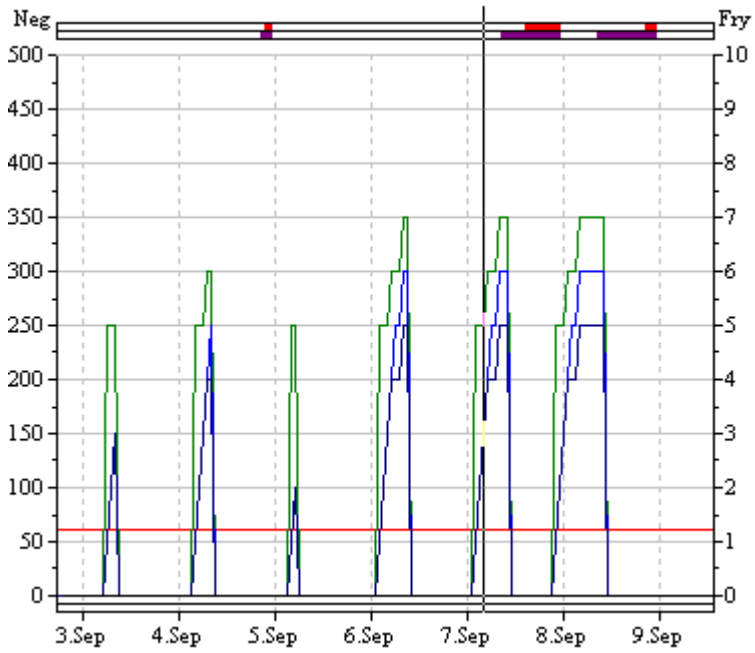
Potato Late Blight *Phytophtora infestans* Data Presentation in µLINK and MetWin II

- The software presents the results of Smith Periods in 2 lines at the top of the graphic. The lower line indicates Near Smith and the upper line indicates complete Smith Period.
- Negative Prognosis is presentet as an increasing line between 0 and 500. If the value reaches 150 it is indicated by a line at the botton of the graph. If the value reaches 270 a second line occurs.
- FRY Blight Units are presented in three lines (for susceptible, moderate susceptible and moderate resistant cultivars) as vlaues between 0 and 7.



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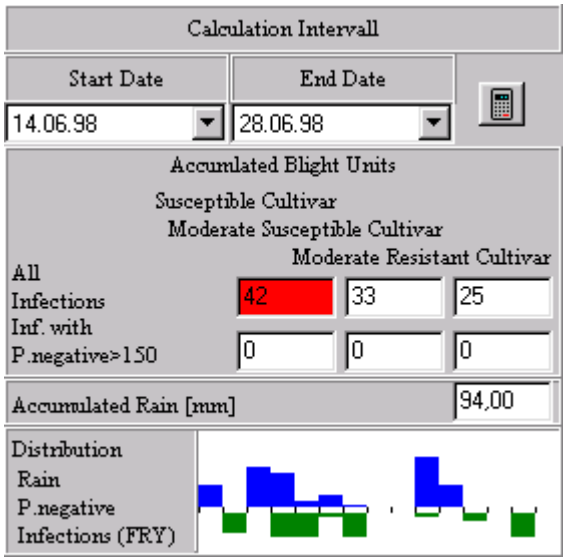
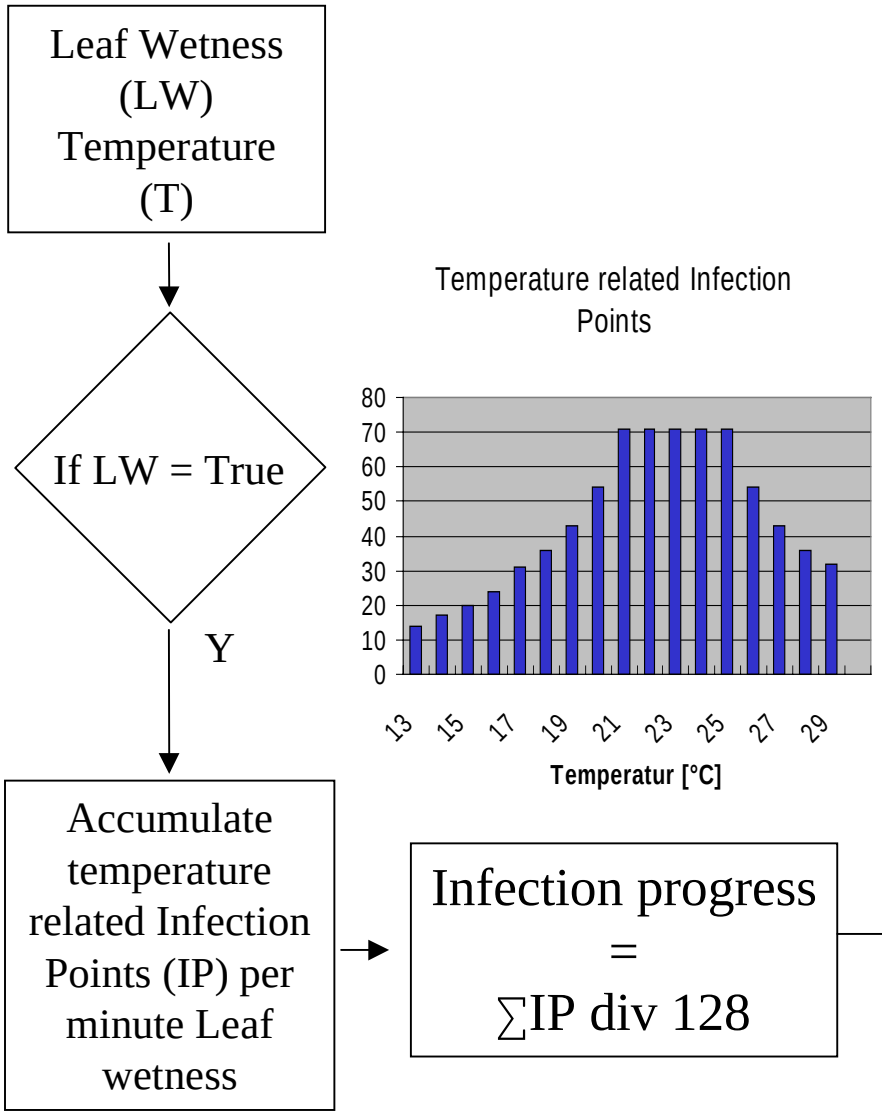
Potato Late Blight *Phytophtora infestans* FRY Blight Unit Accumulation in µLINK and MetWin II

- The software accumulates FRY Blight Units over a selected interval.
- It shows the results for susceptible, moderate susceptible and moderate resistant cultivars independent from Negative Prognosis and separate together with the condition Negative Prognosis value higher than 150.
- Distribution of Rain, Pnegative > 150 and FRY Infections is shown in a small graphic at the bottom of the window.



Early Blight of Tomato and Potato *Alternaria alternata*

Infection Model:



... Model assesses the possibility of Infection, severity of Infection, grades the previous day for disease Severity and accumulates Disease Severity over periods on:

- Hourly Temperature during a 5 day period
- Hourly Relative Humidity during a 5 day period
- Accumulated Rain during a 7 day period
- Temperature
- Leaf wetness duration

Results:

- Infection progress value on actual day
- Infection severity on actual day
- Disease severity for every day
- Accumulated disease severity for a certain period

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Early Blight of Tomato and Potato *Alternaria alternata*

Disease Severity Evaluation Model:

This model is calculated at the end of a day 11:30pm. The model calculates and compares the disease severity values following both the tables aside and uses the higher value of both.

Mean Temp of actual day[°C]	Hours of Leaf Wetness of actual Required to Produce Daily Disease Severity Value (S) of:				
	0	1	2	3	4
13 – 17	0 – 6	7 – 15	16-20	21+	
18 – 20	0 – 3	4 – 8	9-15	16-22	23+
21 – 25	0 – 2	3 – 5	6-12	13-20	21+
26 - 29	0 - 3	4 - 8	9-15	16-22	23+

Temperature Average of last 5 days [°C]	Hours RH>90% within last 5 days [h]	Total Rain within last 7 days [mm]	Disease Severity Value
<22	<60	<2.5	0
>22	<60	<2.5	0
<22	>60	<2.5	1
<22	<60	>2.5	1
<22	>60	>2.5	1
>22	>60	<2.5	2
>22	<60	>2.5	2
>22	>60	>2.5	3

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Early Blight of Potato *Alternaria alternata* Data Presentation:

Infection Progress and Infection Severity:

µMETOS and µLink shows you the Infection progress figures and the infection severity on the hourly data.

Disease Severity Value:

µMETOS and µLink shows you the Disease severity values on the daily data.

Disease Severity Value Accumulation:

µMETOS and µLink gives the opportunity to accumulate Early Blight Disease Severity Values over a selected time interval. Tis Accumulation is Part of the Fry Units and Alternaria Severity Accumulation Screen.

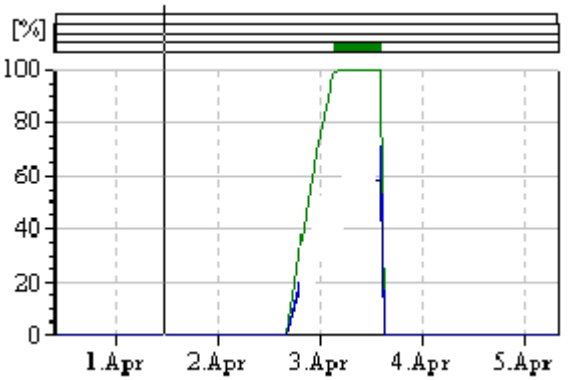
Early Blight (Alternaria Alternata)
Infection, Inf.Severity, Click both Disease Severity
M-DD HH INF SEVE

Label

5-12 07 85
5-12 08 100 *

M-DD HH INF SEVE
M-DD HH INF SEVE

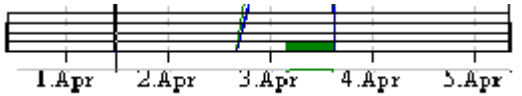
1st Screen, hour



5-12 _____ *
5-13 _____ ****

M-DD _____ SEVE
M-DD _____ SEVE

1st Screen, day



__5-10 --- 5-17__
12

__M-DD --- M-DD__
Rain FS FM FR AS

2nd Screen Accumulation

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Early Blight of Potato *Alternaria alternata* Data Use:

Infection Progress and Infection Severity:

This is indicating the possibility of an Early Blight Infection. The Severity Value indicates the iportance of the Infection. If the disease is allready present in the crop Information about date and severity of infections are helpful to check the applied spry program and correct it with curative sprays if needed.

Disease Severity Value:

Disease Severity indicates how favourable the climate was for the disease. Under unfavourable climate conditions no fungicide control of the disease is needed.

Disease Severity Value Accumulation:

The developers of the model are supporting the use of the model as a negative prognosis. A accumulated disease severity from planting date until now of 35 indicates the need of the first spray against *Alternaria alternata*. A threshold to indicate the next sprays have to developed for your certain area

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