Pessl Instruments Viticulture Disease Models of MetWin II and µMETOS

Function and Functionality of the Grape Vine Downy Mildew, Grape Vine Powdery Mildew and Grape Vine Grey Mould Models

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Grape Vine Downy Mildew:
Biologic Cycle

Primary Infection, Generative Cycle

Plasmopara viticola is overwintering with oospores in the leaf litter, oospore formation takes place in late summer and fall

The oospores are forming makrosporangias under warm and humid conditions in late spring and early summer

The makrosporangia will release zoospores in free water

Zoospores will be moved by splashing rains toward young leaves, clusters and green tips of the vines

If temperature is high enough and a water film is lasting long enough infection takes place

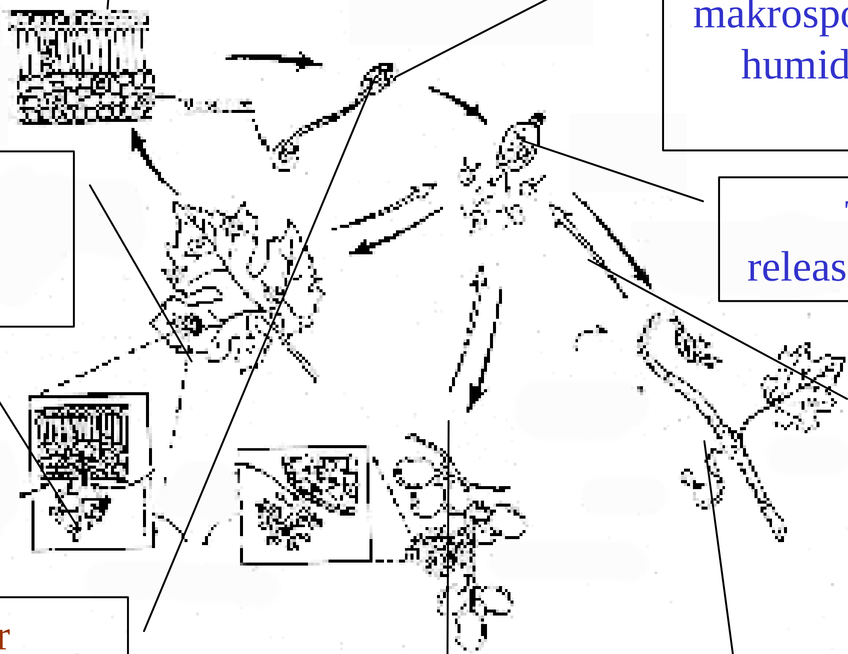
Secondary Infection, Vegetative Cycle

Infected tissue is forming oil spots at the end of incubation period

Oil spots will form sporangia at night if temperature and relative humidity is high enough

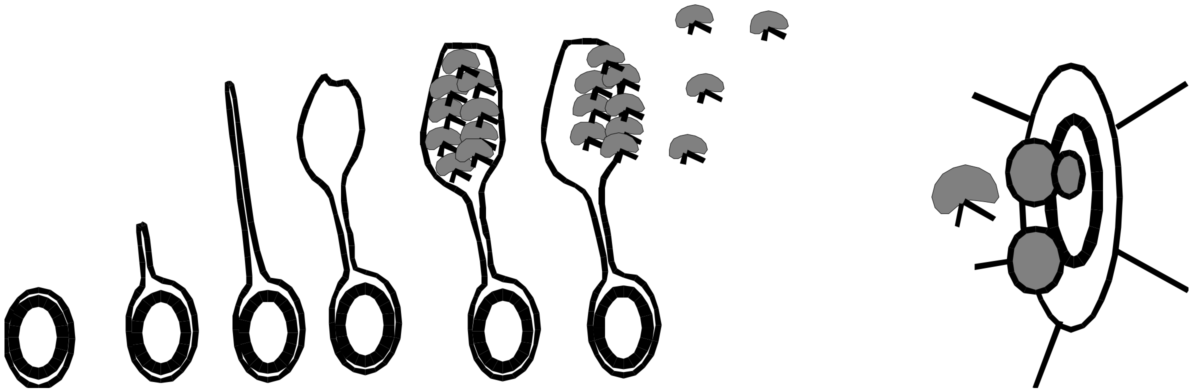
Sporangia are remove by water droplets or wind, they will release their zoospores into free water

If the zoospores are on green vine surface with stomata and temperature is high enough and a water film is lasting long enough infection takes place



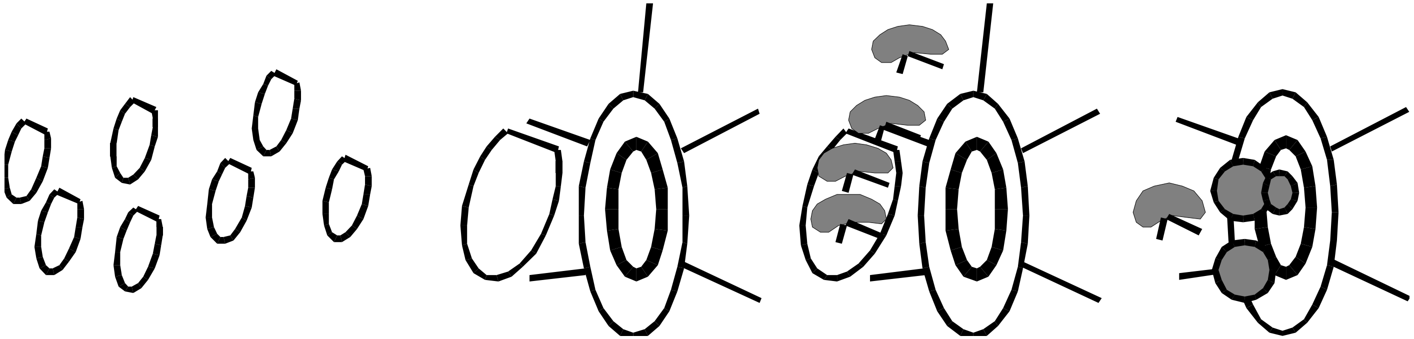
Grape Vine Downy Mildew Epidemic can start

endogenous



This happens in all vineyards where makrosporangia formation takes place. Epidemic starts with primary infection (generative propagation).

exogenous



This happens in vineyards where no makrosporangia formation takes place. Epidemic starts with secundary infection (vegetative propagation) if oilspots are present in vineyards nearby. The model for primary infections is not important for this vineyards.

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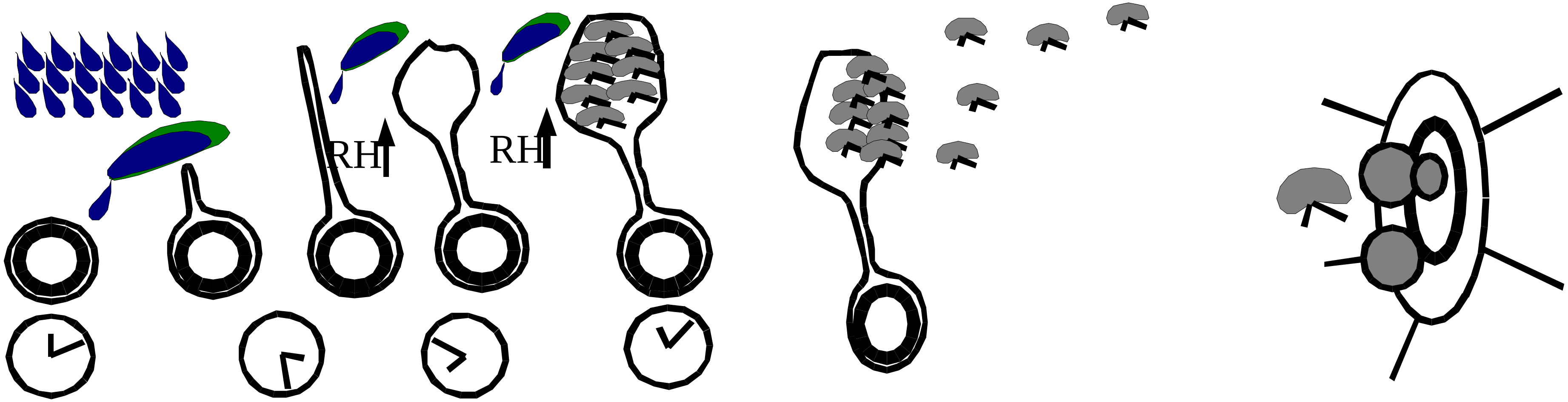
Grape Vine Downy Mildew Primary Infection Model



Makrosporangia Formation

... is started by a rain causing wet leaf litter. Moist leaf litter assumed as long as leaf wetness is lasting or relative humidity is higher than 70% and temperature ranges between 8°C and 24°C with an optimum between 18°C and 24°C. Moist period has to last 15 to 24 hours. Makrosporangia formation ends with the end of the moist conditions.

Zoospore Dispersal

... is done by a splashing rain.

Infection

...needs leaf wetness for approximately 50°C accumulated hourly temperatures and temperatures higher than 6°C.

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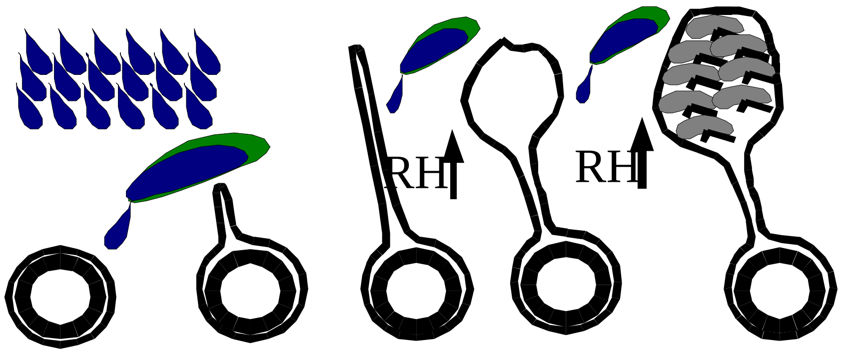
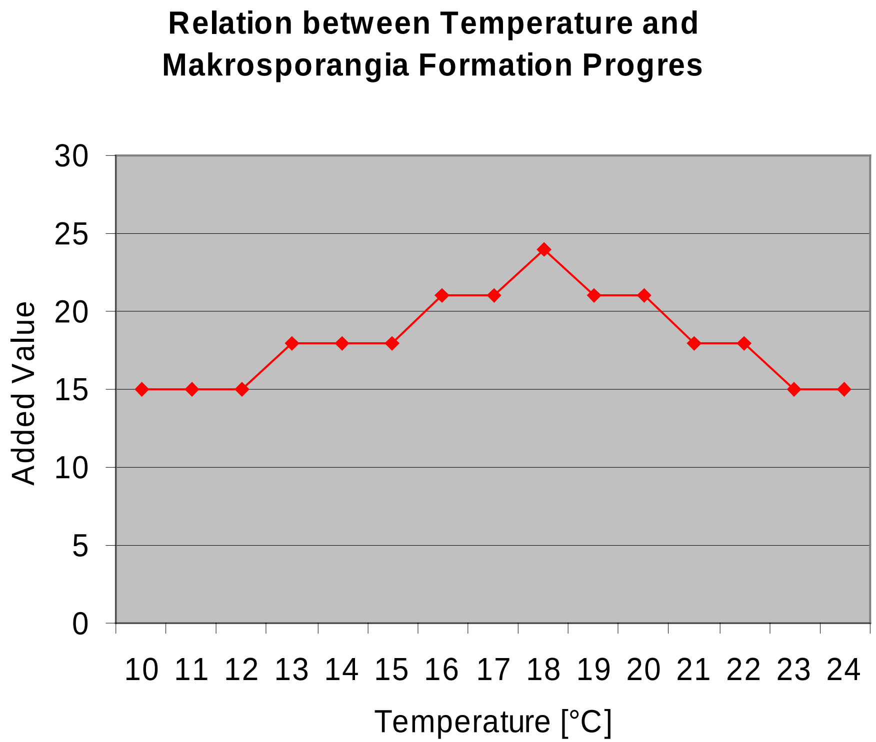
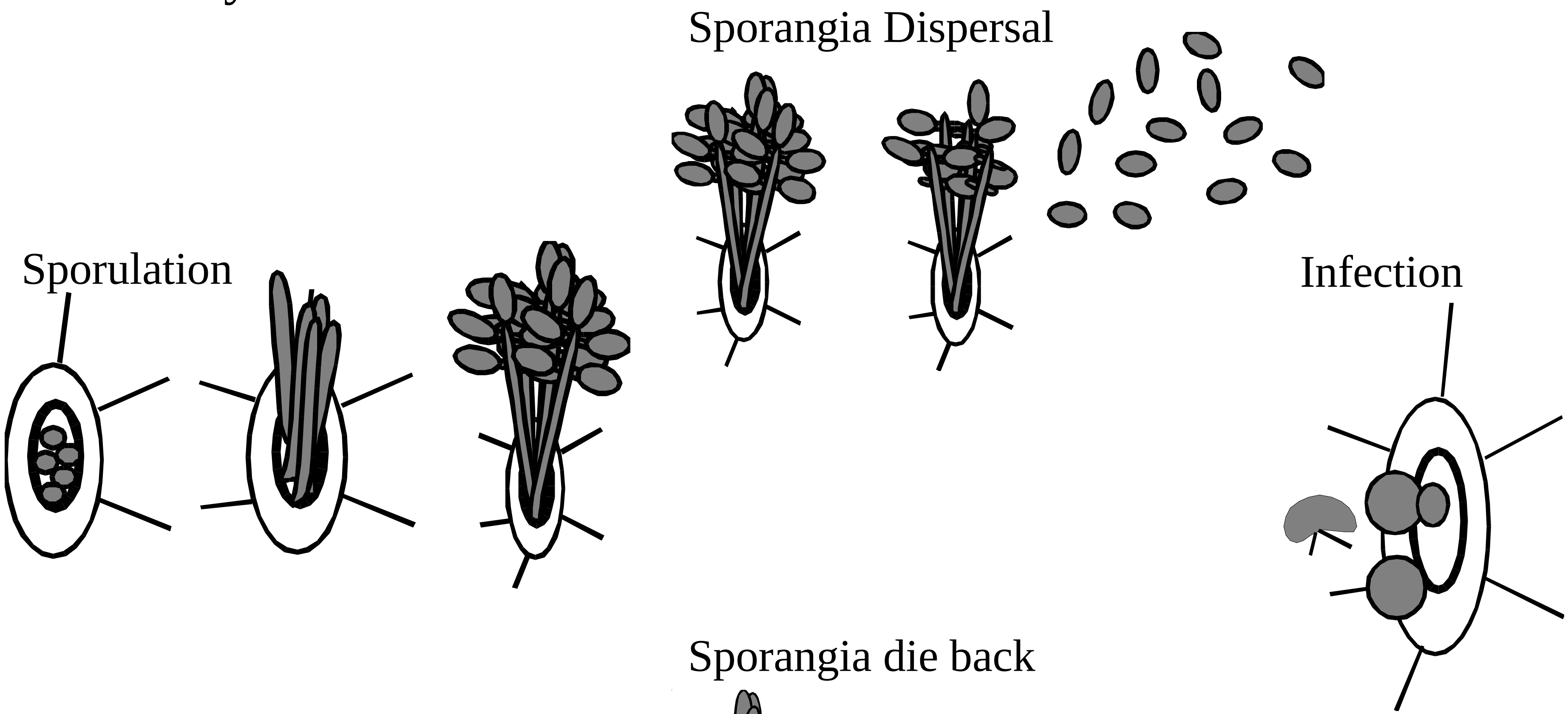
Grape Vine Downy Mildew Makrosporangia Formation Model

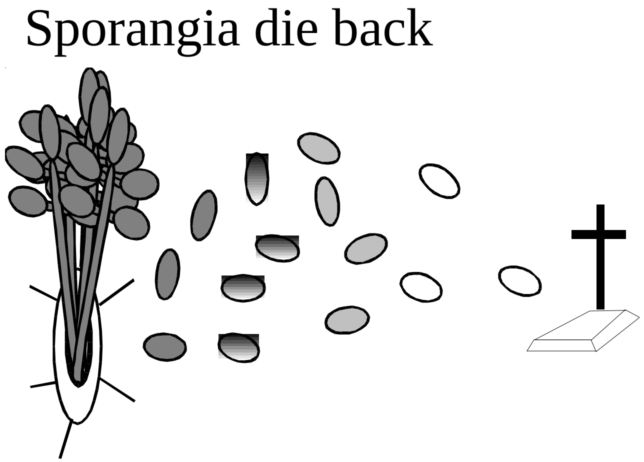


After a rain for every minute with Leaf Wetness or Relative Humidity >= 80% a value following the graph aside is accumulated. If the accumulated value reaches 22,000 Makrosporangia formation is completed.



Grape Vine Downy Mildew
Secondary Infection Model

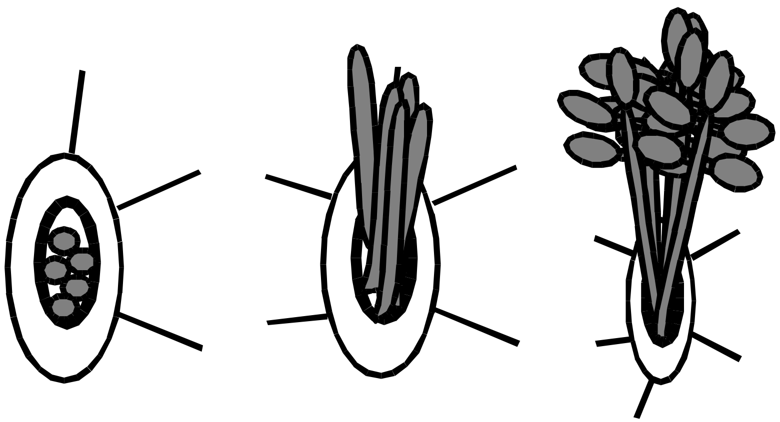




are the 4 parts of the
Secondary Infection
Model.

Grape Vine Downy Mildew Secondary Infection Model

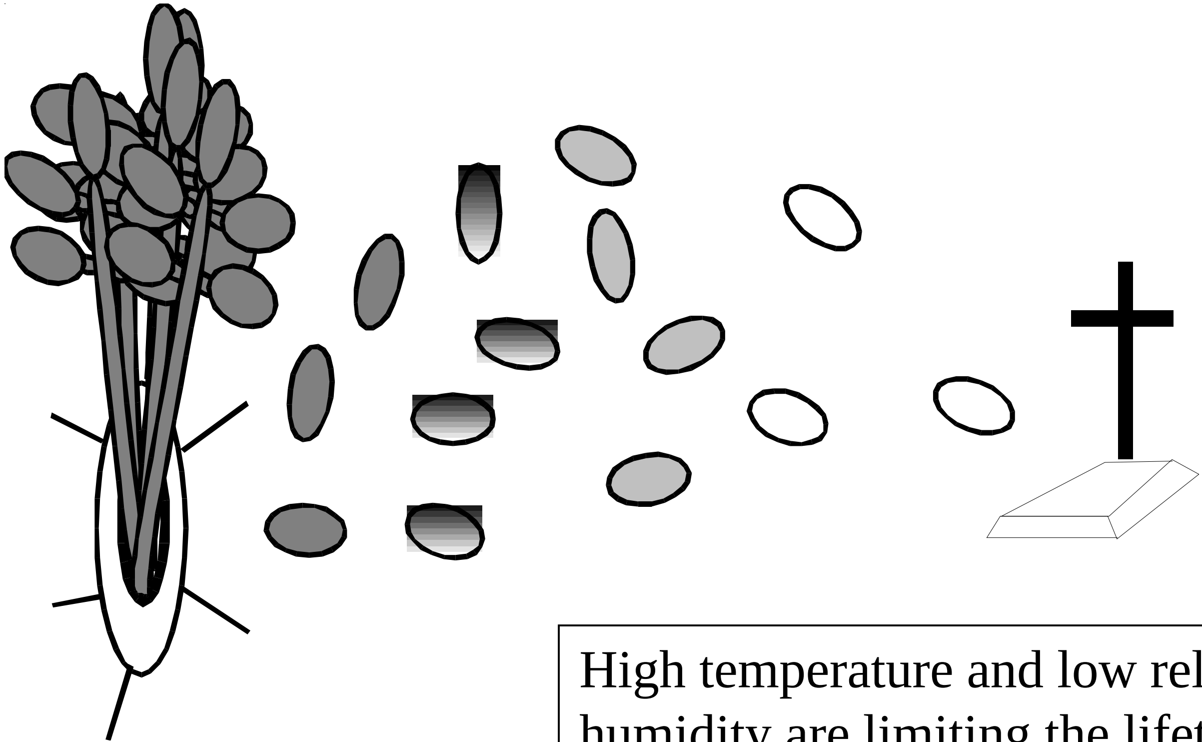
Sporulation



Starts	Progresses
...with the end of daylight	...if relative humidity is higher than 95% and temperature is higher than 11°C. Maximum production takes place with temperature between 18°C and 24°C. Sporulation is complete after 3 hours at optimum temperature or after 4 hours at minimum temperature. It stops with daylight.

Grape Vine Downy Mildew Secondary Infection Model

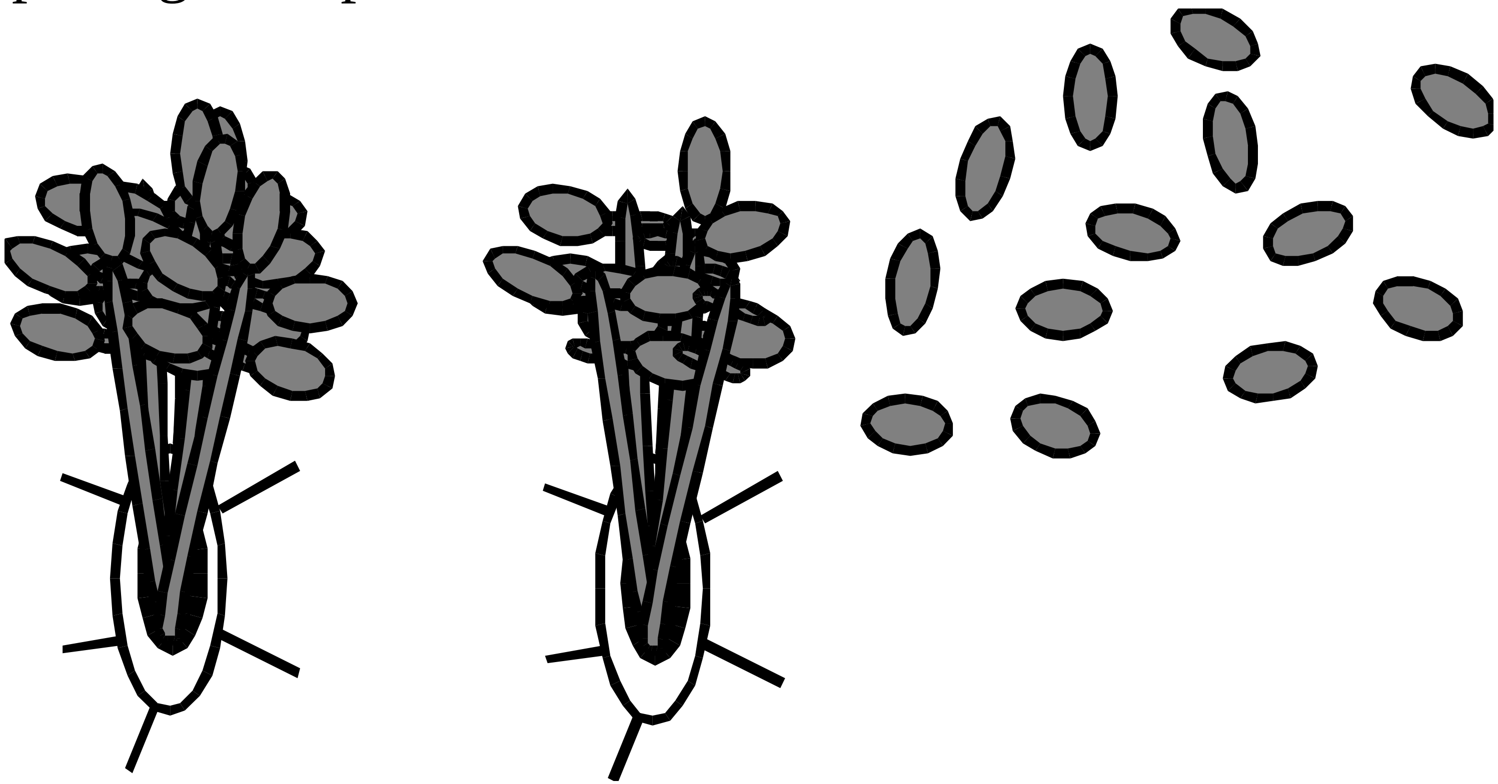
Sporangia die back



High temperature and low relative humidity are limiting the lifetime of sporangia.

Grape Vine Downy Mildew Secondary Infection Model

Sporangia Dispersal



Moist sporangia are sticky and can only be dispersed by rain. Sporangia stay moist as long as relative humidity stands high. They will be dispersed by 2 mm of rain.

Dry sporangia are not sticky anymore. They are dry if relative humidity is below 70%. Dry sporangia are dispersed by wind within less then 2 hours.

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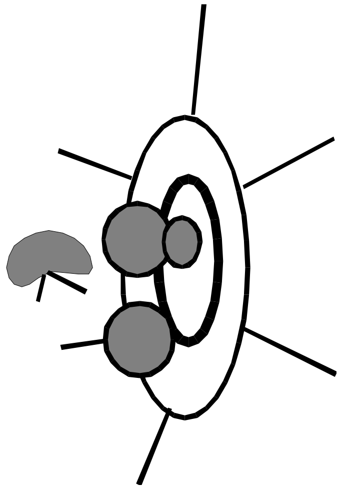
Grape Vine Downy Mildew Secondary Infection Model

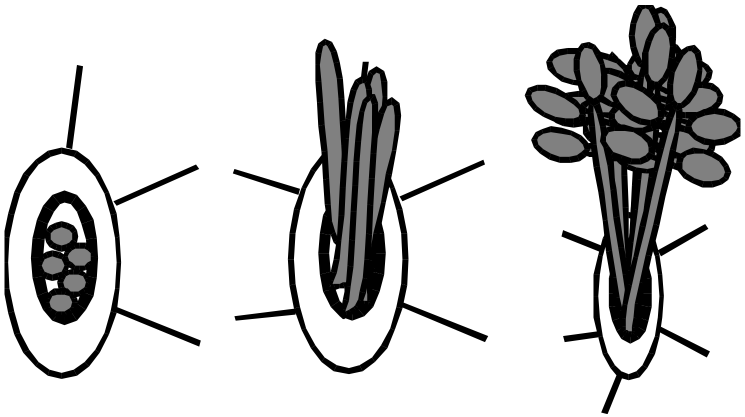
Infection



Conditions

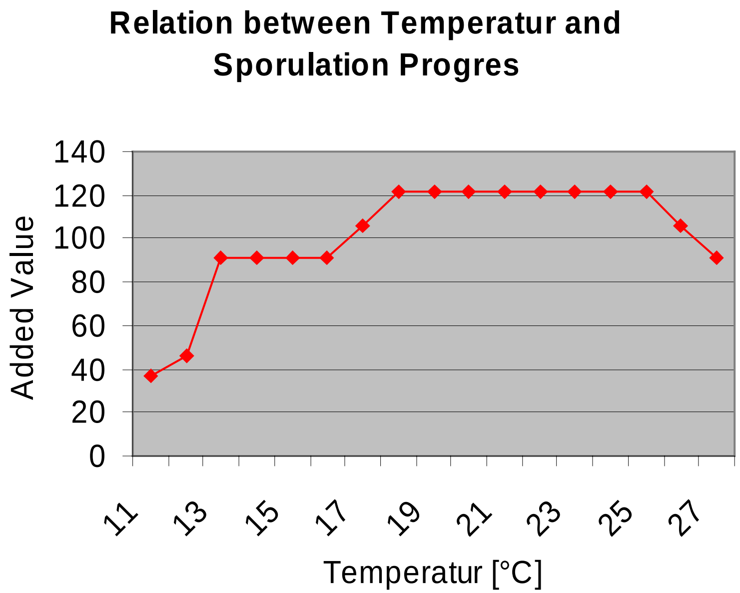
Leaf wetness for approximately 50°C accumulated hourly tempera-tures and tem-peratures higher than 6°C.

Grape Vine Downy Mildew
Secondary Sporulation Model

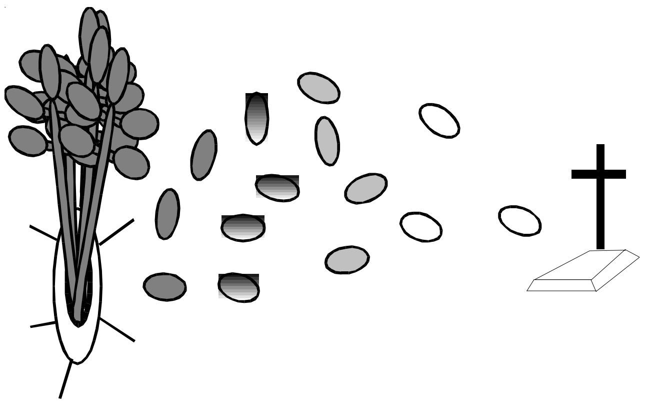


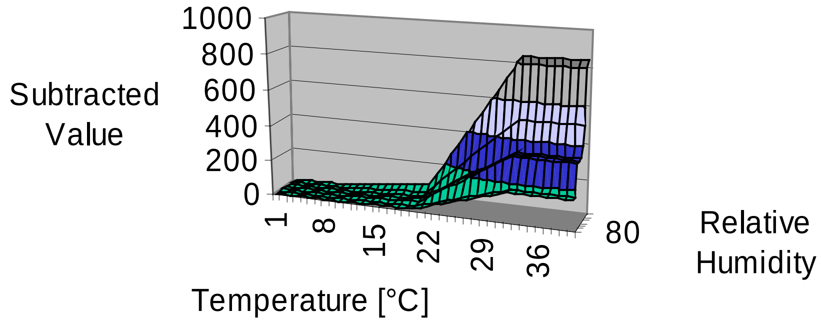
Sporulation starts with end of daylight. Every consecutive minute with relative humidity >= 93% and Temperature between 11°C and 27°C adds on the value graphed out beside.

Sporulation is finished when the accumulated value reaches 22,000.



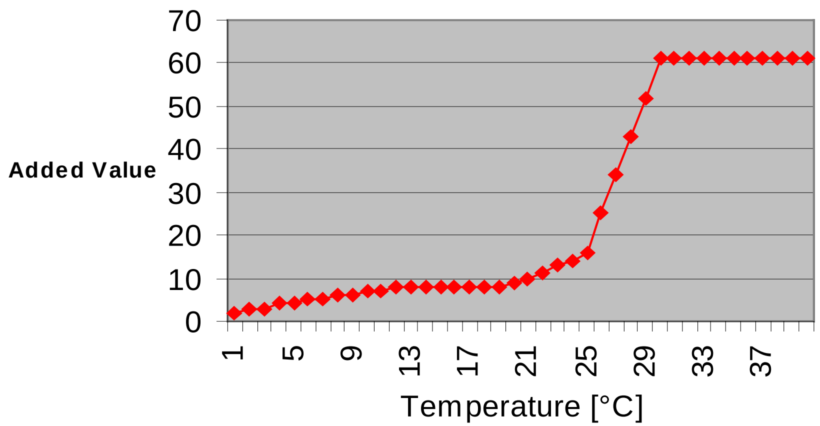
Grape Vine Downy Mildew Secondary Sporangia die back Model





When Sporangia formation has been finished, Sporangia have a suspected lifetime of 22,000 units. Every minute a value following the graph aside is subtracted. If the residual is 0 Sporangia die Back starts. Speed of Sporangia Die Back is depending on temperature following the second graph.

Sporangia will stay alive for a long cool and wet period and they will die very fast (within 6 hours) in dry and hot weather. Do to this the model has mostly Sporangia present if the weather is cool and wet. This makes the model a little conservative.



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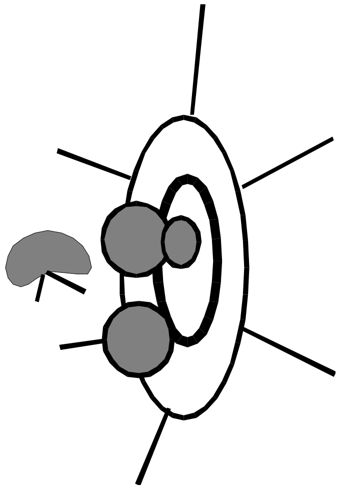
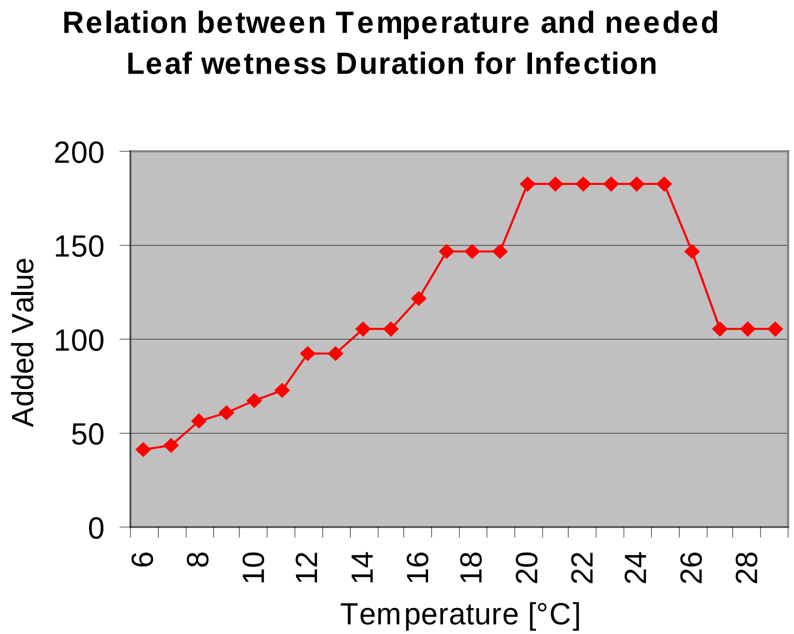
Grape Vine Downy Mildew Primary and Secondary Infection Model



The Infection Model is the same for primary and secondary infection, because there is no difference between zoosproes from makrosporangia and from sporangia.



For every minute of Leaf Wetness a value following the graph aside is accumulated. If the accumulated value reaches 22,000 Infection is finished. In optimal conditions infection could be finished after 2 hours of Leaf Wetness.

Infection severity is evaluated by the fact if infection takes place immediately after sporulation or later. In first case more than 2mm of rain giving moderate, more than 4 mm of rain giving severe infection. In second case more than 4 mm of rain giving moderate infection no strong infection is shown.

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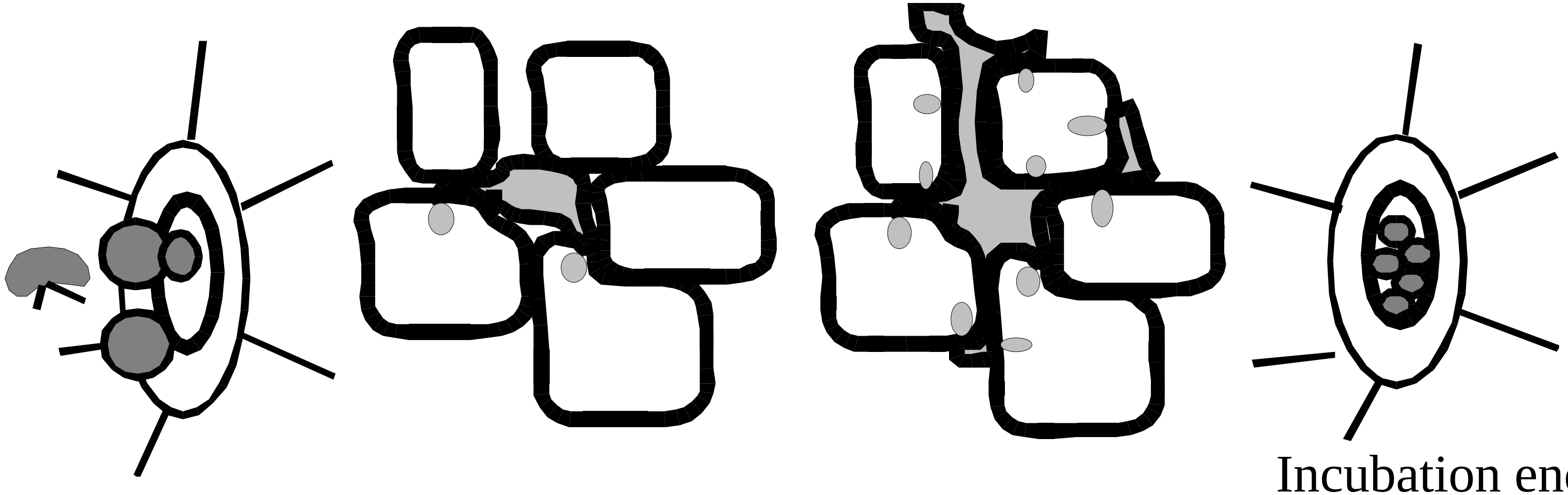
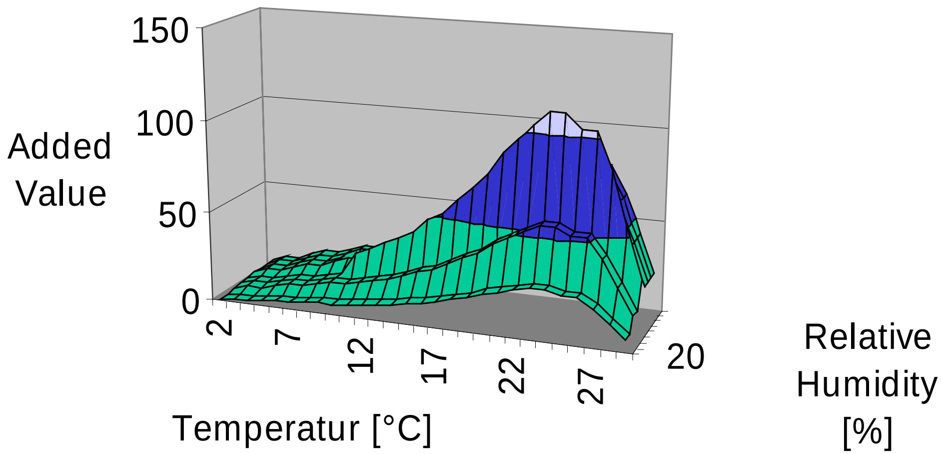
Grape Vine Downy Mildew Secondary Incubation Model



Incubation starts with the begin of infection. From now on every hour of infection adds on the value coming from the graph beside.

Relation between Temperatur, Relative Humidity and Incubation Progress



Incubation ends with the possibility of sporangia formation (first oilspots may be visible). This is reached, when the accumulated values are reaching 7,300.

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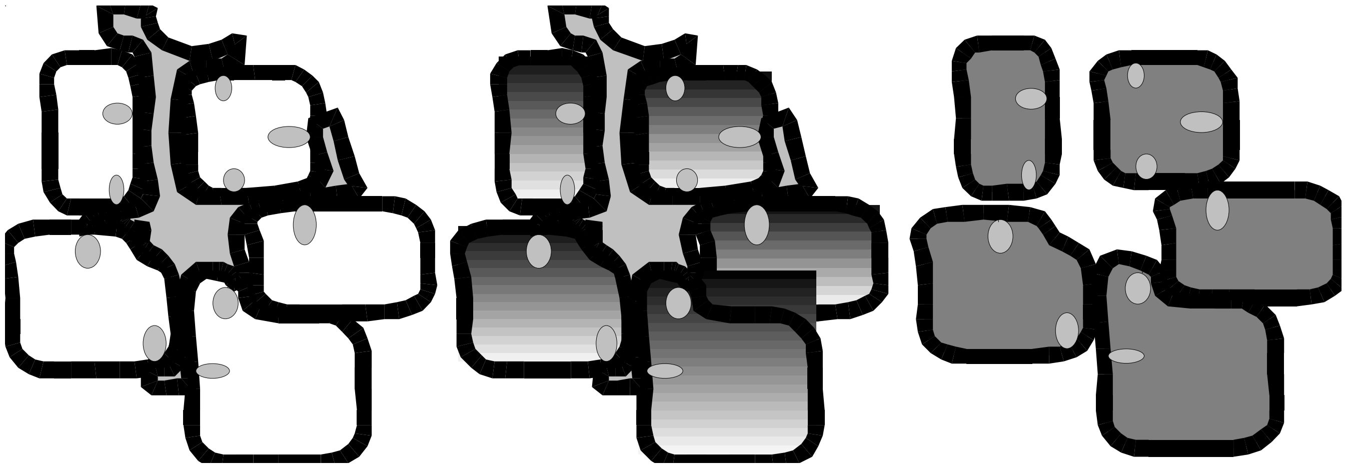
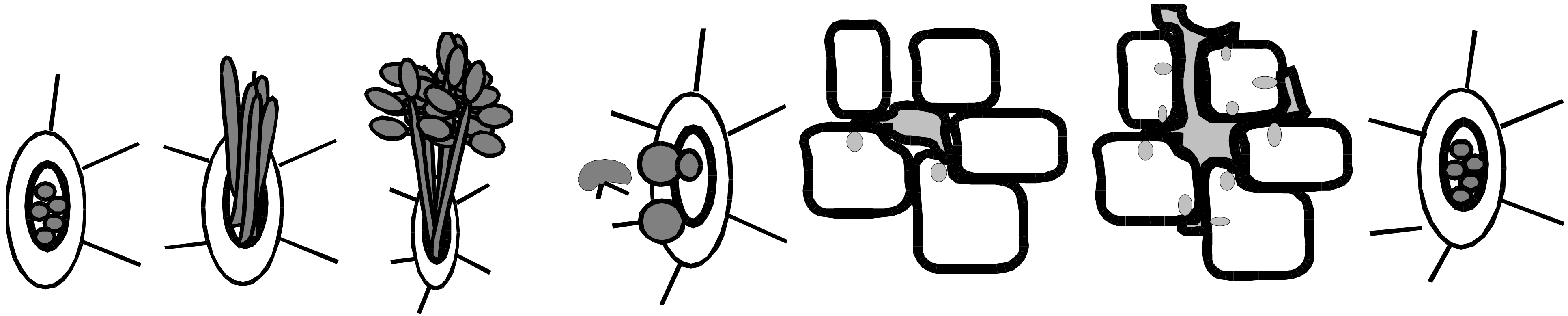
No Model for suspected lifetime of oil spots



Grape Vine Downy Mildew Fungicide Selection Model

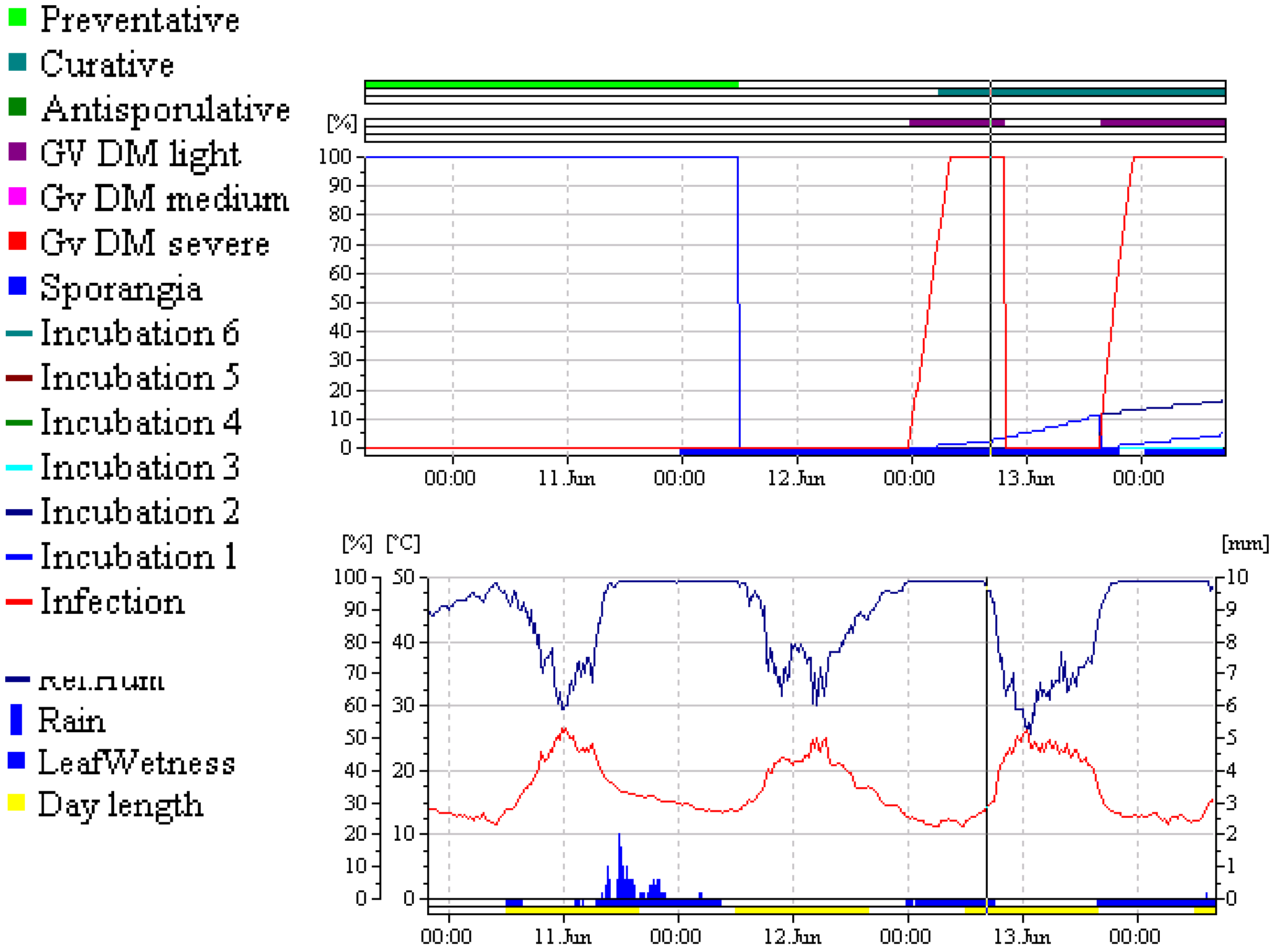


If Sporangia are present a preventative fungicide is supported.

Up to 30% of Incubation a curative fungicide is supported.

Incubation higher 80% up to Sporulation a antisporulative and a preventative fungicide is supported.

Grape Vine Downy Mildew graphical presentation in MetWin II



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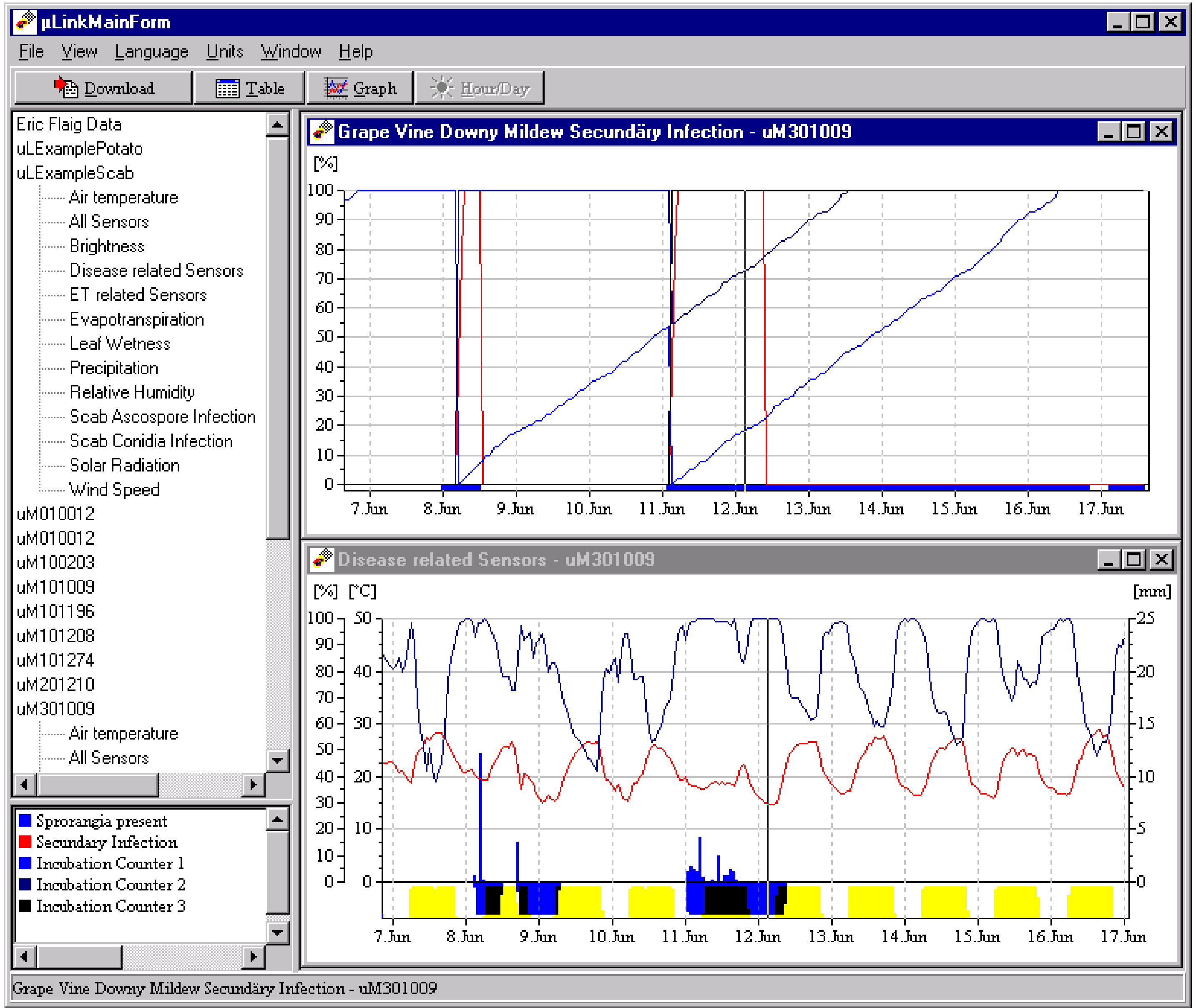
Grape Vine Downy Mildew graphical presentation in µLink



Grape Vine Downy Mildew data presentation on µMETOS display

Do to the limited space on the µMETOS display all values which are calculated from 0 to 100 are shown from 0 to 10 (X). Unfortunately this display is very complex.

µMETOS display shows the presence of makrosporangia and sporangia as asterix. Infection is shown as value from 0 to 10 (X). = means no infection in progress. 1 to 9 means infection in progress and 10 means infection finished. Incubation counters are shown in similar way.

GVDM Primary Infection
MakroSpor, Inf, Inc 1-3
M-DD HH MI I123

Label

```
5-12 07  * 0 3 6 X
5-12 08  * 1 1 3 6
```

```
M-DD HH MI I123
M-DD HH MI I123
```

Screen

GVDM Secundary Infection
Sporangia, Inf, Inc 1-3
M-DD HH SI I123

Label

```
5-12 07  * 0 3 6 X
5-12 08  * 1 1 3 6
```

```
M-DD HH SI I123
M-DD HH SI I123
```

Screen

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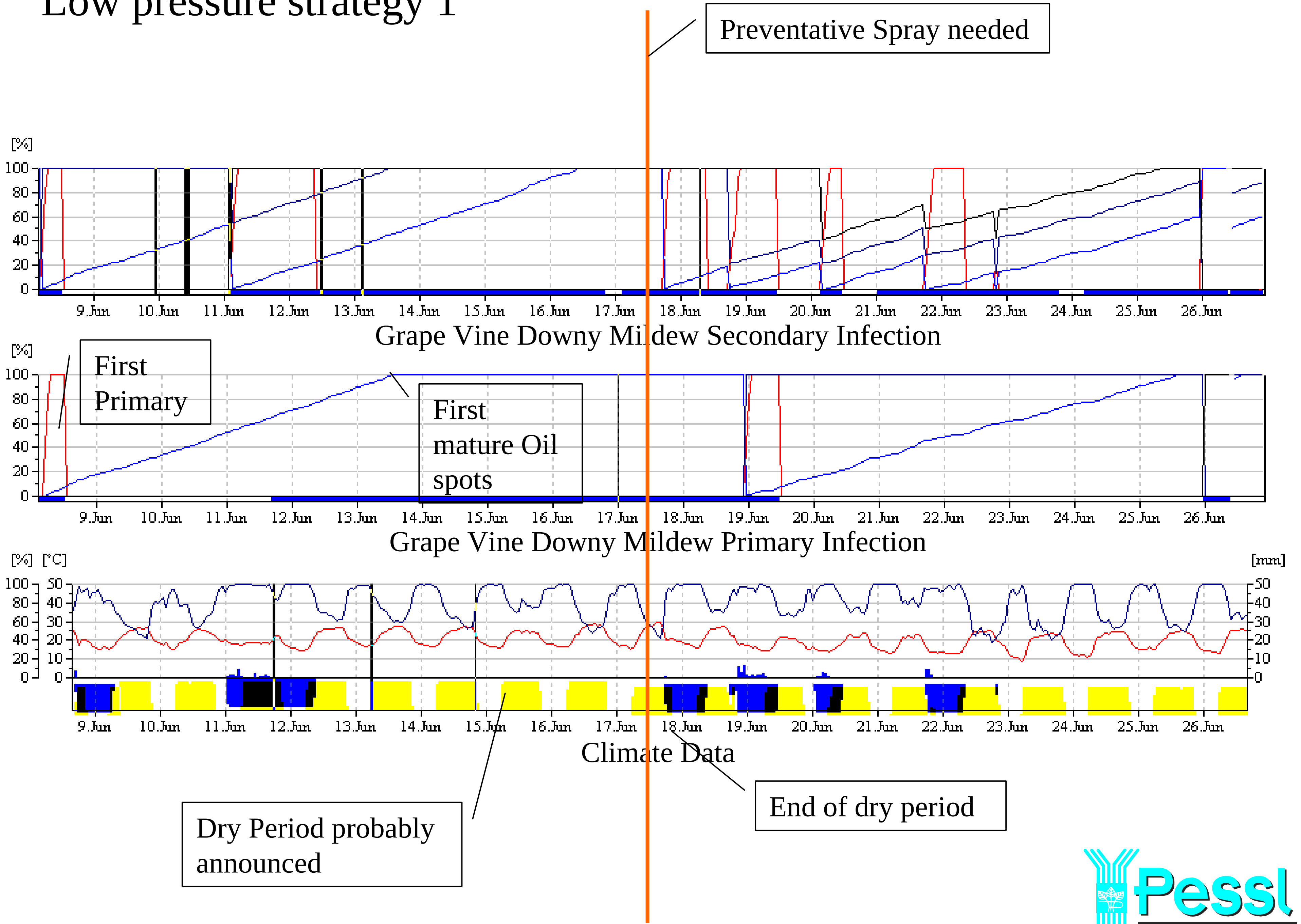
Grape Vine Downy Mildew practical use of the model:

The model is pointing out infection dates for primary and secondary grape vine downy mildew infections. This is the most critical information for this disease. Infections which have not been covered by either preventative or curative fungicides can be disastrous for the yield and or the quality. Information over infection severity is helpful to decide whether a curative fungicide is needed.

There are different fungicide strategies used on base of downy mildew models throughout Europe. In situations where disease pressure is mainly low to moderate the following first strategy example is very successful.

In high pressure area information is helpful to check the spray program if it could cover most the infections (second strategy example).

Low pressure strategy 1

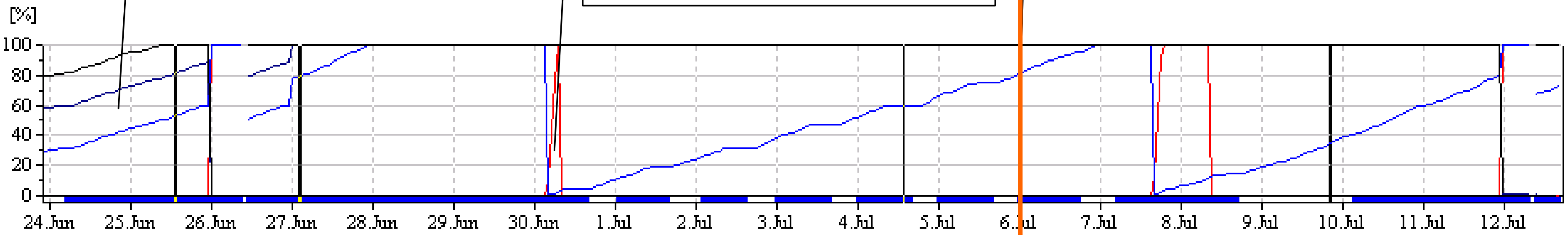


Low pressure strategy 2

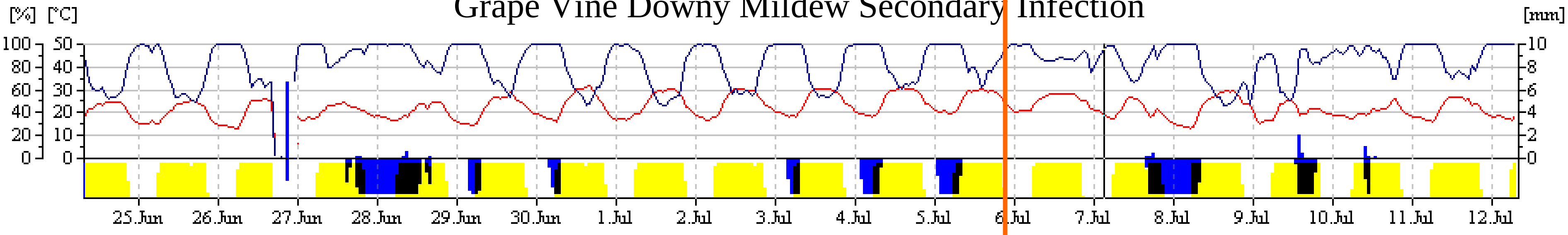
This infections has been covered by preventative spray

This infection is tolerated spores are coming from aged oil spots

80% of incubation mature oil spots soon available preventative spray needed



Grape Vine Downy Mildew Secondary Infection



Climate Data

Note: This is only working where the overall risk is low and only one primary infection is happening.

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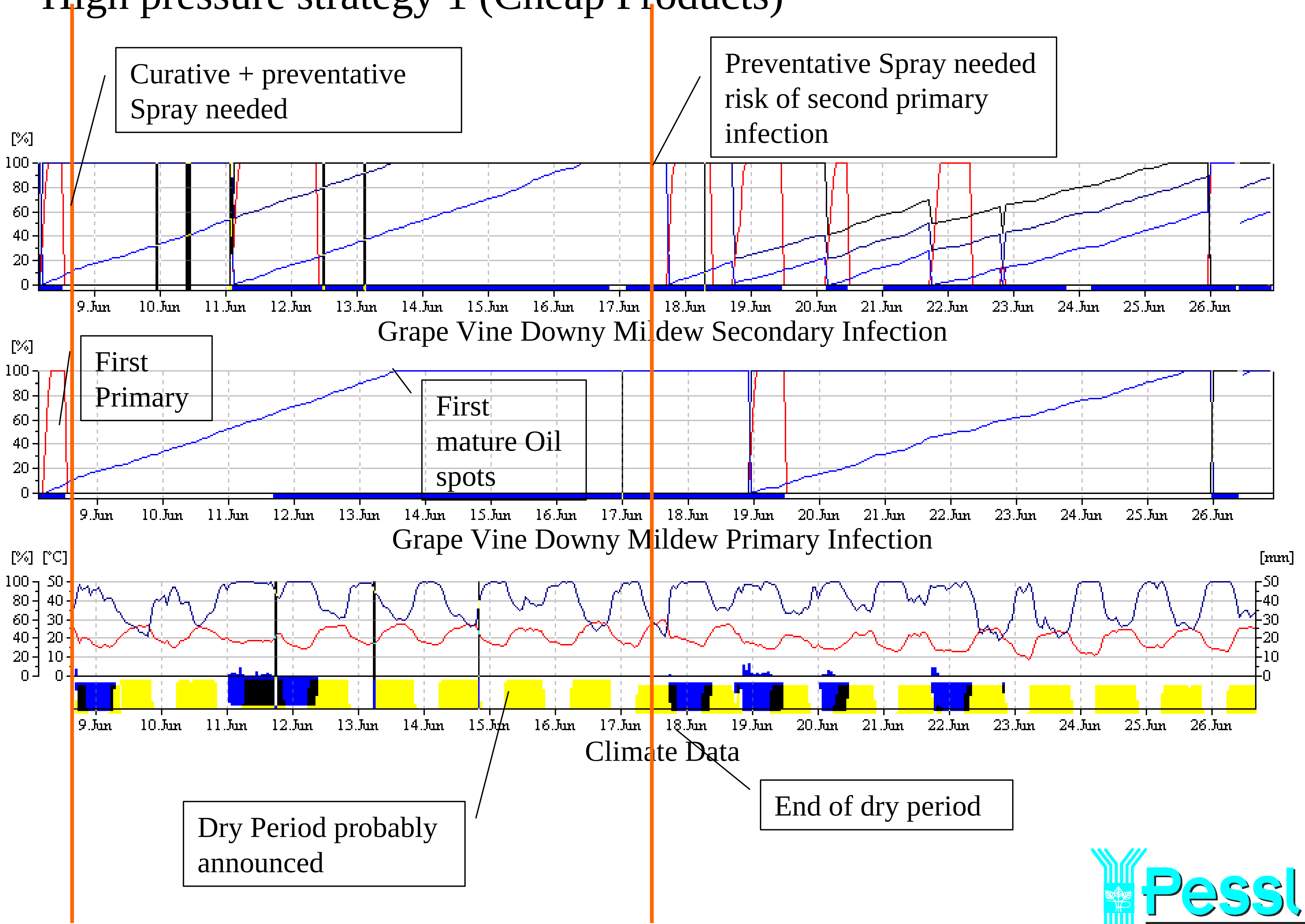
High pressure strategy 1 (Cheap Products)

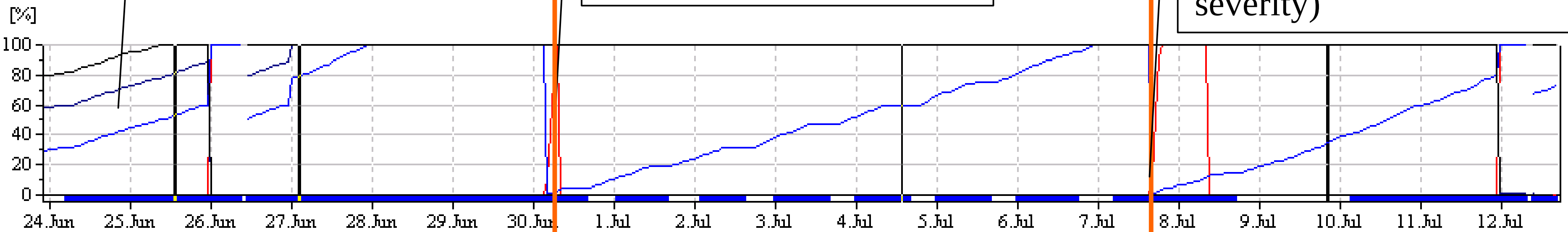


High pressure strategy 2

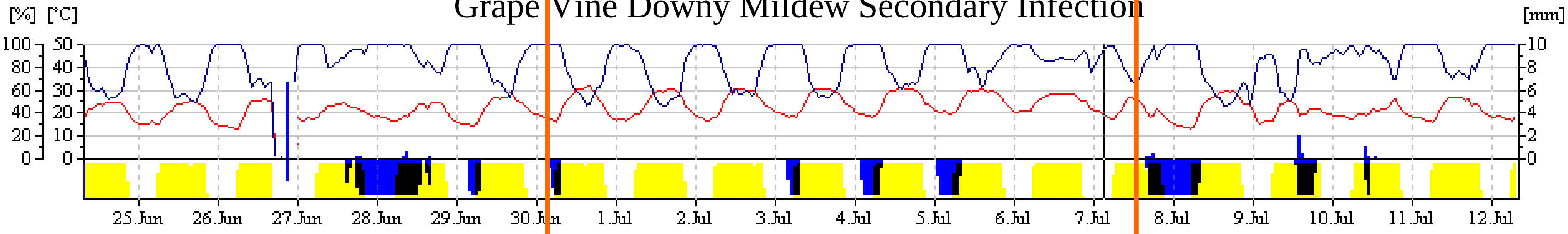
This infections has been covered by preventative spray

This infection has to be covered? No rain only low severity of infection.

This infection has to be covered!!! (rain, high severity)



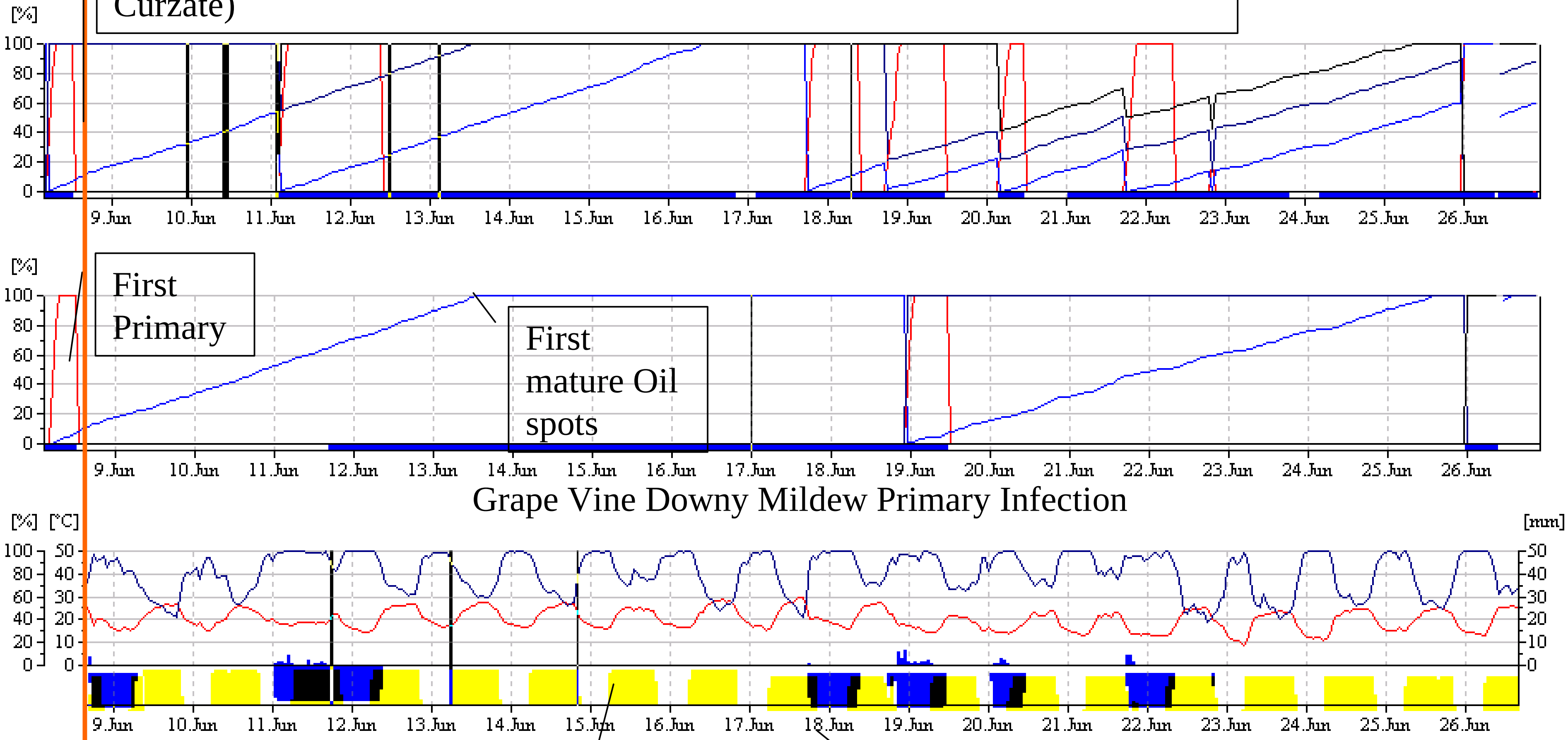
Grape Vine Downy Mildew Secondary Infection



Climate Data

High pressure strategy 2 (cheap)

Curative + preventative Spray needed working for 14 days (Ridomil, Actuan, Curzate)

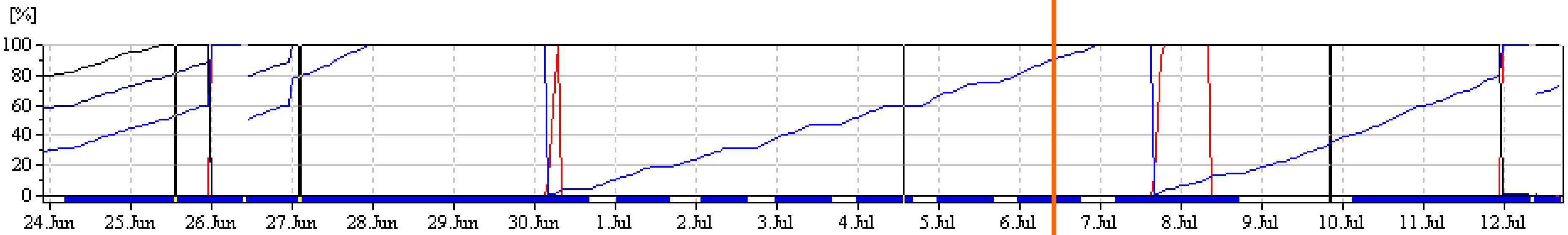


Dry Period probably announced

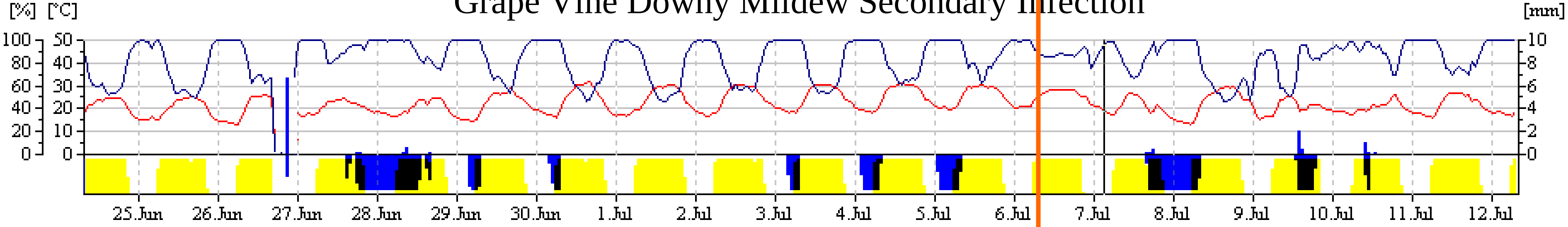
End of dry period

High pressure strategy 2 (Intelligent)

Antisporulative Spray (Dimetomorph)



Grape Vine Downy Mildew Secondary Infection



Climate Data

Grape Vine Powdery Mildew

Biologic Cycle

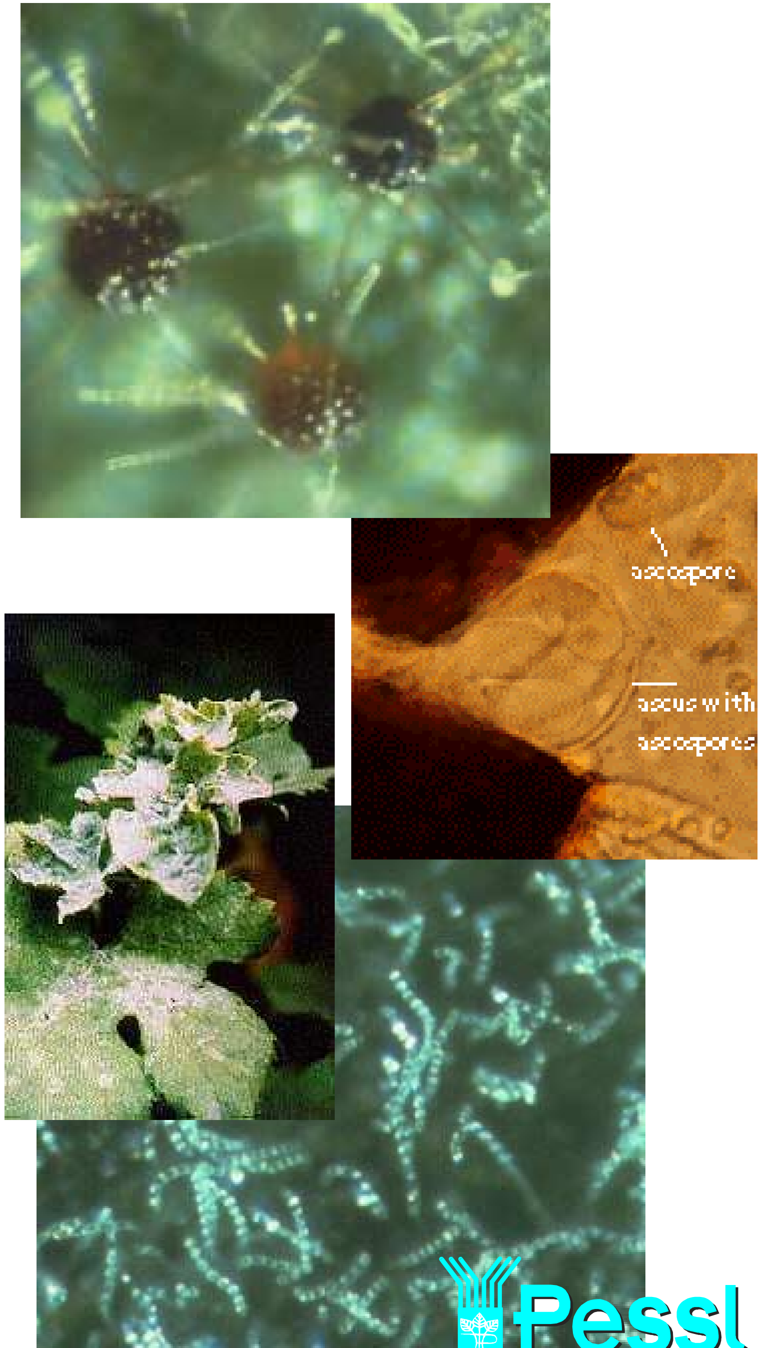
Uncinula necator hibernates either in fruiting bodies (Cleistothecia) or with mycelia in dormant buds.

Cleistothecias will release their ascospores during spring and early summer under the presence of free water.

Mycelia hibernated in dormant buds will start growing when the bud breaks and a shoot covered by Powdery Mildew will be visible approximately 14 days before bloom. This shoot are called “Flag shoots”

Millions of Conidia are formed by the dense mycelia covering the flag shoots.

Either ascospores from cleistothecia or conidia from flag shoots will start to infect the green and healty tissue of the vines.



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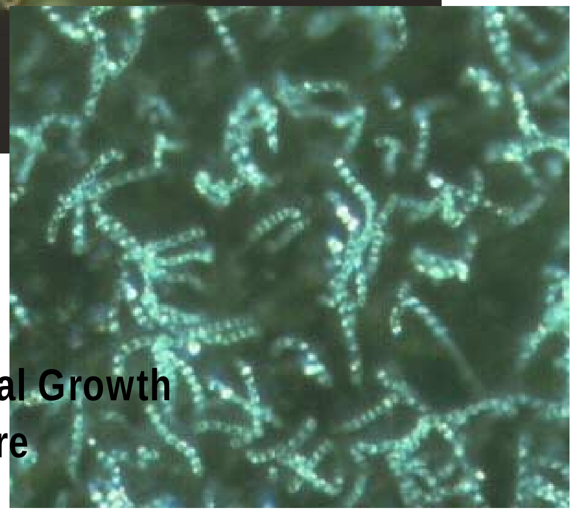
Grape Vine Powdery Mildew

Fungal Growth, Conidia Formation and Germ Tube Formation

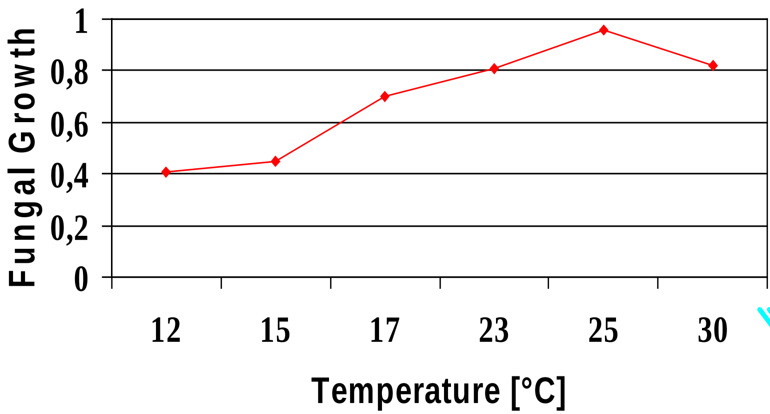
Conidia of *Uncinula necator* are formed in a wide range of climatic conditions. Fungal growth, condia formation and germ tube formation is mainly influenced by temperature.

Conidia Formation and Germination takes place at a relative humidity between 30% and 90%. No free water is needed. There may be a negative impact of very high relative humidity and the presence of free water.

There is no specific climate situation needed for infection. An infection model is therefore impossible for this disease.



Relation between Fungal Growth and Temperature



Grape Vine Powdery Mildew Risk Model

The risk model reflects the big influence of temperature on the condia formation, conidia germination and fungal growth at this pathogen.

Risk starts:

3 days with equal or more than 6 hours of:

21°C <= Temperature < 32°C → 60 Points

Risk increases:

every day with equal or more than 6 hours of:

21°C <= Temperature < 32°C → 20 Points more

Risk decreases:

every day when temperature does not reach 21°C → 10 Points less

every day with 6 hours of

32°C <= Temperature → 10 Points less

Grape Vine Powdery Mildew Ascospore Infection Model

Ascospore Infection starts:

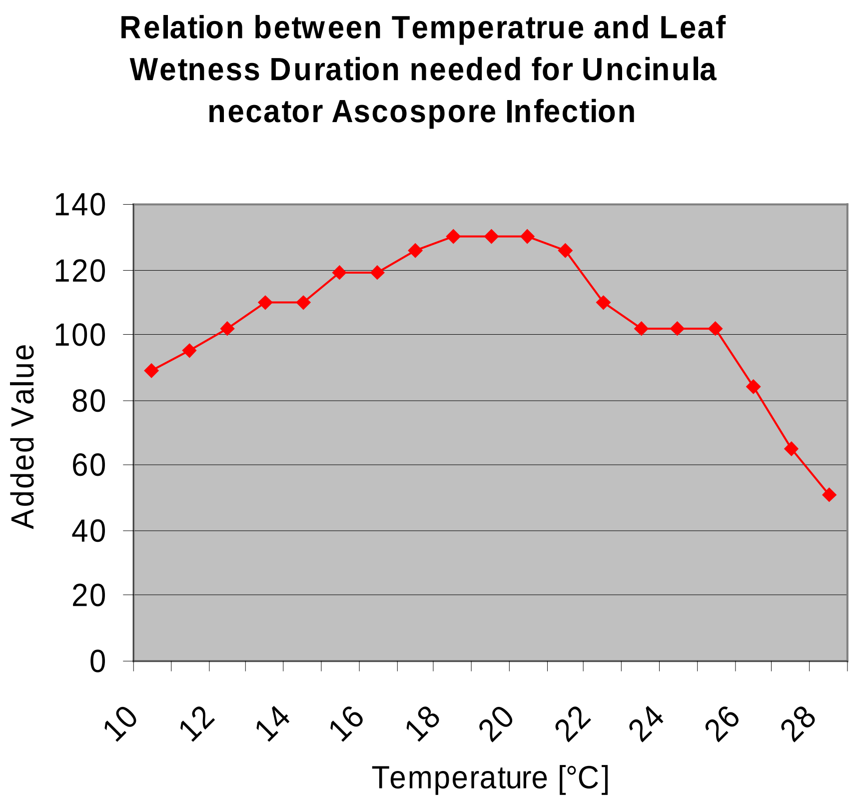
If temperature is higher than 10°C and Leaf Wetness is present.

Ascospore Infection progresses:

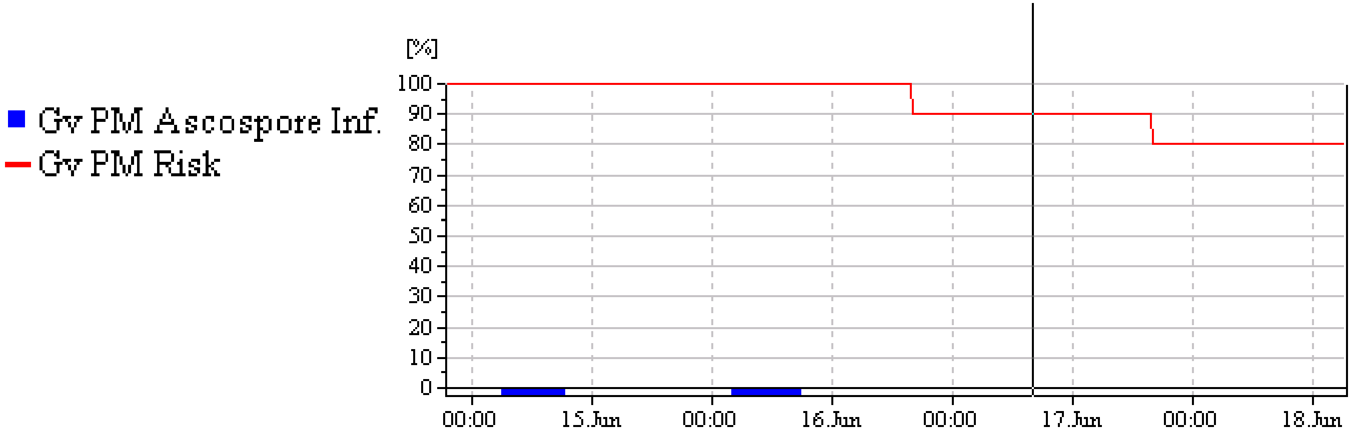
Every minute where the conditions above is fullfilled the values graphed aside are accumulated.

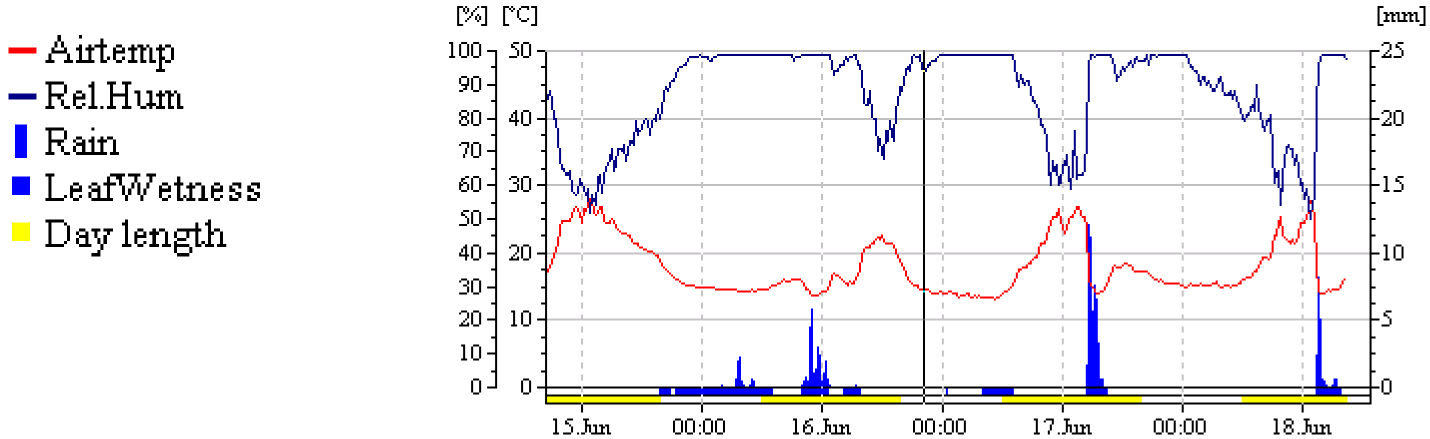
Ascopsore Infection is finished:

If the accumulated value reaches 43,000.

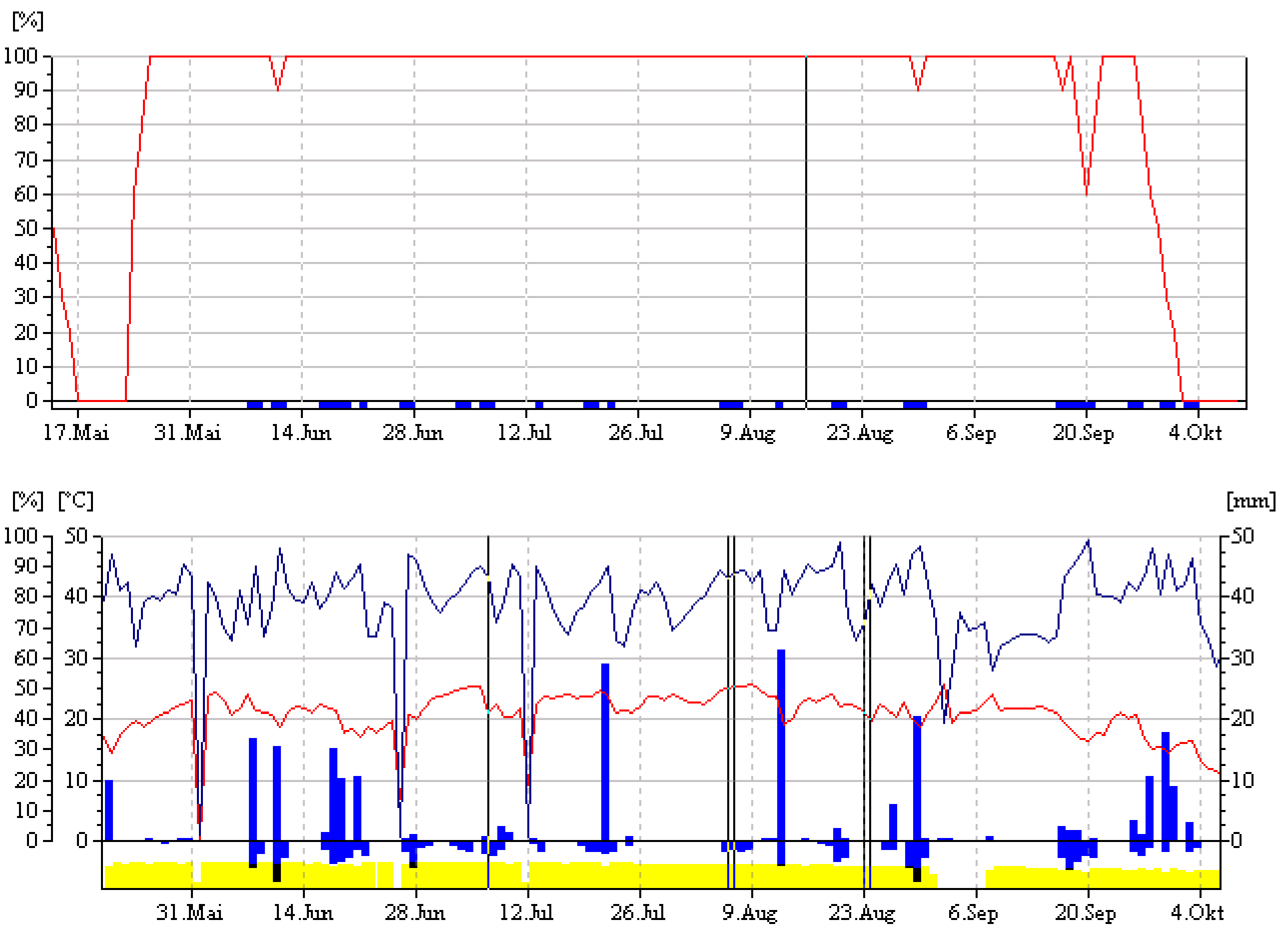


Grape Vine Powdery Mildew Risk and Ascospore Infection Model graphical presentation in MetWin II





Grape Vine Powdery Mildew Risk and Ascospore Infection Model graphical presentation in µLink



Grape Vine Powdery Mildew Risk and Ascospore Infection Model presentation on the µMETOS display

µMETOS displays the Powdery Mildew models together with the Botrytis model. It displays possible ascospore infections as an asterix and it displays the risk figure from 0 to 100 (XX).

GVPM Ascospore Inf, Risk
Botrytis Risk
M-DD AI MR BR

Label

5-12 07 * 60 20
5-12 08 70 20

M-DD AI MR BR
M-DD AI MR BR

Screen

Grape Vine Powdery Mildew Risk and Ascospore Infection Model practical use

Grape Vine Powdery Mildew is a very much inoculum driven disease. This restricts the use of the model. First decision which have to be made is what is the major source of inoculum. Is it flag shoot or is it Ascospore. If flag shoots are present the value of the ascospore infection model is null.

The ascospore infection model points out days of possible ascospore infection. It points out very much such days. In Portugal this dates will be important from the middle of April to the middle of May. Use this days to check for the presence of the disease in the vineyards.

The risk model points out periods where climate is favourable for disease propagation. This will mostly be the fact from June to end of August. The mdoel indicates very good years where disease can start more early or where disease will never be a big problem.

Decision rule for the risk model:

less than 20 Points => prolongate spray interval (sulfor can be used)

20 to 60 Points => normal spray interval (use systemic mainly non DMI fungicide)

more than 60 Points => shorter spray interval (use DMI fungicide with shorter spry interval)

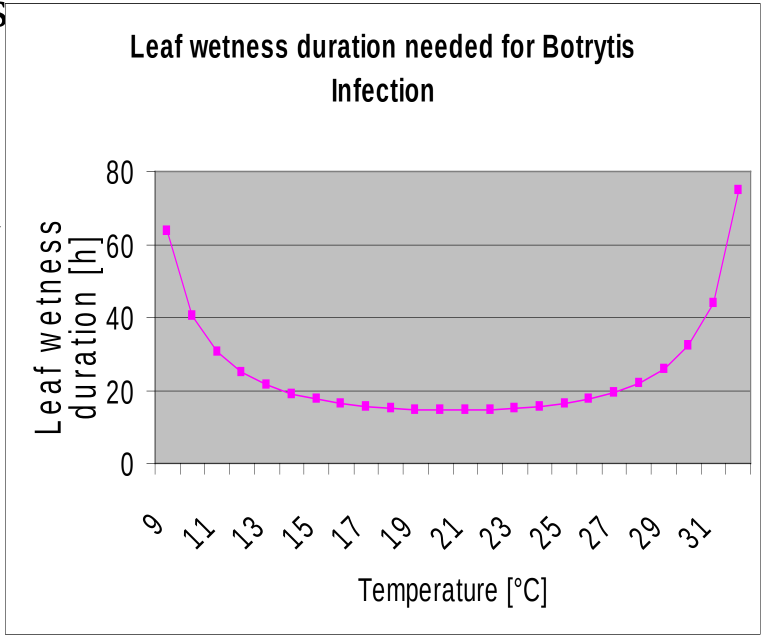
Grape Vine Grey Mould (*Botrytis cinerea*)

Biology

Botrytis cinerea is a fakultative parasite. It growth on dead plant material too. Do to this fact it is always present in vineyards and orchards.

Botrytis cinerea is related to moist climate. For infection it needs very high relative humdity or the presence of free water. The fungus is unable to infect healthy adult plant material by spores. Infection takes place on young shoots of the vine during longer wet periods or an shoots damaged by hail storms.

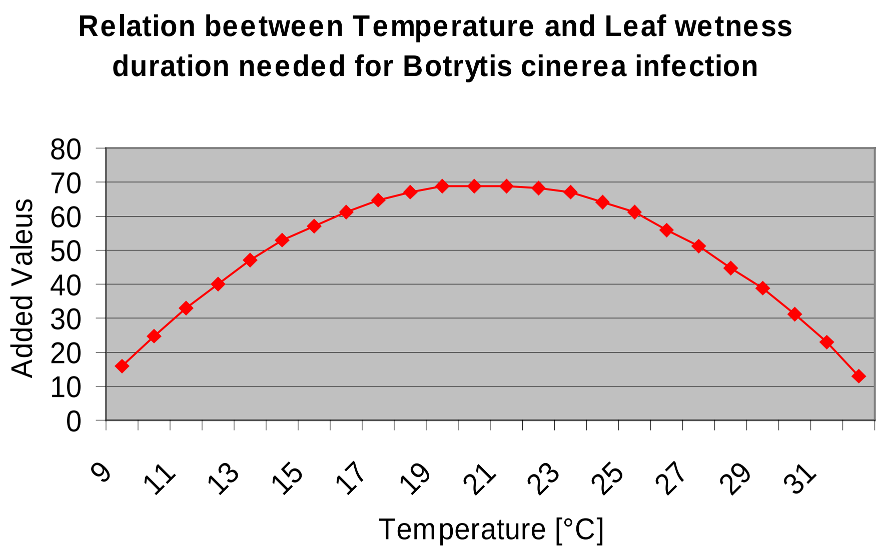
Fruit infection on grapes, strawberries or kiwi is only possible on fruits near to maturity. Main source of inoculum are dead petals infected by *Botrytis cinerea*.



Botrytis cinerea infection is favoured by leaf wetness. For the infection of detached berries the relation between leaf wetness duration and temperature leading to infection is shown in the graph beside.

Grape Vine Botrytis Risk Model

For every consecutive minute of leaf wetness when temperature is between 9°C and 32°C the model adds a value depending on temperature (graphed out beside) to a counter. This counter is evaluated by the risk model at the end of the leaf wetness period.



Risk starts:

If counter >= 60,000 ⟶ 30 Points

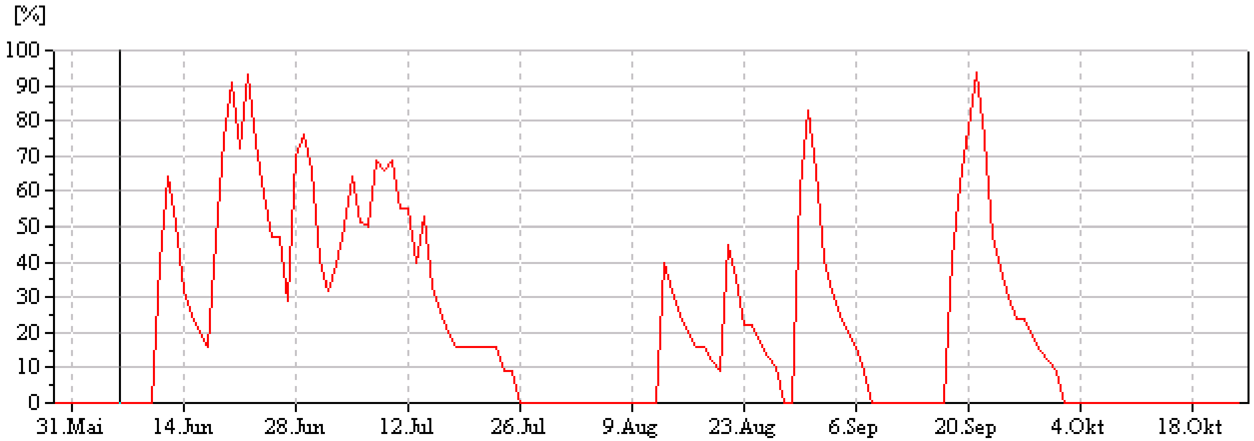
Risk increases:

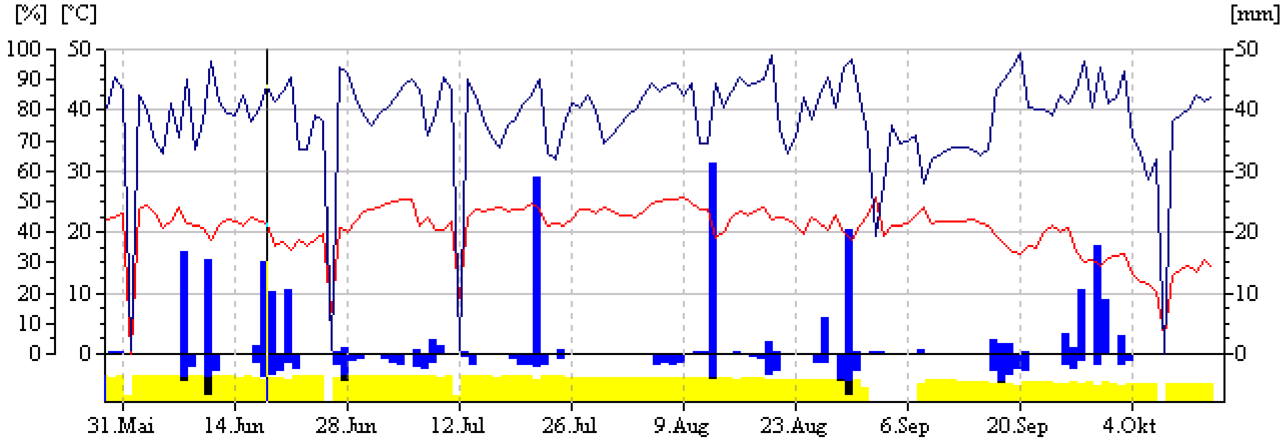
x = counter/2,000 ⟶ +x Points

Risk decreases:

Every day where leaf wetness period is shorter than 4 hours
x= Risk/5 ⟶ -x Points

Grape Vine Botrytis Risk Model graphical presentation in MetWin II and µLink





Grape Vine Botrytis Risk Model practical use

The applied threshold for the Botrytis risk figure is site specific. This means you will need experience with the model to adapt this risk figure to your climate. In areas where fall tends to be try accepted risk is much higher than in areas where fall tends to be wet.

The model points out how favourable a period of time was for the disease. High risk values in periods where death or living plant material susceptible for *Botrytis cinerea* will show a good correlation to the increasing presence of the pathogen.

In viticulture and kiwi production high risk values during blossom or short after blossom pointing on a high load of inoculum inside the clusters. For strawberries high risk values during blossom are pointing on a high percentage of latend infected fruits which can cause problems in post harvest behaviour.

Pessl Instruments