



**AGGRESSIVENESS TESTING IN
PHYTOPHTHORA INFESTANS
- EXPERIENCES AND SUGGESTIONS
FOR PROTOCOLS**

Alison Lees (JHI, UK)

Björn Andersson (SLU, Sweden)

Didier Andrivon (INRA, France)

Geert Kessel (WUR, The Netherlands)

WHAT IS AGGRESSIVENESS?

- Aggressiveness is the quantity of disease caused by a pathogenic strain on a susceptible host (Vanderplank, 1963).
- Aggressiveness is the quantitative result of pathogen – host interactions.
- Aggressiveness can be seen as the sum of several monocyclic components, e.g. infection efficiency, latency period, spore production and lesion growth rate.
- From an epidemiological standpoint (i.e. over the course of a polycyclic epidemic) aggressiveness is the rate of disease development in a crop under field conditions

COMPONENTS OF AGGRESSIVENESS

INFECTION EFFICIENCY

- **How many sporangia are needed to get an infection?**

- Least probable number, dilution assay

- **Proportion of infected leaves**

- Odds of infection

SPORE PRODUCTION

- **Number of sporangia formed per mm² or per lesion**

- **Sporulation duration**

- No. of spore crops/ leaf area

- No. of days spores are formed and distributed

LESION GROWTH

- **Lesion size after a fixed time**

- **Lesion growth rate**

LATENCY PERIOD

- **Time from inoculation to first sporangia formed**

COMPONENTS OF AGGRESSIVENESS vs. AGGRESSIVENESS INDEX

- **Aggressiveness index = Attempt to sum up components into one figure**



- Easier to compare isolates



- An index can obscure differences in the individual components of aggressiveness
- Equal weighing of all components may not be appropriate

- **Other possibilities:**

1. Reconcile the monocyclic and polycyclic definitions through an index proportional to R_0 (basic reproduction number) to get an aggregative index with epidemiological meaning. (Montarry et al 2010, Skelsey et al 2005)
2. Simulation (temporal epidemiological model)

MEASURING AGGRESSIVENESS: WHAT ARE THE PITFALLS?

- **Aggressiveness is quantitative**
 - We're interested in small, but measurable differences
- **Aggressiveness = f (isolate, host, environment)**
 - Three sources of variation to manage, two of which are creating only 'noise'
 - Usual solution: to measure the variation in the pathogen-dependent components while keeping host and environmental influences (as) constant (as possible), **BUT...**

MEASURING AGGRESSIVENESS: WHAT ARE THE PITFALLS?

- **Aggressiveness = f (isolate, host, environment)**
- Host physiological status is difficult to homogenise and repeat in potato
- Small variations in environment can make big differences which results in low reproducibility

MEASURING AGGRESSIVENESS: WHAT ARE THE PITFALLS?

- **Many factors influence - difficult to limit experimental variation**
 - **Isolate**; general condition, type of artificial media used, time on artificial media, time of year (?)....
 - **Test plant**; crop - whole plants - leaves - leaflets – leaf discs, plant age, leaf position on plant, leaflet position on leaf, growing conditions, time of year....
 - **Environment**; temperature, moisture, quality and quantity of light....

WHERE CAN IT GO WRONG?

- **Well, at almost every experimental step...**
 - Many internal replications
 - Keep conditions as identical as possible between batches
- **...and during interpretation**
 - Know what you're after:
 - Individual differences for components
 - An aggregate aggressiveness estimate over a monocycle
 - An aggressiveness estimate over the course of an epidemic
 - Don't overtrust statistics
- *Never repeat an aggressiveness test that worked – it won't work twice...*

WHAT ABOUT TUBERS?

- **Everything that is true for leaves is also true for tubers**
 - On tubers it is also possible to separate IE, LP, LGR etc...
 - Physiological state of the tubers is important (fresh, after desiccation, during/ after storage...), maybe even more so than for leaves
 - Testing can be done on tuber slices or whole tubers

LAB VS. FIELD

PLOT (2x3m) OF BINTJE 9 DAYS AFTER INOCULATION

ISOLATE N03-259:

- 3 % infectious sporangia
- 5.2 days latency period
- 4 mm/day lesion growth
- 50 sporangia/mm²



LAB VS. FIELD

PLOT (2x3m) OF BINTJE 9 DAYS AFTER INOCULATION

ISOLATE DK03-33:

- 5 % infectious sporangia
- 4 days latency period
- 7 mm/day lesion growth
- 250 sporangia/mm²





AGGRESSIVENESS TESTING IN *PHYTOPHTHORA INFESTANS* – EXPERIENCIES AND SUGGESTIONS FOR PROTOCOLS

HOW DO WE PROCEED FROM HERE?

- Protocols on Euroblight website? One protocol or several?
- Review paper?
- Other ideas?