



Is oospore production of *Phytophthora infestans* modulated by level and components of partial resistance?



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Introduction

Partial resistance



| Slows down the rate at which disease increases within a single plant or population of identical plants [Van der Plank, 1968]

| Partial resistance can act by:

1. Lengthening the latent period
2. Reducing progress of parasite in plant tissue
3. Limiting spore production
4. Reducing infectivity (success of infection)

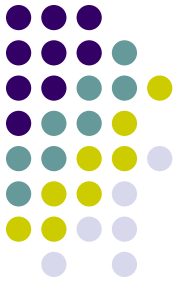
Components
of partial
resistance

| Can be measured

- | in the field (visual score) *NIAB scores, AUDPC, ...*
- | in controlled conditions (calibrated tests)

Introduction

Sexual reproduction

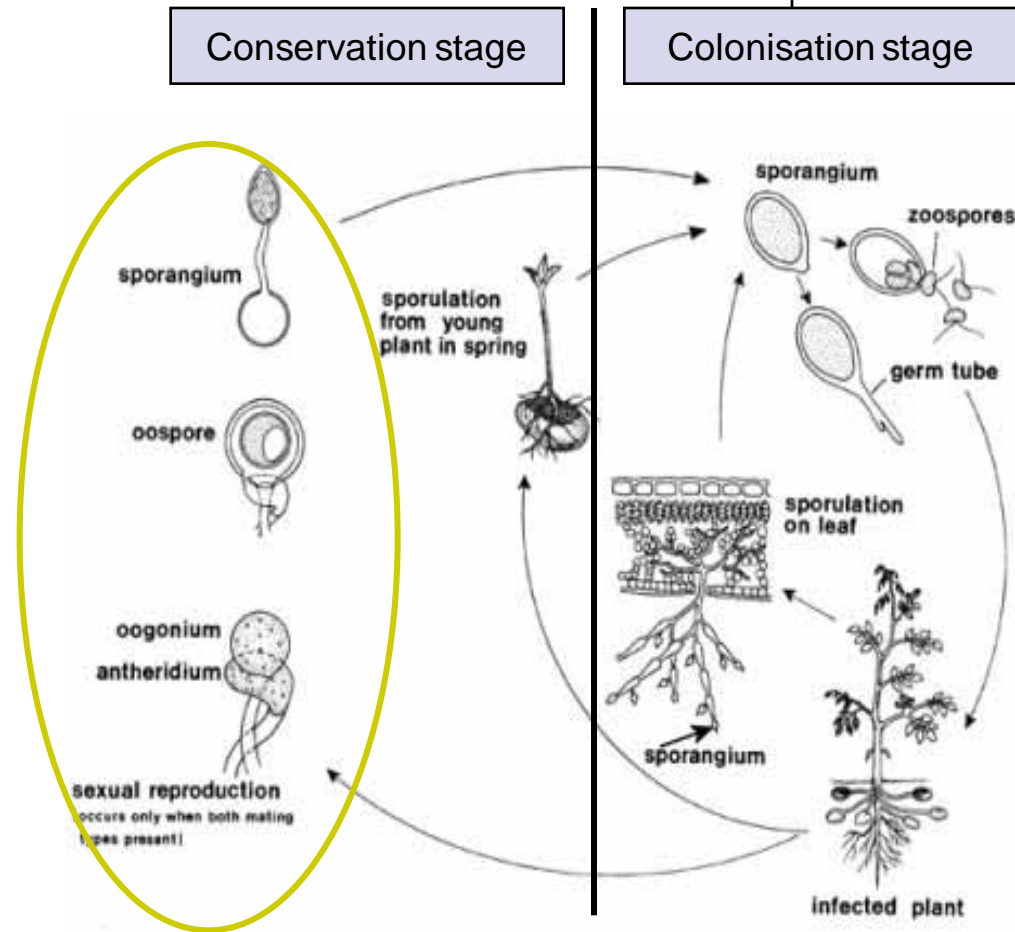


Conservation stage during the hard season

Phytophthora infestans = Heterothallic species

Presence of the **two mating type** (A1 and A2) required to induce differentiation of sexual organs

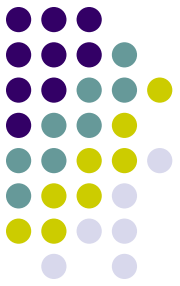
Controlled by sexual hormones



This is a simplified disease cycle for late blight of potato.

Introduction

Oospore production vs. partial resistance



Æ How partial resistance (during colonisation stage) could modulate oospore production ?

- | What we know...
 - | In whole plants :
More oospores for medium levels (NIAB scores) (Hanson & Shattock, 1998) or for high levels (Strömberg & al, 2001) of partial resistance
 - | In leaf discs :
More oospores on medium level (Hanson & Shattock, 1998; Drenth & al, 1995; Strömberg & al, 2001) or sometimes on low level (Hanson & Shattock, 1998) with some exceptions

BUT

- | Results obtained for only one pair of strains in each case
- | What do field scores mean regarding partial resistance?

Objectives



Link quantitative and qualitative characteristics of partial resistance and oospore production for different pairs:

- è Effect of partial resistance levels
- è Effect of components of resistance/aggressiveness

Approach

- | Testing behaviour of strains on cultivars with different levels of partial resistance
- | Assessing oospore production by pairs of these strains

Materials ...

Plant material



Æ 10 cultivars of *Solanum tuberosum*

- | 2 reference cultivars

Bintje, Désirée

- | 7 old cultivars, bred before introduction of *Solanum demissum* R genes

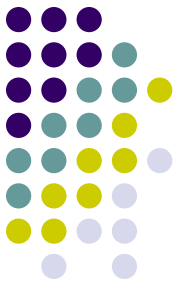
Robijn, Roode Industrie, Furore, Rosafolia, Möwe, Herbstrote, Noorstar

- | 1 cultivar built by INRA and interesting to test inra114-92T



Materials ...

Pathogen



| 6 strains of *Phytophthora infestans*

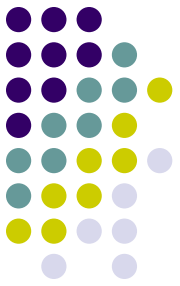
| 4 A1 } 8 possible pairs
| 2 A2 }

Chosen for their aggressiveness on
cv. Bintje in earlier tests

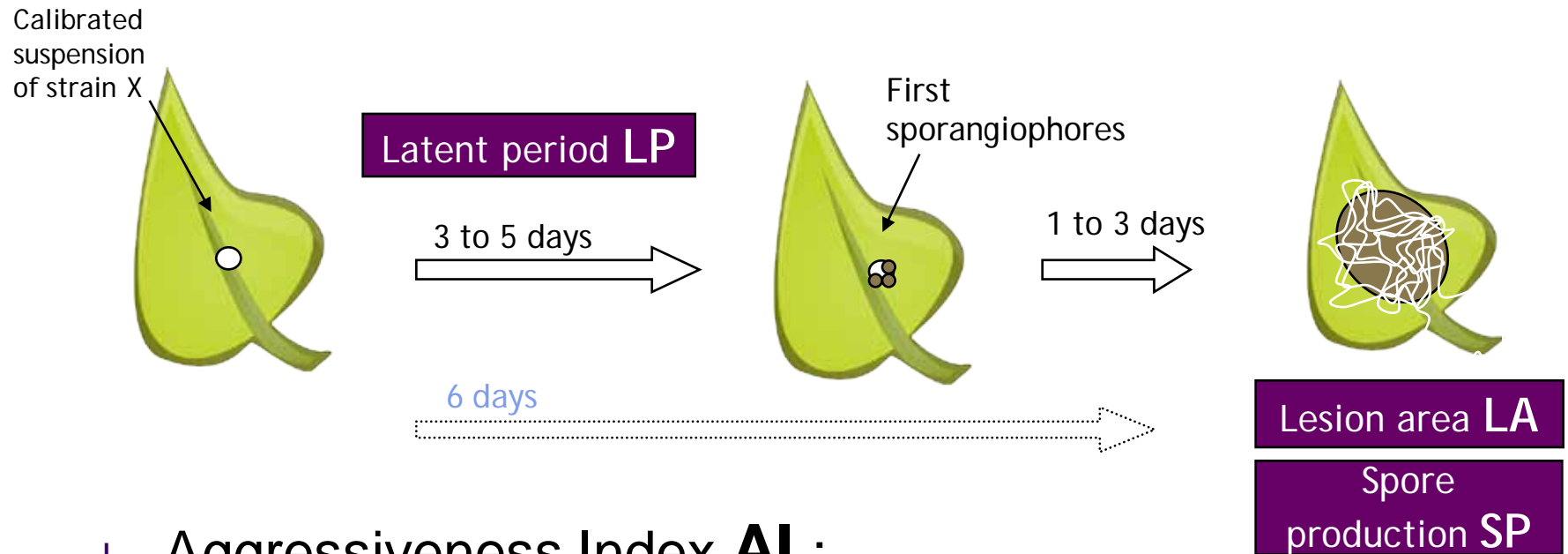


... and methods

Test of aggressiveness



- | Detached leaflets
- | Three aggressiveness components

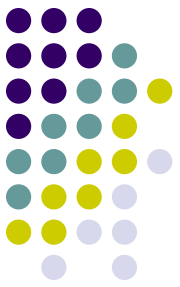


- | Aggressiveness Index **AI** :

$$AI = \text{Log}(LA * SP / LP)$$

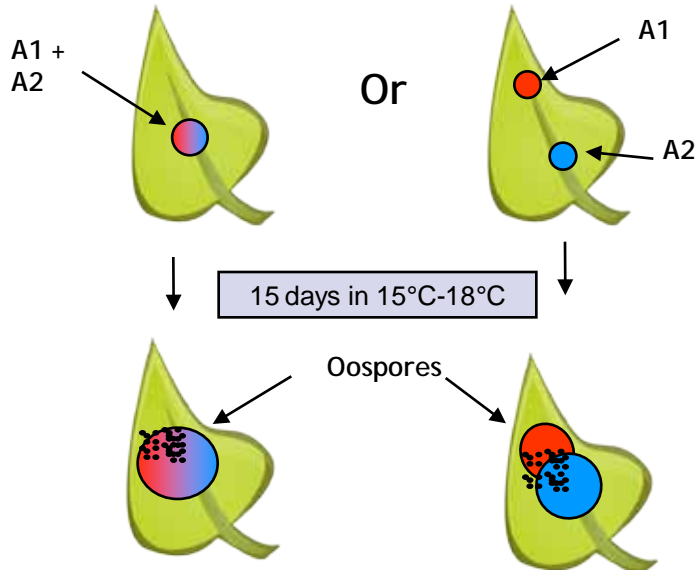
... and methods

Production of oospores



Inoculation

- | 8 couples on 10 cultivars
- | 2 inoculation mode
- | 6 leaflets/modality



Counting of oospores

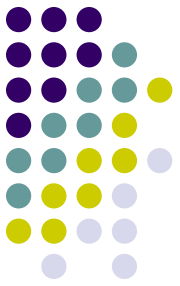
- | Pretreatment with bleach



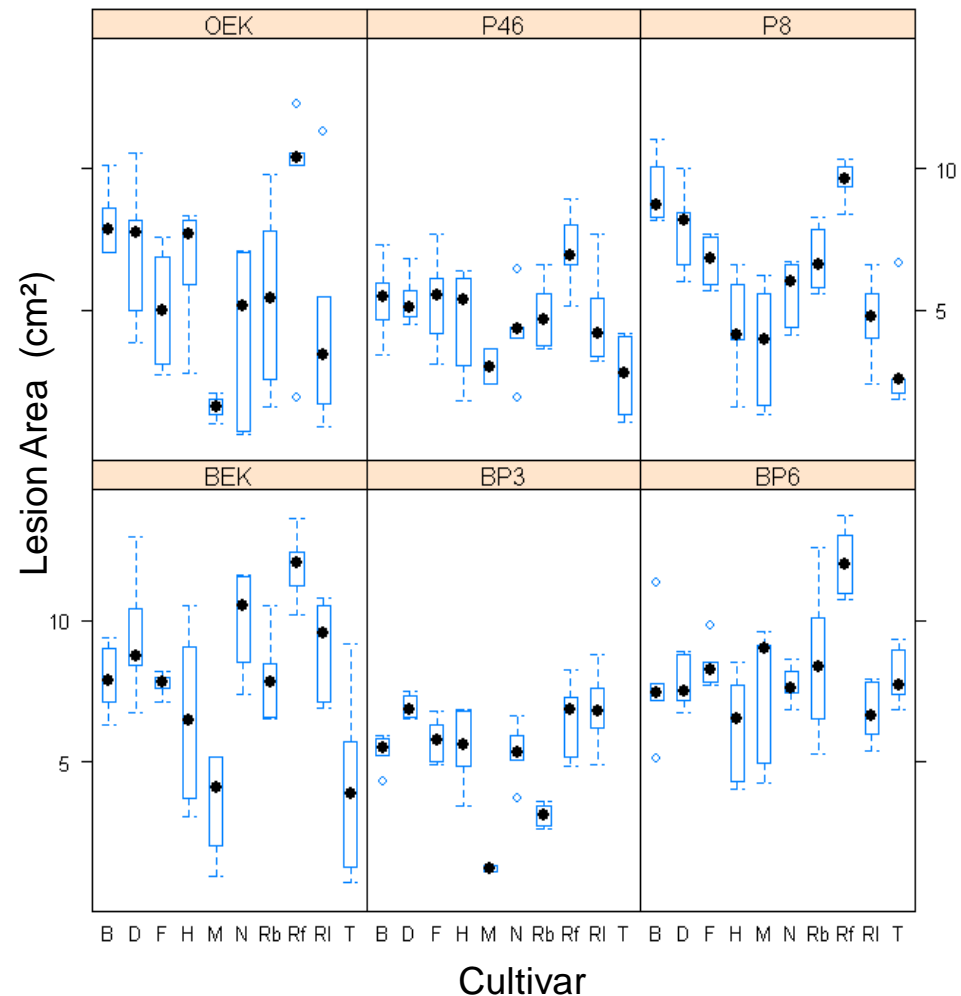
- | Grinding
- | Measurement of concentration with haemocytometer

Results

Aggressiveness/components of resistance

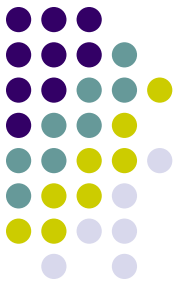


- | Interaction between strains and cultivars for each component
- | No consensus ranking of cultivars for their level of resistance on each component
- | Each interaction strain/cultivar must be considered separately



Results

Aggressiveness of a couple?



- | Aggressiveness data for each strain **alone**
 - F Objective : link characteristics of resistance/ aggressiveness to oospore production
- | Oospore P one pair = 2 compatible strains
- | What is aggressiveness of a pair???

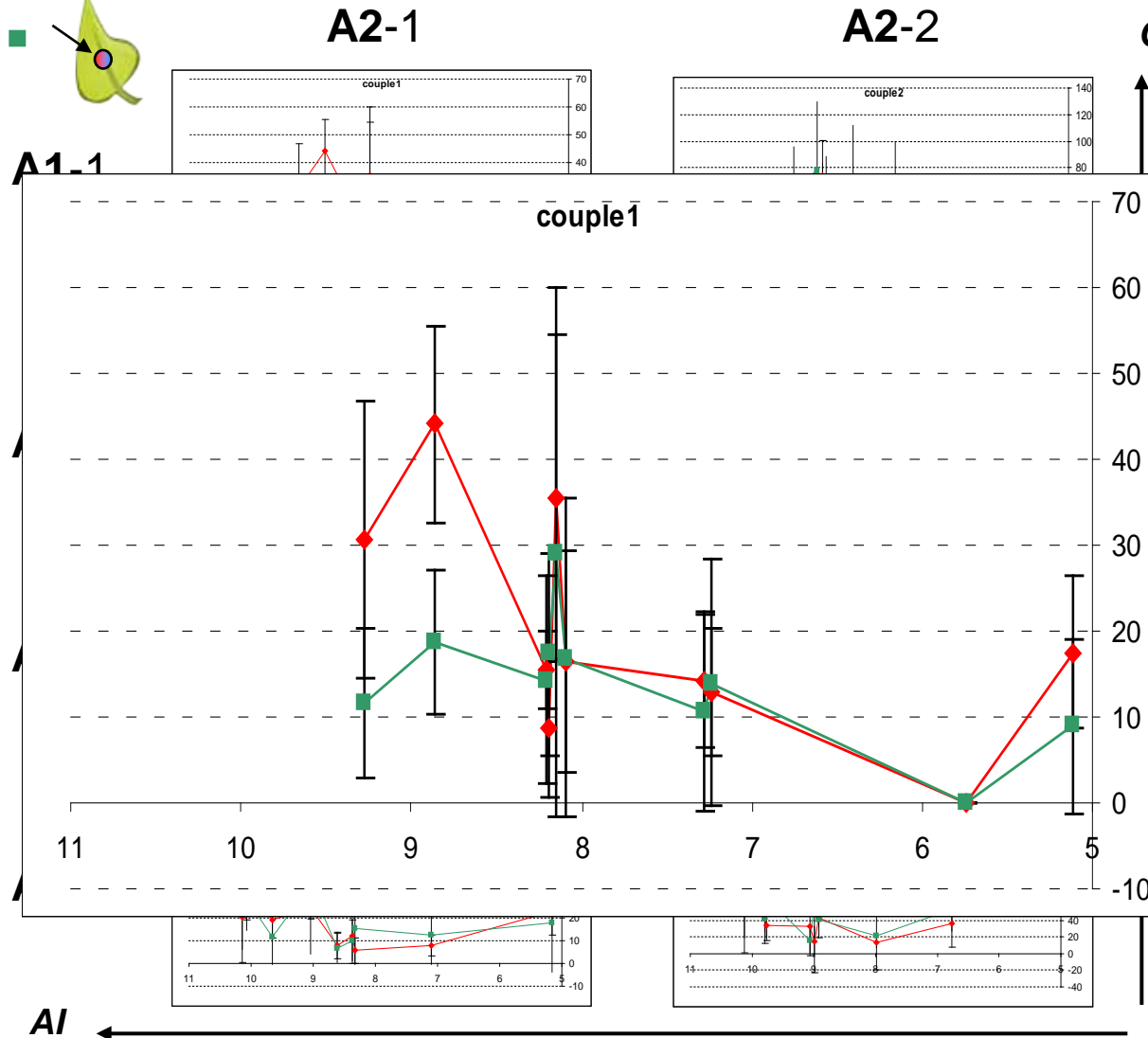
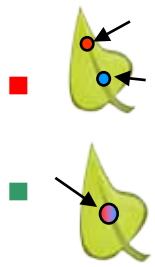
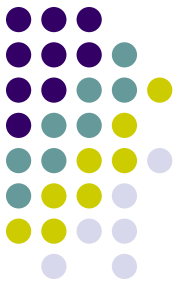
- |
$$\frac{\text{aggr}_{A1} + \text{aggr}_{A2}}{2}$$

- | \max or \min (aggr_{A1} ; aggr_{A2})

è Mean of each parameter

Results

Oospore production vs. aggressiveness index

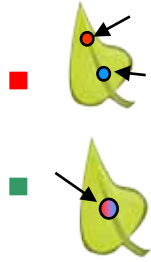
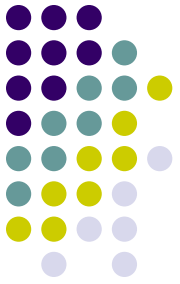


- Variability between reps
- For each pair :
 - The more aggressive the pairs, the higher the oospore production
 - Mixed inoculation gives often more oospores

AI ←

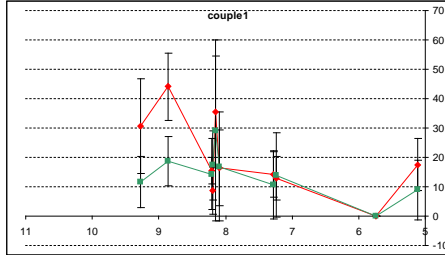
Results

Oospore production vs. aggressiveness index

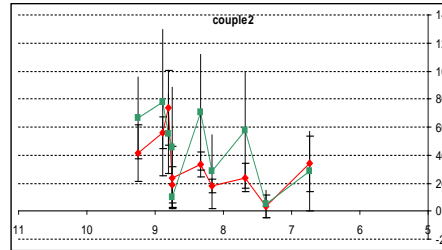


A1-1

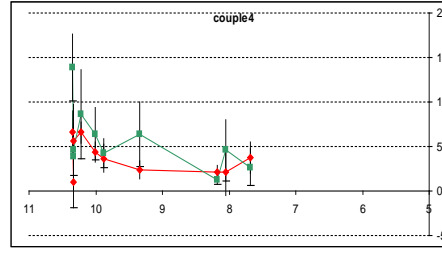
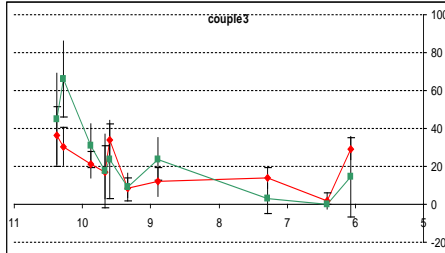
A2-1



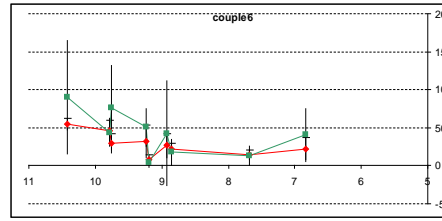
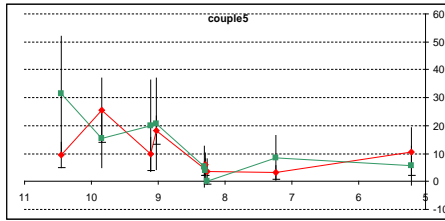
A2-2



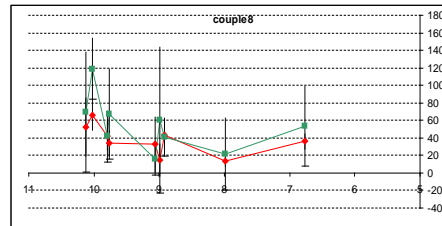
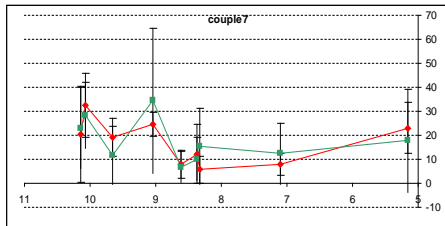
A1-2



A1-3



A1-4



Oospores/mm³

- Variability between reps

- For each pair :

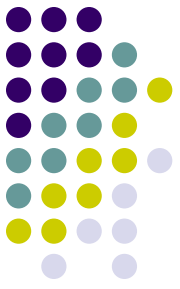
F The more aggressive the pairs, the higher the oospore production

AI

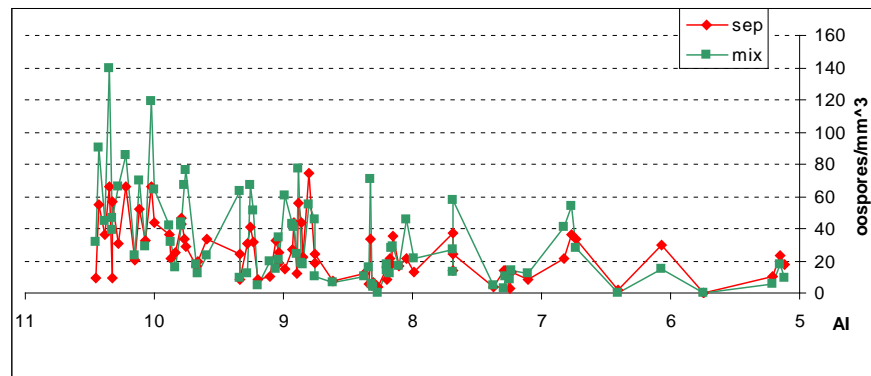


Results

Oospore production vs. aggressiveness index



- | Same conclusion when pooling all data.



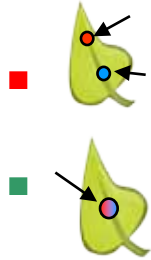
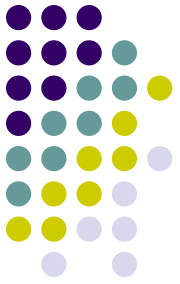
> Which component has more influence in oospore production?

è **Hypotheses** :

1. **Lesion area** : rapidity of strain growth
 2. **Latent period** : rapidity of growth start
 3. **Spore production** perhaps energy and metabolites allocated for sporulation could be a disadvantage in oospore production
- } Role in meeting of strains

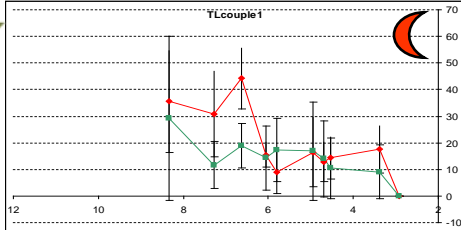
Results

Oospore production vs. lesion area

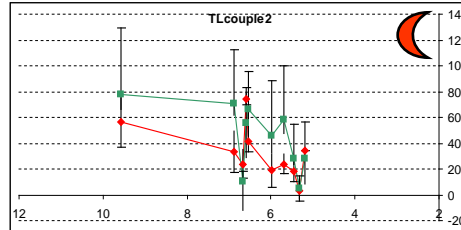


A1-1

A2-1

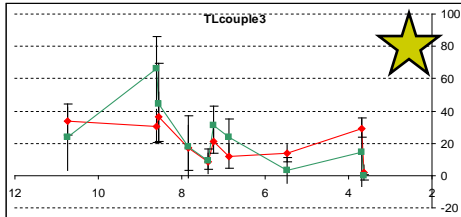


A2-2

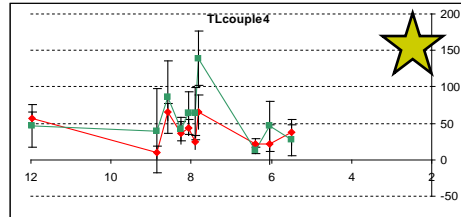


A1-2

A2-3

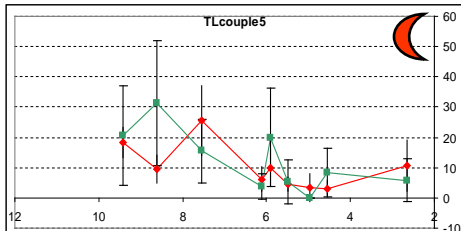


A2-4

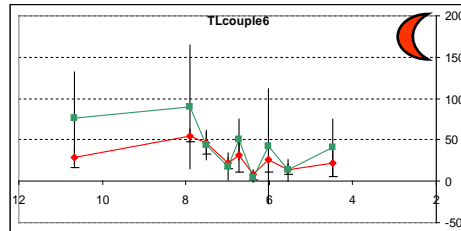


A1-3

A2-5

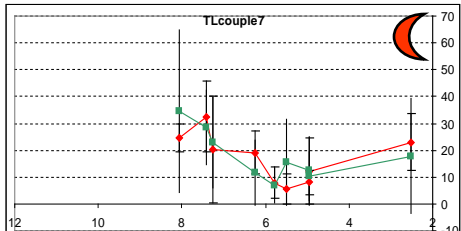


A2-6

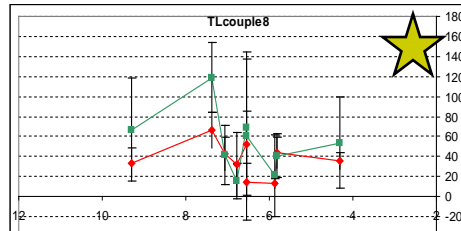


A1-4

A2-7



A2-8



Oospores/mm³

- 2 kinds of response according to pairs:

F Higher oospore production for medium levels of resistance for this component ★

F Higher oospore production for lower levels of resistance for this component ☾

LA ←



Discussion / Perspectives

- | First results show : differential production of oospore on cultivar with
 - | different components of partial resistance
 - | different levels of partial resistance
- è Analyses must be continued

- | Repeatability of experiment must be checked
 - | data collected, but not analysed yet

- | An interesting question is
 - « **How to measure the aggressiveness of a pair of strains?** »

Thank you for your attention

Thank you to :



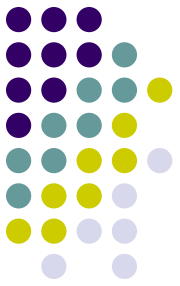
INRA Ploudaniel

J.E. Chauvin

R. Pellé

For implicating in my work

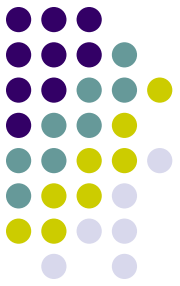




Name	Mating type	Lesion area	Spores/cm ²
P46	A1	-	-
2BEK21	A1	+	+
2OEK24	A1	-	+
2BP3-06	A1	+	-
P8	A2	-	-
2BP6-07	A2	+	+

Results

Oospore production vs. partial resistance



Pair n°	1	2	3	4	5	6	7	8
Lesion Area								
Latent Period								
Spore Production								

F Higher oospore production for

medium level of resistance for this component

lower level of resistance for this component