

The changing *Phytophthora infestans* population: implications for late blight epidemics and control

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Potato Council Funded Studentship

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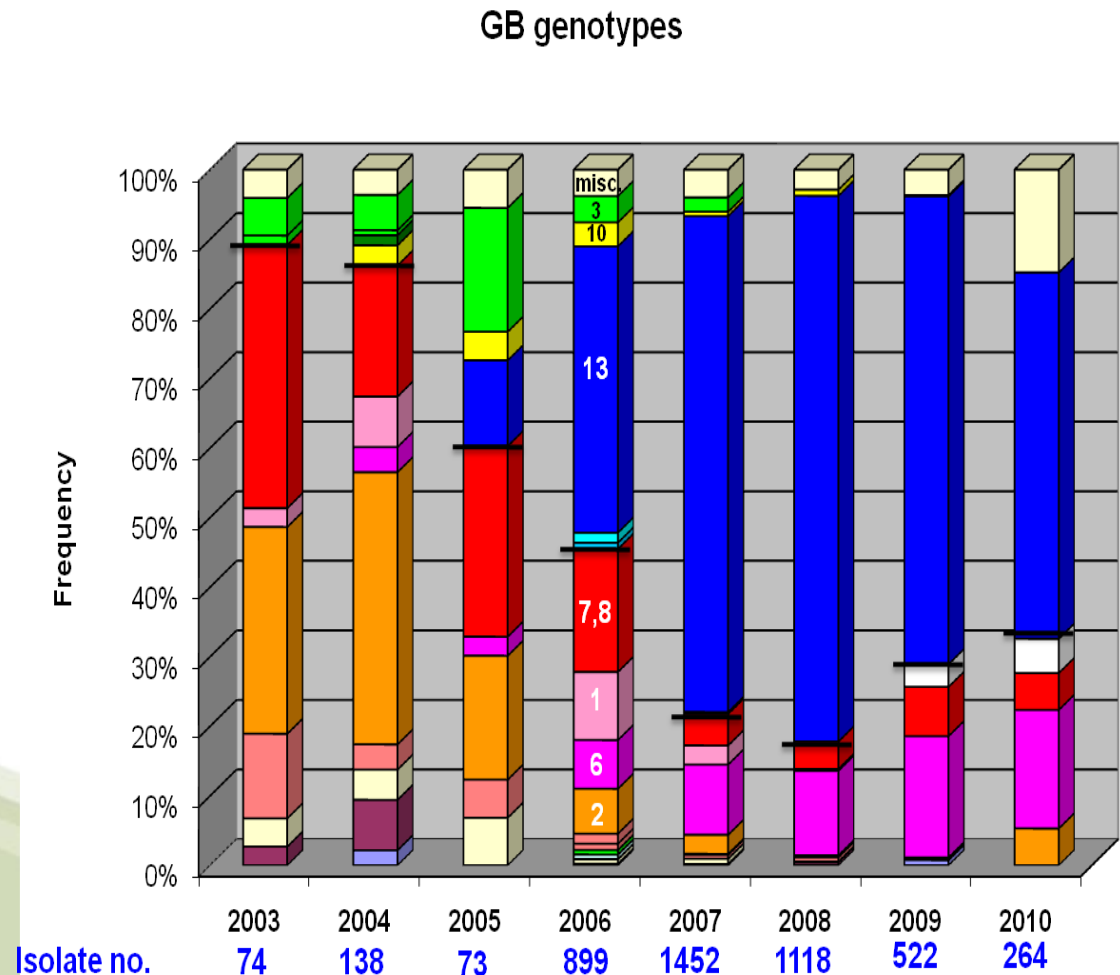
Paul Birch - UoD



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P. infestans Population Change

- Increase in the A2 mating type in UK populations has been observed
- Increase in A2 is due to genotype 13_A2
- Isolates of 13_A2:
 - highly aggressive
 - overcome most R genes
 - resistant to the fungicide Metalaxyl



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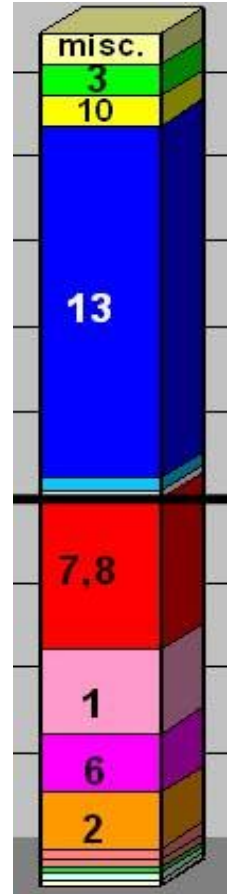
■ Main aims:

- investigate how *P. infestans* has changed and what the implications of this change mean for management
- Effect of temperature on infection and disease
- Competition between *P. infestans* genotypes

Isolate Selection

- Isolates comprising 11 genotypes (characterised using SSR markers)
- Collected between 2006-2008 from many cultivars across the UK

Genotype	Isolate No.
1_A1	2
10_A2	4
13_A2	10
17_A2	2
2_A1	5
3_A2	2
6_A1	9
7_A1	5
8_A1	5
A1 misc	10
A2 misc	4



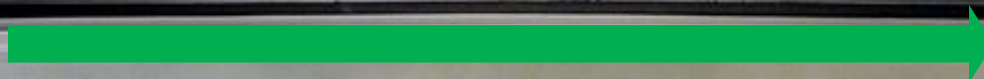
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Why is temperature important?

- The dominance of 13_A2 is thought to be temperature related, in particular with the lower temperatures
 - Aggressiveness test at 13°C, 15°C and 18°C

- The Smith Period
 - “At least two consecutive days where min temperature is 10°C or above and on each day at least 11 hours when the relative humidity is greater than 90%”

6°C

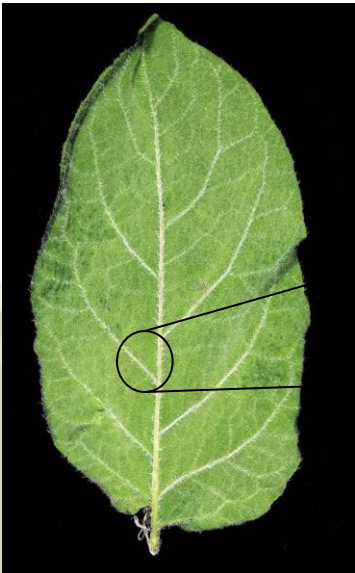
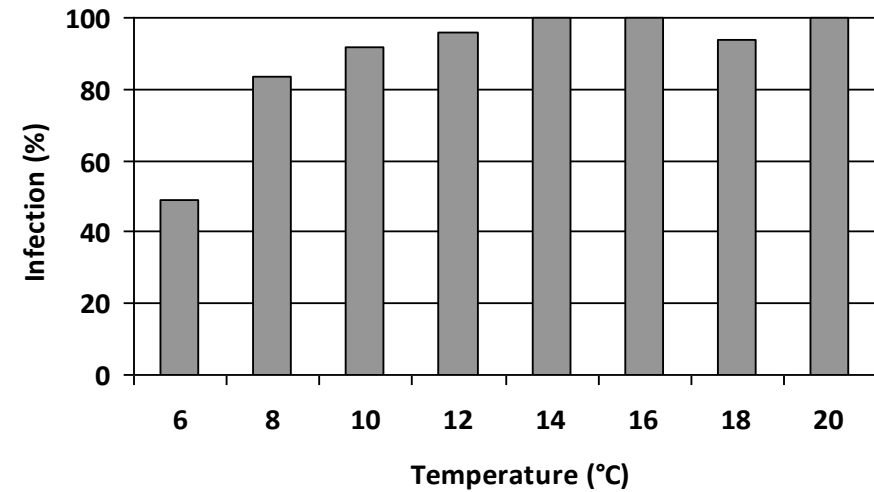


20°C



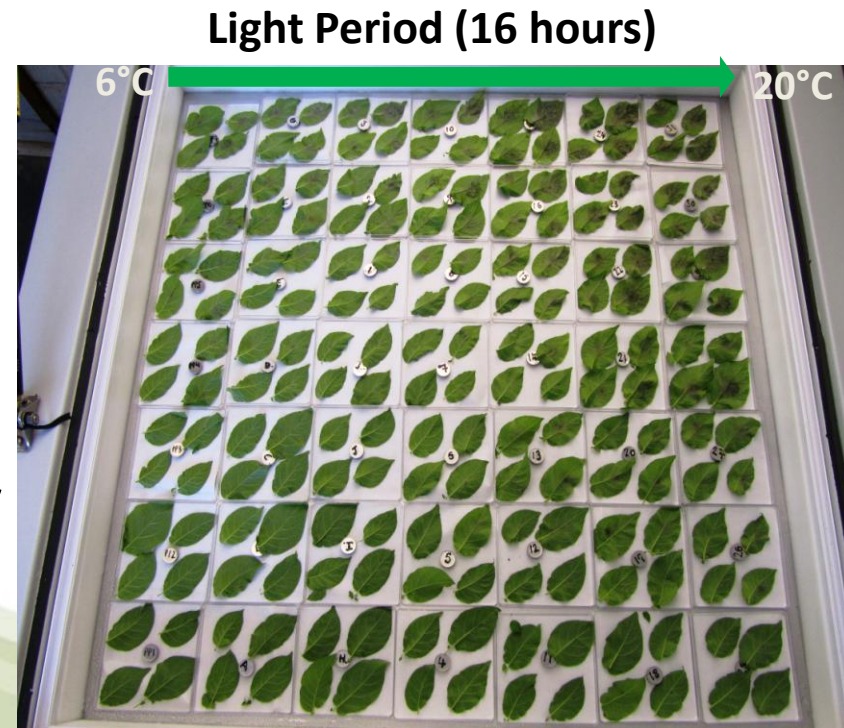
Results

- Approx. 50% of isolates infected at 6°C
- Isolates representing 10/11 genotypes infected at 6°C



Summary

- *P. infestans* infected and grew at temperatures below 10°C
 - infection at below 10°C is not genotype related
 - this has important implications for blight forecasting
 - more windows of opportunity for infection
- Other work
 - Diurnal experiment
 - Gradient was set at 6°C to 20°C.
 - Gradient switched with the light cycle (16 hour light 8 hour dark) allowing many temperature combinations to be examined



Summary

■ *P. infestans* infected and grew at temperatures below 10°C

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■ Other work

- Diurnal experiment
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- Gradient switched with the light cycle (16 hour light 8 hour dark) allowing many temperature combinations to be examined

Dark Period (8 hours)



Competition

- Aggressiveness testing showed that at 15°C 13_A2 was not the most aggressive genotype
- What other mechanisms could cause dominance?
- Competition has been described as the ability of an individual to inhibit another individual, whilst resisting inhibition

Competition field study

- Two cultivars were used
 - Cara (resistant)
 - Maris Piper (susceptible)
- The trial involved three treatments
 - 13_A2 + 6_A1
 - 13_A2 + 7_A1
 - 13_A2 + 8_A1
- Inoculation
 - Two corners of the plots



1	5	9	13
2	6	10	14
3	7	11	15
4	8	12	16



Plot Diagram



41 drills

Treatments

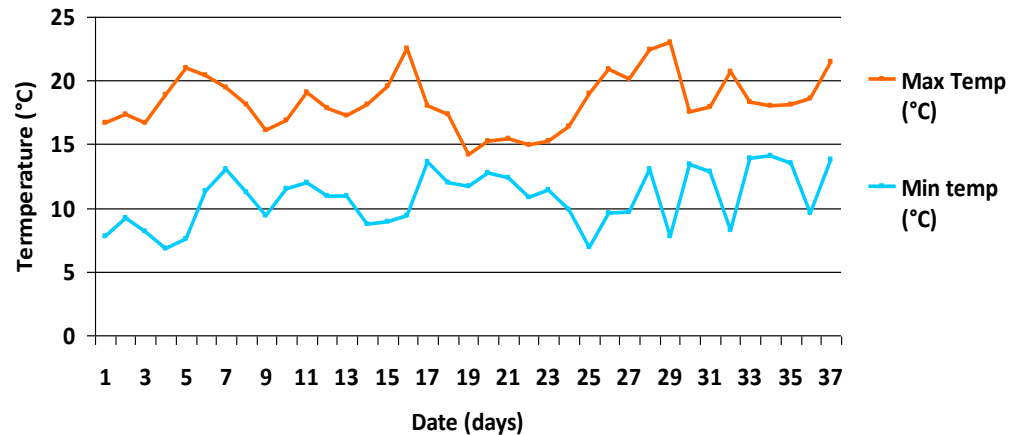
1. 13_A2 + 6_A1

2. 13_A2 + 7_A1

3. 13_A2 + 8_A1

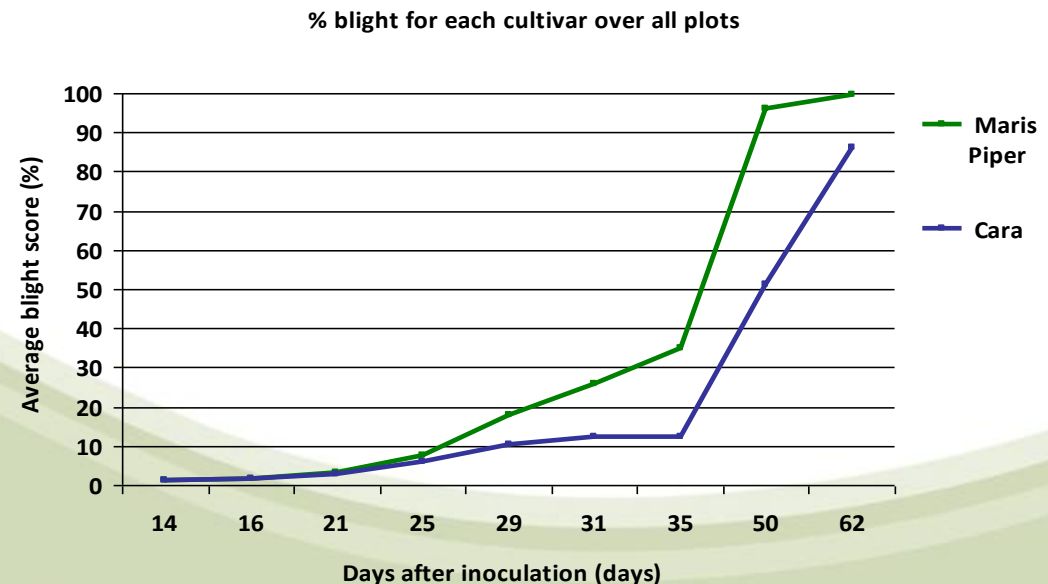
Results

- Disease was first observed 16 days after inoculation and progressed to 62 days after inoculation



- Min temperature below 10°C after inoculation

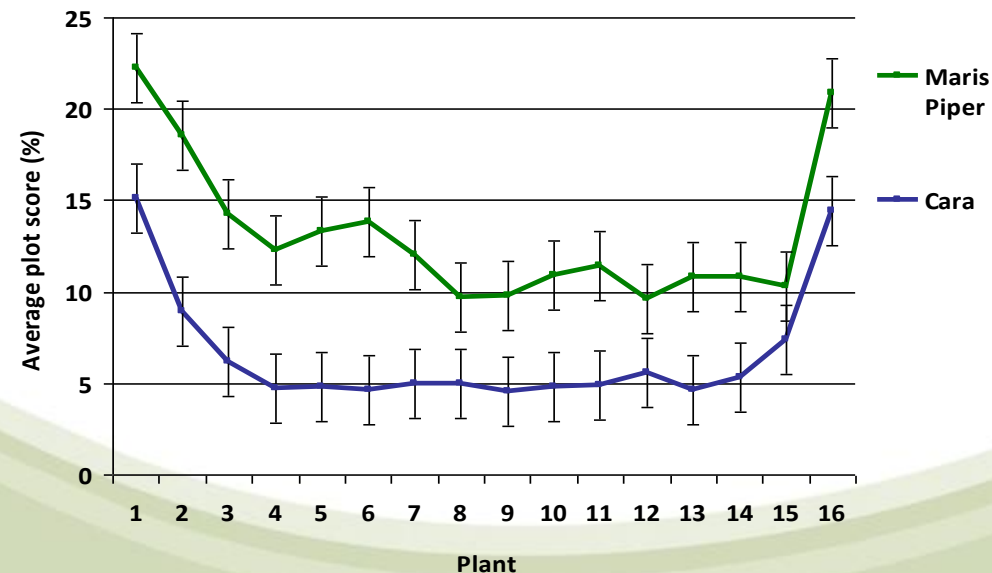
- Slower epidemic on Cara compared with Maris Piper as expected



Results - Cultivar

- There is significant difference between cultivars for disease severity ($P \leq 0.001$)
- Plant 1 and 16 have the most disease as they were inoculated.
- Spread from plant 1 and from plant 16 appears to be equal on Cara
- Spread from plant 16 progresses less to its neighbouring plants than from plant 1 on Maris Piper

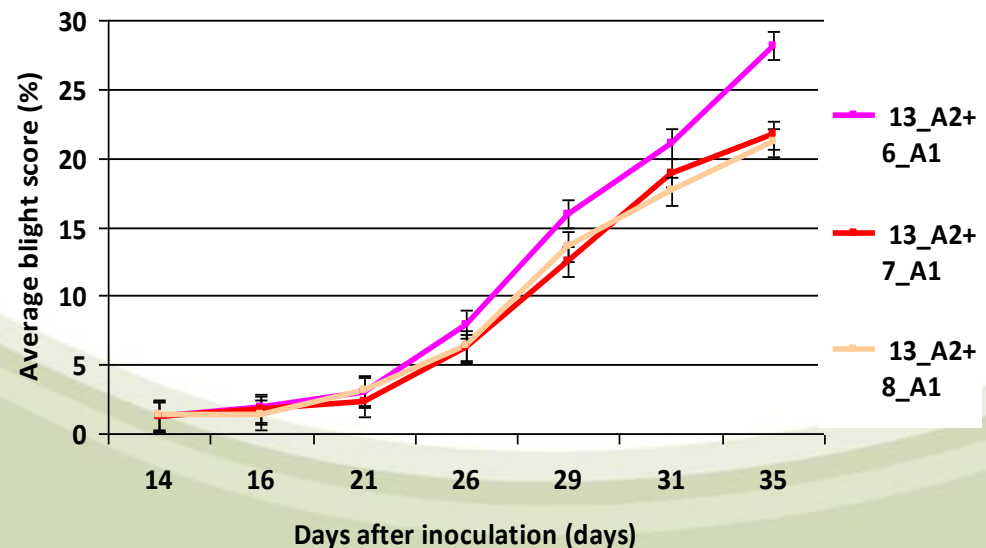
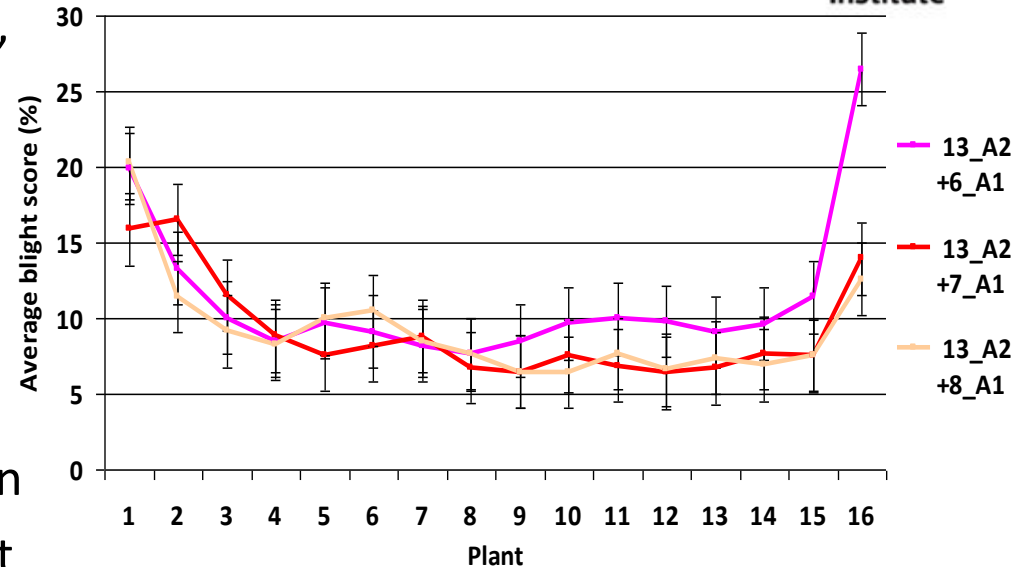
1	5	9	13
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Results - Treatment

- All plants have similar blight scores, except for plant 16 inoculated with 6_A1
- Inoculation with 13_A2 + 6_A1 causes significantly more disease on two dates, with the most significant difference being on the last date

1	5	9	13
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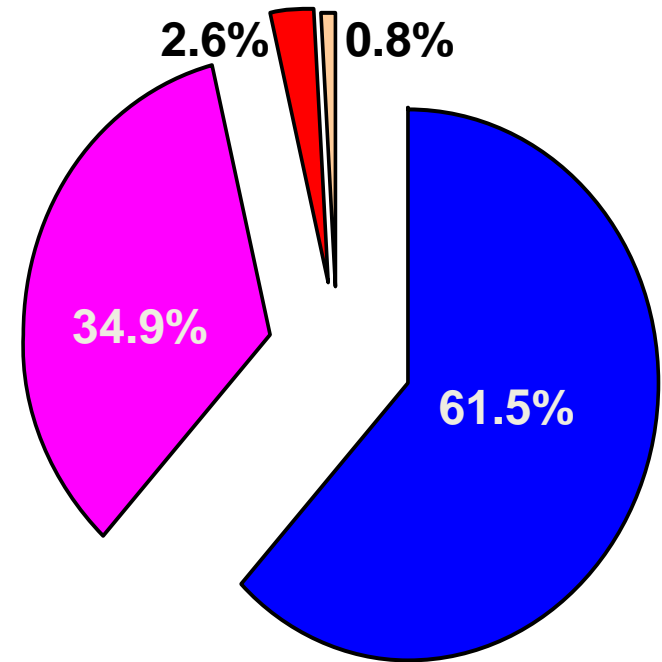


Results - Genotype

■ Sampling

- four leaflets with single lesions were taken from each plant
- FTA cards were used

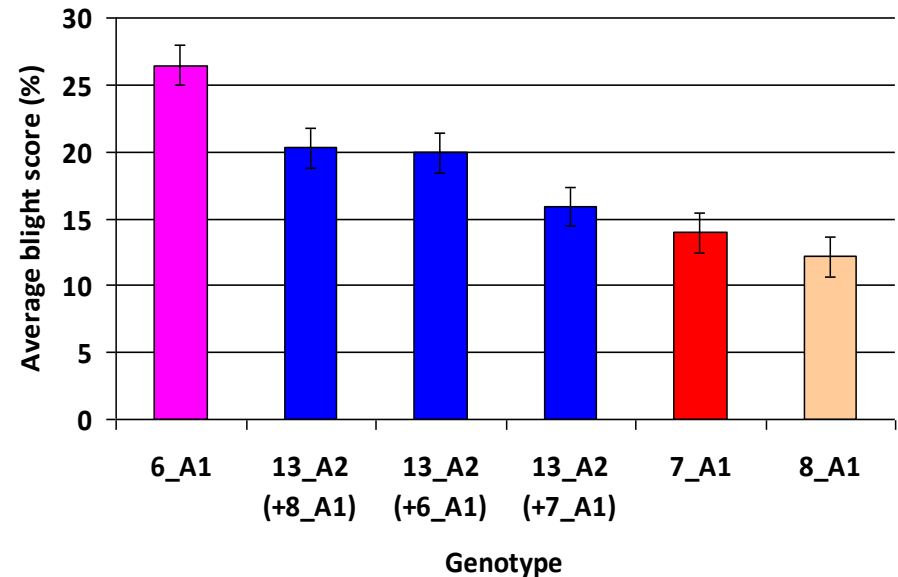
■ 13_A2 is the most prevalent genotype



Pie chart showing the % of each genotype found in all plots. Inoculation of all plots with 13_A2 accounted for.

Results – Inoculated Plants

- Disease severity caused by 7_A1 and 8_A1 is not significantly different
- 6_A1 causes significantly more disease than other genotypes



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Summary

■ Competition

- Cara is more resistant to all genotypes compared with Maris Piper
- 13_A2 is the most prevalent genotype
- However, dominance of 13_A2 is not due to aggressiveness alone
 - *In vitro* studies at 15°C do not indicate that 13_A2 is more aggressive, but some aggressiveness/fitness components are having an effect in the field
 - temperature may have an effect

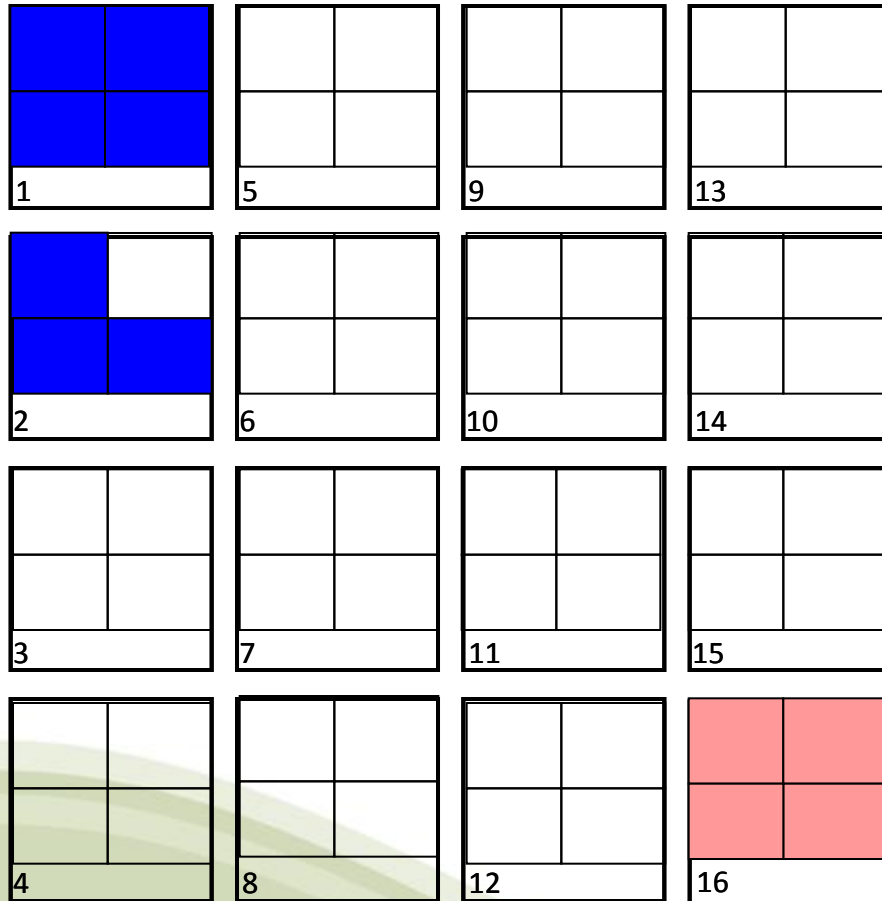


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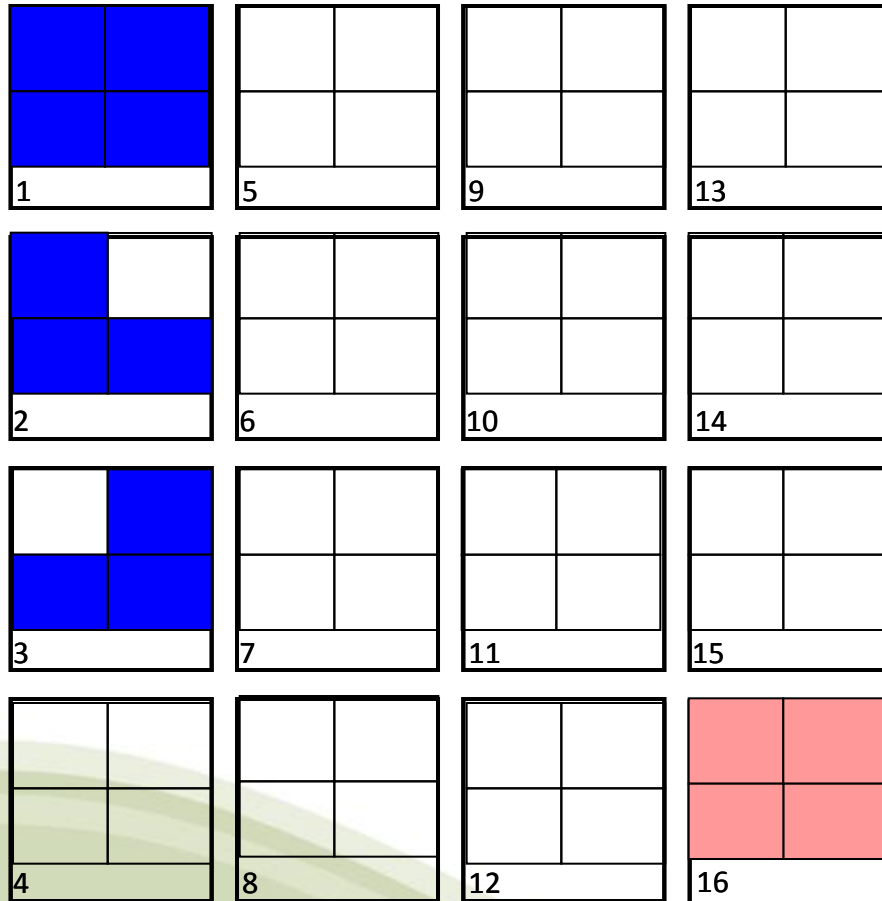


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Plot 6 – Sample date one



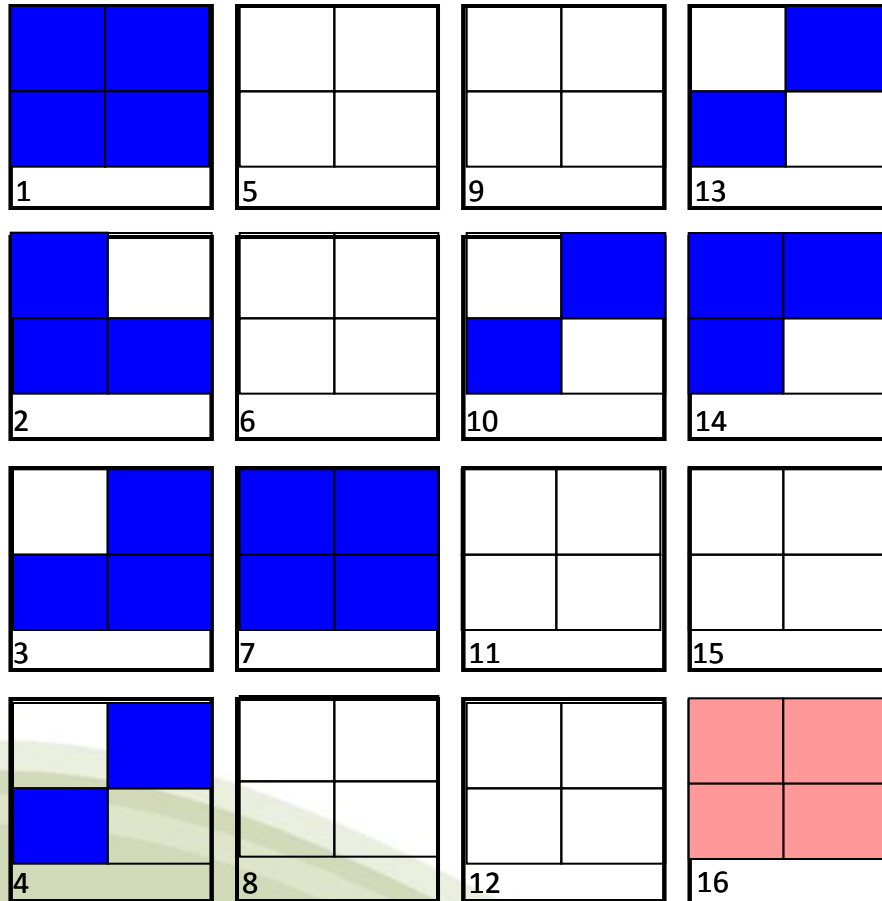
Plot 6 – Sample date two





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Plot 6 – Sample date three





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Plot 6 – Sample date four

