Tracking Late Blight in the Field

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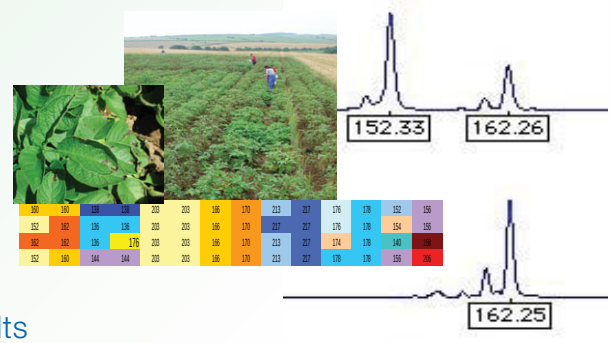


Introduction

Differences in aggressiveness and fitness of potato and tomato adapted strains of *P. infestans* are well documented, but adaptation within potato germplasm itself has not been studied intensively and the rate, mechanisms and significance of such adaptations are not known.

The extent to which cultivar-specific adaptation influences disease in the field is also largely unknown.

The development of co-dominant SSR molecular markers (Lees et al, 2006) has facilitated epidemiological studies to monitor or 'track' isolates with distinct genotypes throughout the growth of a crop.

The effects of management practices, such as host resistance and chemical control on the predominance of particular isolates throughout an epidemic can therefore be studied, as these examples show.

Materials and Methods

- A field trial was carried out simultaneously at 2 sites in Scotland, one on the East (irrigated) and one on the West coast (non-irrigated).
- Five cultivars, representing a range of foliage blight resistance but with as few known R-genes as possible, were planted: Bintje (S), Desiree (I), Teena (I), Pimpernel (R), Stirling (R).
- The trial was designed as a split-plot design with the 8 main plots consisting of 2 fungicide treatments (+/- metalaxyl) replicated 4 times. Sub-plots consisted four-plant plots of each cultivar fully randomised within the plot.
- Plants of cv. King Edward were inoculated with mixed inoculum of 4 isolates of *P.infestans* (C1-C4) that had previously been characterised for relative aggressiveness in glasshouse tests (no significant difference), sensitivity to metalaxyl, virulence and genotype (Table 1). These were then used as infector plants within spreader rows to infect trial plots.
- Lesions were sampled from each plant at 4 sampling dates (2 before and 2 after metalaxyl application) during the epidemic and disease scores made.
- Each isolate sampled was characterised using SSR markers and identified as C1-C4. An analysis of the effect of host on isolate frequency was made.

Table 1: Isolate characterisation

Isolate	Pi02 alleles	Pi33 alleles	Pi26 alleles	Race	Metalaxyl sensitivity
C1	152/162	203/203	177/179/185	1,2,4	I
C2	162/164	203/206	179/181/183/187	1,3,4,7	S
C3	162/162	203/203	179/181/183/187	1,3,4,10,11	R
C4	162/162	203/203	177/181	1,2,3,4,6,7	R

Results

- Application of the fungicide metalaxyl had the expected result, with the largest effect on reducing the frequency of the sensitive isolate C2 at both sites (Fig 1).
- Overall disease rating was consistent with expected host resistance (Fig 2)
- Isolates C1 and C3 are present at lower frequencies across trial sites and cultivars reflecting a reduction in aggressiveness and fitness

Fig 1 Frequency of isolates C1-C4 in the field before and after application of metalaxyl

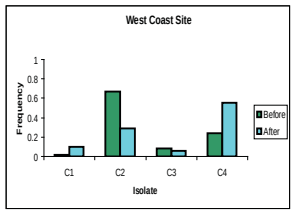


Fig 2.

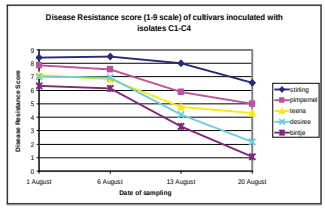
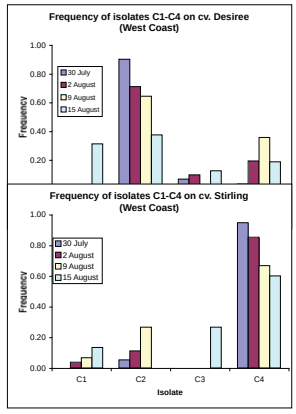


Fig 3.



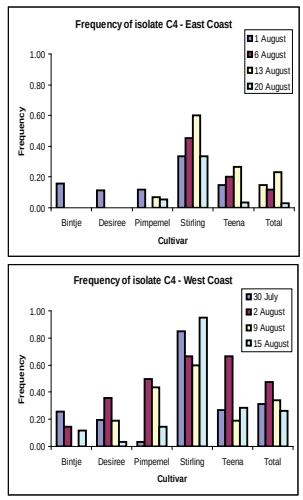
- Isolate C4 outcompetes isolate C2 on the foliage blight resistant cultivar Stirling.

Fig 4 shows that C4 is apparently better adapted to cv. Stirling compared to other cultivars at both sites and at all sampling dates

- C2 was the dominant isolate on all cultivars apart from Stirling at both trial sites over all sampling dates.

An example of this is given in Fig 3: a comparison between cultivars Desiree and Stirling shows that isolate C2 is much less frequent on cv. Stirling compared to cv. Desiree throughout the epidemic.

Fig 4.



Conclusions

SSR markers are a useful tool for 'tracking' distinct isolates of *P.infestans* to investigate the effect of management practices on adaptation of the pathogen population under field conditions.

In these trials it was demonstrated that fitness and aggressiveness of the 4 isolates differed markedly, even in the in the absence of any effect of known host R-genes. For example, there was a clear selection for isolate C4 on the resistant cultivar Stirling.

Strong pathogen competition and host selection can drive population change under agricultural conditions.