

Competition between genotypes of *Phytophthora infestans*

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SUMMARY

Dramatic changes to the GB population of *Phytophthora infestans*, the cause of potato late blight, have resulted in a new set of highly aggressive genotypes dominating the population in Great Britain. One genotype in particular, genotype 13_A2, is an aggressive genotype that can overcome the resistance of some previously resistant potato cultivars and since 2005 has become dominant in the population. The field study reported here investigates the competitive ability of 13_A2 compared with three other genotypes (6_A1, 7_A1 and 8_A1) on the potato cultivars Cara (moderately resistant) and Maris Piper (susceptible). Genotype 13_A2 was found to be the dominant genotype in most plots within the trial. Cara was more resistant to all genotypes compared with Maris Piper.

KEYWORDS

Phytophthora infestans, genotype 13_A2, genotype 6_A1, aggressiveness, competition

INTRODUCTION

For the fifteen years up to 2005, the A2 mating type of *Phytophthora infestans* comprised a low proportion of the population with around 90% of the UK population being the A1 mating type. Since then, there has been a dramatic increase in the A2 mating type with a large proportion being of the genotype 13_A2, sometimes also referred to as 'Blue 13'. Genotype 13_A2 was first identified in 2005 and has dominated the population since 2007 (Cooke *et al.*, 2010). Within genotype 13_A2 there are variants: between 2003 and 2009 13_A2_1 was the dominant variant but it has declined in frequency and now 13_A2_2 dominates in Scottish *P. infestans* populations. 13_A2 is a highly aggressive genotype and can overcome the resistance of some previously resistant potato cultivars. Competition between genotypes may be a factor that has contributed to the dominance of genotype 13_A2 as this cannot be explained by aggressiveness alone. In 2007 a field study showed that 13_A2 dominated when co-inoculated with other genotypes in field plots (Cooke *et al.*, 2010), but in a 2010 aggressiveness study 13_A2 was not always the most aggressive genotype on detached leaflets (Chapman, A., unpublished data). A direct competitive interaction may be occurring if aggressiveness alone does not account for dominance (Young, 2007). There could be inhibitory effects that would give one genotype a competitive advantage over other genotypes (Young, 2007).

METHODS

The field trial was planted on the 4th May 2011 at the Agri-Food and Biosciences Institute, Belfast, Northern Ireland. The two potato cultivars used were Cara and Maris Piper with foliar late blight resistance ratings of 5 and 4 (on a 1-9 scale of increasing resistance) respectively. Each plot was surrounded by a guard row of the potato cultivar Sárpó Mira. Three inoculation treatments were used in the trial: the top left corner plant (Plant 1) of each plot was inoculated with genotype 13_A2 and the bottom right corner plant (Plant 16) was inoculated with genotype 6_A1, 7_A1 or 8_A1. Inoculation took place on the 29th June 2011. A fully randomised block design was used with four replicate blocks each containing six plots of 16 plants. A unit plot consisted of four rows of four plants. Plots were monitored daily until the first signs of infection were found on the inoculated plants and then disease assessments for every plant took place every 3 to 5 days using the ADAS blight assessment key (Anonymous, 1976). Up to four leaflets with single lesions were collected from each plant depending on the number of lesions present and the lesions were sampled onto a Whatman FTA card (Whatman FTATM Classic Card, Cat No. WB120205, GE Healthcare UK Limited) for storage according to the manufacturer's instructions until they were genotyped using SSR analysis (Lees *et al.* 2006).

RESULTS

Cultivar

On a whole plot basis there was a highly significant difference in percentage foliar blight between cultivars from 27 days post inoculation onwards (27 days: $P=0.006$, 32 days: $P<0.001$, 36 days: $P<0.001$). After 27 days, disease was clearly progressing rapidly in Maris Piper, increasing from 17.7% foliar blight (after 27 days) to 35% (after 36 days), whereas on Cara disease increased only slightly from 10.3% (after 27 days) to 12.3% (after 36 days) (Figure 1). Thirty-six days into the epidemic Maris Piper (35%) had nearly three times more foliar blight than Cara (12%).

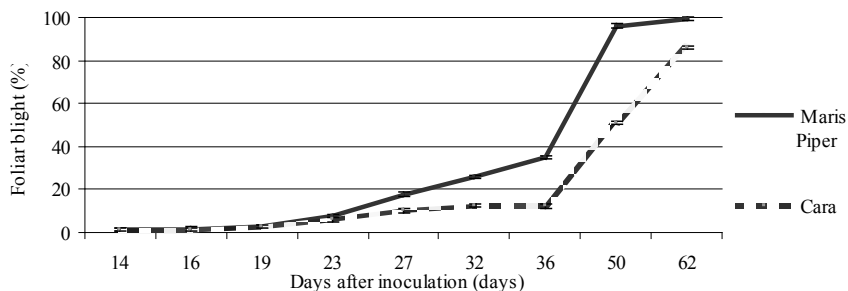


Figure 1: Average disease severity for all plots. Values for both cultivars

Inoculation treatments

No significant effect of treatment was observed on Cara, with percentage foliar blight scores of 12.3% for all treatments. Conversely, Maris Piper showed percentage foliar blight scores of 44%, 31% and 30% for the treatments 13_A2+6_A1, 13_A2+7_A1 and 13_A2+8_A1, respectively with treatment 13_A2+6_A1 having a significantly larger percentage foliar blight score ($P<0.001$).

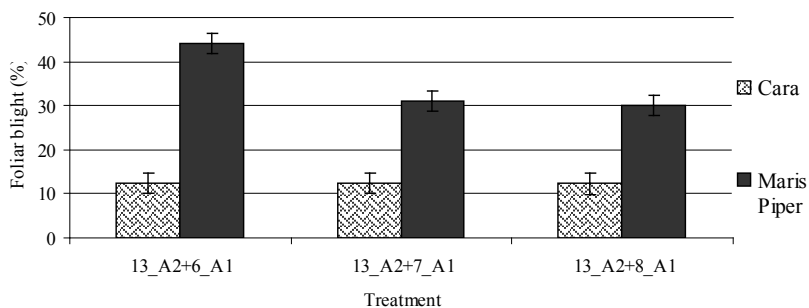


Figure 2: Average disease severity for each treatment on potato cultivars Cara and Maris Piper

Genotyping

In total, 994 samples from individual blight lesions were collected and genotyped. Across all the plots genotype 13_A2 was predominant but only by 3.4%. 13_A2 contributed 49.7% of the samples (this percentage has been weighted to account for the fact that there was three times more 13_A2 inoculum initially introduced into the field). Genotype 6_A1 had the second largest disease incidence at 46.3% with genotypes 7_A1 and 8_A1 at 2.1% and 1.9%, respectively. 13_A2 completely dominated the plots when it was paired with 7_A1 and 8_A1. 13_A2 also caused the largest percentage of lesions when comparing treatments. In the treatment 13_A2+6_A1, 60.9% of the lesions sampled were caused by 13_A2 and 39.1% by 6_A1 (Figure 3).

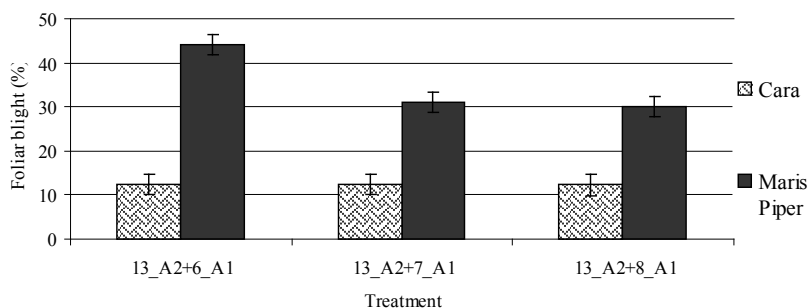


Figure 2: Average disease severity for each treatment on potato cultivars Cara and Maris Piper

CONCLUSIONS

The focus of this study was to investigate the competitive ability of *P. infestans* genotypes based on their spread through plots from inoculated plants in a field trial. The study showed a significant difference in foliar blight susceptibility between Cara and Maris Piper with Cara being more resistant to all of the genotypes tested compared with Maris Piper. Genotype 13_A2 was the most prevalent genotype: it was found in each plot hence its dominance could be due to the rate at which genotype 13_A2 spreads from plant to plant.

ACKNOWLEDGEMENTS

The authors would like to thank the Potato Council for funding the project.

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