Overview of the Teagasc late blight trials conducted at Oak Park Carlow on an annual basis. Photo courtesy of Colum Kennedy, CELUP.

INTERNATIONAL YEAR OF PLANT HEALTH 2020

Keeping a weather eye for blight

TEAGASC researchers are collaborating on the evaluation and improvement of late blight forecasting models.

The phrase "blighty weather" is often used during the summer months to describe mild damp weather conditions. In the broadest sense the phrase is correct as these are the weather conditions that favour the spread and development of potato late blight. It was this apparent association between weather conditions and subsequent outbreaks of late blight that led researchers in the earlier part of the 20th century to devise late blight forecasting models to aid farmers in making decisions on whether to apply fungicides for its control. One such model was devised by Austin Bourke of Met Éireann in the mid 1950s and, later referred to as 'the Irish Rules', was fundamental to the control of late blight in Ireland in the following decades. Since the inception of these models, potato production systems have dramatically changed, with production more centralised and on a much larger scale. Associated with these changes has been a continual change of *Phythophthora infestans* populations, the pathogen causing the late blight disease, with more aggressive and/or fungicide-resistant strains regularly emerging and dominating local populations. As the original model devised by Bourke was reflective of both the production system and *P. infestans* population present in Ireland over 50 years ago, an evaluation of whether improvements in the predictive power of the Irish Rules model to reflect current production and *P. infestans* populations could be made was long overdue. As part of a collaborative effort between Teagasc, Maynooth University and Met Éireann as part of the Department of Agriculture, Food and the Marine- (DAFM) funded EPIC project (2015-2020), a critical evaluation of the current model was undertaken. Utilising late blight outbreak data from the Teagasc potato breeding trials conducted annually at the Teagasc Crops Research Centre at Oak Park Carlow and the detailed weather data collected by Met Éireann's automated synoptic weather station located on site, the relationships between weather conditions during the summer months and the first occurrences of late blight in the trials was analysed. Initially, the current model was used as a baseline and its ability to accurately predict outbreaks was determined. As anticipated the model was overly conservative, completely missing the onset of outbreaks on numerous occasions and only reaching the threshold to trigger a warning in four of the ten years. Model parameters were evaluated and recalibrated to better reflect the current pathosystem, with thresholds for pathogen activity being reduced mainly with regard to relative humidity requirements. Based on these revisions alone the conditions favouring disease development were identified in all ten seasons, with a high level of sensitivity identified in eight of these seasons.

Implications for fungicide application

The implications of these changes on the frequency of fungicide applications was also evaluated. The typical prophylactic seven-day fungicide programmes currently utilised by growers were compared to a control programme with targeted fungicide applications with regard to the timing of application and dosage applied based on the current model (Default IR), the most efficient based on the above (Optimised IR) and a slightly modified version reducing risk of early

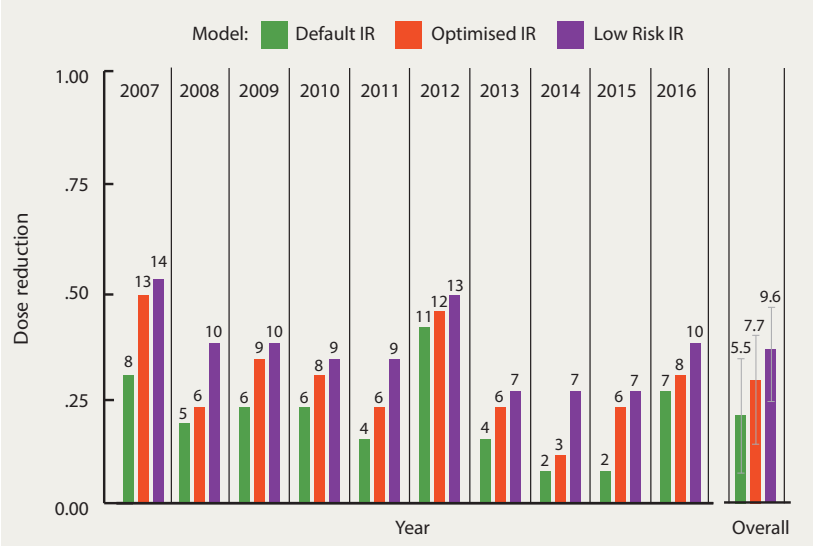

FIGURE 1: Theoretical reductions in fungicide usage based on the use of forecasting models. While the current model (IR) provides significant reductions in fungicide use, it fails to adequately provide protection from the development of late blight. Both the Optimised and Low Risk models provide significant reductions in fungicide use but are also able to accurately predict the onset of the disease.

outbreaks of blight (Low Risk IR). In theory, both the Optimised and Low Risk models could reduce the number of applications on average across the season and total quantities of fungicides applied by more than 50 % (**Figure 1**).

The next step of the validation was undertaken under field conditions. Field trials were conducted during 2016-2019 at Oak Park (main image). To facilitate the research a software application was devised whereby the observed and 10-day forecasted weather provided by Met Éireann were used to calculate risk according to several models. Risk outputs were converted into spray recommendations, whether to apply fungicide or not and at which dose, and provided to the field trials team. In the trials these were compared to an untreated control, a typical seven-day full-dose programme routinely utilised by Irish growers, a half-dose fungicide programme, a programme based on the current model and, finally, a comparison to a Danish late blight prediction system. To further advance the principles of integrated pest management, the trials included a range of potato cultivars varying in their susceptibility to late blight, including the market standards such as Rooster and British Queens. Comparable to the theoretical exercise, the currently used version of the Irish Rules, while significantly reducing fungicide usage, was unable to prevent the development of late blight. In contrast, the control programme based on the Low Risk IR model provided comparable control of late blight to the full fungicide programme, but significantly reduced both the number of applications and total dose of fungicides applied by >50 %. In the context of the EU's Farm to Fork strategy, which is focused on reducing chemical inputs by 50 % by 2030, this is a highly significant result and underlines the importance of accurate forecasting as a disease control measure. The value of cultivar resistance was also apparent in these trials, with minimal late blight detected on either of the resistant control cultivars included in the trials.

Implications

As the availability of pesticides continues to decrease across Europe due to the development of resistance and increased regulation of the sector, it will become increasingly important to devise control programmes that reduce the need for chemical inputs. Through this research, significant reductions in fungicide usage on Irish potatoes can be achieved with minimal impacts to production. However, as production systems continue to change and the pathogen adapts as highlighted, continual evaluations and revisions to disease forecasting systems will be required.

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For further information relating to this project, including the details relating to the data analysis used for the model evaluation and field trials, please see https://mladencucak.github.io/AnalysisPLBIreland/ and https://mladencucak.github.io/PLBFieldTrial/index.html.

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