Strategies to Control Late Blight in Potatoes in Europe

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Abstract

In Europe an aggressive genetically diverse population of potato late blight is present which regularly causes problems in all potato growing regions. It is therefore of the utmost importance that blight is managed in an integrated way by combining a range of measures. Hygiene measures can keep the number of primary sources of inoculum low. In a number of European countries campaigns are ongoing to increase the awareness of growers to reduce the risk of early inoculum sources such as dumps, volunteers and infected seed. The use of varieties with stable resistance for foliar and tuber blight is also a part of an integrated control strategy. In intermediate resistant varieties possibilities are investigated to reduce the input of fungicides. Fungicides still have a key role to play in the integrated control of late blight. In order to optimize the use of fungicides it is important to know the effectiveness and type of activity of the active ingredients to control blight. The use of fungicides should be targeted by using information on infection conditions based on weather data, disease pressure and fungicide characteristics. Decision Support Systems (DSS) can be used to integrate and organize all the available information required for decisions to control late blight.

INTRODUCTION

Late blight was first introduced into Europe in the 1840s and is now the most serious potato disease. Nowadays an aggressive genetically diverse population with both the A1 and A2 mating type is present which regularly causes problems in all potato growing regions in Europe. In this situation the first outbreaks of late blight are detected earlier in the season and the development of the epidemic during blight conducive weather can be faster compared to the pre-1980s situation in which Europe had an asexual genetically similar population. It is therefore of the utmost importance that potato late blight is managed stringently by combining a range of control measures. In this paper some examples are presented of elements that can be part of an integrated control strategy of potato late blight. Measures are described related to the management of primary infection sources as well as the integration of resistant cultivars in the control strategy. Also the optimal use of a wide range of fungicides is presented and some examples of Decision Support Systems used in Europe are presented.

PRIMARY SOURCES OF INOCULUM

An important element of integrated control is reducing the primary sources of inoculum. Dumps, volunteer potatoes, latently infected seed tubers and oospores are well known to be responsible for early outbreaks. Surveys of early outbreaks carried out in The Netherlands from 1999-2005 showed that 37% of the early outbreaks originated from latently infected seed (Evenhuis et al., 2007). Other primary sources identified were oospores (17%) and nearby infections including dumps (15%). In The Netherlands, farmers are intensively informed about the necessity to cover dumps before 15 April. This campaign resulted in a significant reduction in the number of uncovered dumps (Schepers et al., 2000). In the United Kingdom, dump hygiene is also an important part of the ‘Fight

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against Blight' campaign launched by the British Potato Council (Bradshaw et al., 2004). More and more circumstantial evidence becomes available that also oospores can act as a primary source of infection (Evenhuis et al., 2006; Widmark et al., 2007). Preventing the formation of oospores by a stringent control strategy up to desiccation of the crop and a rigorous control of volunteer potato plants, on which oospores can also be formed abundantly, are important elements in reducing the role of oospores as a primary inoculum source. Bødker et al. (2006) showed that crop history of potato and rotation length influenced the time of the first outbreak. The first outbreaks were detected earlier in the season when rotation length was shorter and it was speculated that the soil borne oospores could be (partially) responsible for this development.

Control of volunteers is often very labor-intensive since every plant has to be individually treated with glyphosate. An automated detection and spraying equipment is being developed to create a system that is effective, quick and less labor-intensive (Nieuwenhuizen et al., 2008).

Scouting for early outbreaks and publishing this information on the internet is a tool that can support growers and advisors to adequately adapt the control strategy when early sources are observed in the region. Especially proper timing of the first spray is essential to prevent late blight outbreaks. Maps with (early) outbreaks are published on the internet in almost all important potato growing regions in Europe. For example information on early outbreaks in the Nordic (DK, FIN, N, S) and Baltic (EE, LT, LV) countries is presented on www.web-blight.net.

CULTIVAR RESISTANCE

When there is a strong demand by buyers, super markets or governments for less fungicide input, the late blight resistance of a cultivar provides an important tool to achieve this. Both partial resistance and fungicides can slow down the development of the late blight epidemic. In a number of European countries, trials have been carried out in which the possibilities of reducing the fungicide input in resistant cultivars have been investigated (Nærstad et al., 2007; Spits et al., 2007). In Western Europe, resistant cultivars are not grown on a large scale because commercially important characteristics such as quality, yield and earliness are usually not combined in the same cultivar with late blight resistance. In the grower's perspective, the savings in fungicide input that can be achieved with resistant cultivars are not compensated for by the higher (perceived) risk for blight. In countries where fungicides are not available or very expensive, the use of resistant cultivars is the most important way to reduce damage from blight.

Another barrier for use of resistant cultivars is the risk that the resistance proves not to be durable. Especially with the sexually reproducing population of *P. infestans* the risk for breaking the resistance could be increased. Breeders are constantly trying to produce cultivars that combine commercially important characteristics with late blight resistance: either by conventional breeding by crossing and selection or by GM-techniques. In the EUCABLIGHT project the available European data on host resistance is collated and the available data are presented into a harmonized and readily accessible database so as to allow breeders and geneticists to compare or exploit sources of resistance in their breeding programmes and the information can be used in integrated control strategies (www.eucablight.org).

The stability of resistance is very important. In many European countries the cultivars are tested for resistance to late blight. With a dynamic *P. infestans* population it is important to know how frequently these tests are updated. It is recommended that the harmonized protocols developed in EUCABLIGHT are used to test the resistance and stability of resistance. Resistance genes used in cultivars are not known. It is also difficult to find information on the use and distribution of resistant cultivars.

FUNGICIDES

Fungicides still play a key role in the integrated control of late blight. The threshold for late blight is zero; growers do not tolerate late blight. The efficacy and sideeffects (environment, toxicity) but also economic, social factors and legislation will influence the strategy to control late blight.

The control strategy is primarily preventive but when blight enters the crop, the strategy will have to focus on trying to stop/suppress the epidemic. It is important that growers and advisors have all the information/tools necessary to control late blight efficiently. A control strategy can be based on a schedule with more or less fixed intervals or can be based on the recommendations derived from a Decision Support System. In a strategy the timing of the first spray, the product choice, the dose rates, the timing and the last sprays are important elements. These elements can differ from country to country depending on growing conditions, varieties, registered fungicides and weather conditions (Anonymous, 2001). In order to optimize the use of fungicides it is important to know the effectiveness and type of activity of the active ingredients to control blight. During yearly EuroBlight Workshops on integrated control of potato late blight, the fungicide characteristics of the most important fungicides are discussed (www.euroblight.net). The ratings are based on the consensus of experience of scientists and agrochemical companies (Fig. 1).

DECISION SUPPORT SYSTEM

These systems integrate all relevant information to generate spray recommendations. All potato growing regions in Europe have one or more regional Decision Support Systems (DSS) available (www.euroblight.net). By timing the sprays in an optimal way, on average a reduction in 1-2 sprays per season can be obtained (Hansen et al., 2002). By applying an effective preventive strategy dramatic disease outbreaks that have to be stopped by intensive spraying schemes are prevented. It is important to realize that growers/advisors will only use these DSSs when they help them to increase the efficacy of their control strategy and save their time and money (Magarey et al., 2002). Therefore it is important to convince farmers/advisors that information from DSSs will increase the efficacy of their control strategy without increasing the risk.

DSS can deliver general or very site-specific information to the users by extension officers, telephone, fax, e-mail, SMS, PC and websites on the internet. Recent developments regarding DSS in Estonia (Koppel and Runno-Paurson, 2007) and France (Chatot et al., 2007) were presented during the last EuroBlight Workshop in Bologna.

Literature Cited

Anonymous. 2001. Guidelines on good plant protection practice: potato. Bulletin OEPP/EPPO Bulletin 31:183-199.

Bødker, L., Pedersen, H., Kristensen, K., Møller, L., Lethinen, A. and Hannukkala, A. 2006. PPO-Special Report no. 11:53-56.

Bradshaw, N.J., Bain, R.A., Prentice, M. and Clayton, R.C. 2004. The ‘Fight against Blight’ campaign 2003. PPO-Special Report no. 10:237-246.

Chatot, C., Roudaut, R. and Loret, S. 2007. Steady progression in using potato late blight DSS-MilPV in Brittany (France): a safe tool for farmers to comply with EU agroecological regulations. PPO-Special Report no. 12:297-301.

Evenhuis, A., Spits, H.G. and Schepers, H.T.A.M. 2006. Efficacy of fungicial protection of newly developing potato leaves against *Phytophthora infestans*. Crop Protection 25:562-568.

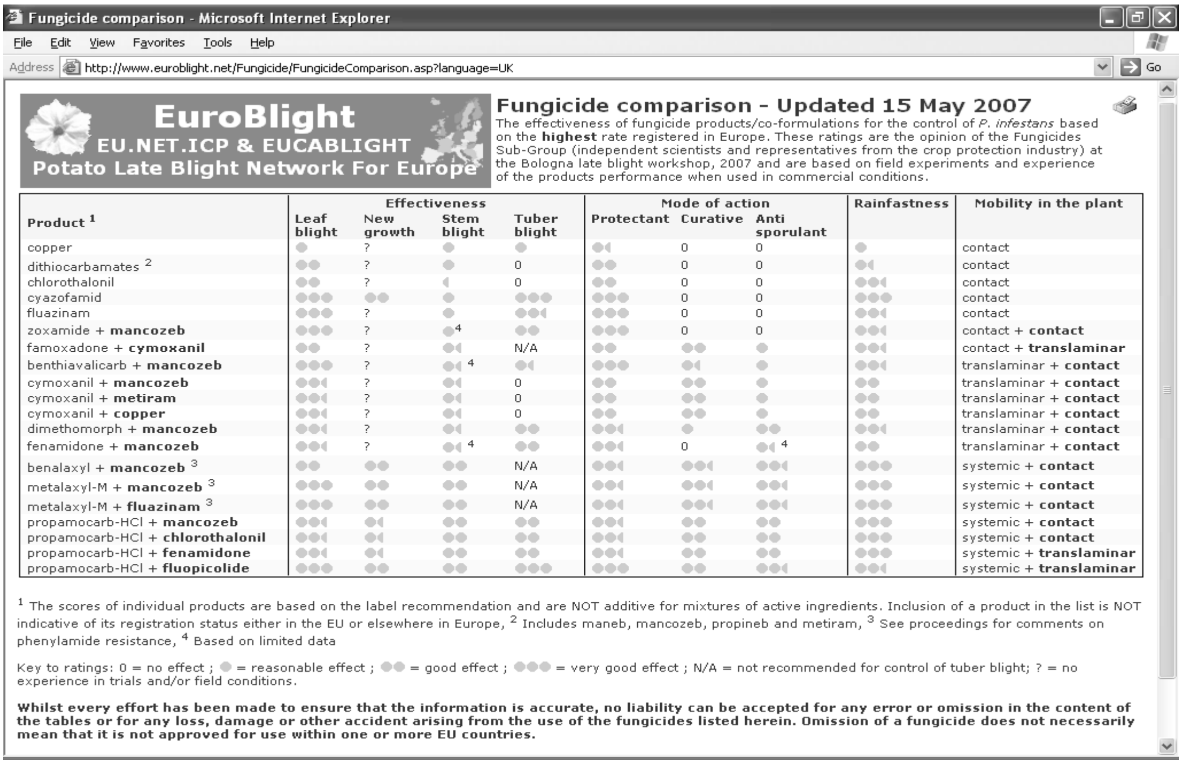
Evenhuis, A., Turkensteen, L.J., Raatjes, P. and Flier, W.G. 2007. Monitoring primary sources of inoculum of *Phytophthora infestans* in The Netherlands. PPO-Special Report no. 12:357-363.

Hansen, J.G., Kleinhenz, B., Jörg, E., Wander, J.G.N., Spits, H.G., Dowley, L.J., Rauscher, E., Michelante, D., Dubois, L. and Steenblock, T. 2002. Results of validation trials of Phytophthora DSSs in Europe, 2001. PPO-Special Report no. 8:231-242.

Koppel, M. and Runno-Paurson, E. 2007. A simple DSS for control of potato late blight. PPO-Special Report no. 12:251-254.

Magarey, R.D., Travis, J.W., Russo, J.M., Seem, R.C. and Magarey, P.A. 2002. Decision Support Systems: quenching the thirst. Plant Disease 86:4-14
Nærstad, R., Hermansen, A. and Bjor, T. 2007. Exploiting host resistance to reduce the use of fungicides to control potato late blight. Plant Pathology 56:156-166.
Nieuwenhuizen, A.T., Hofstee, J.W., Henten, E., van der Steen, S. and van de Zande, J.C. 2008. Automated detection and spraying of volunteer potato plants in sugar beet fields. 5th International Weed Science Congress, Vancouver, British Columbia, Canada, 23-27 June 2008, Abstract no. 607:252-253.
Schepers, H.T.A.M., Dogterom, J. and Kloos, J.P. 2000. The Masterplan Phytophthora: a nationwide approach to late blight. PAV-Special Report no. 6:131-136.
Spits, H.H., Evenhuis, A. and Schepers, H.T.A.M. 2007. Fungicide dose rates & cultivar resistance: results of five years of field experiments in The Netherlands. PPO-Special report no. 12:165-170.
Widmark, A.-K., Andersson, B., Cassel-Lundhagen, A., Sandström, M. and Yuen, J.E. 2007. *Phytophthora infestans* in a single field in southwest Sweden early in spring: symptoms, spatial distribution and genotypic variation. Plant Pathology 56:573-579.

Figures



Fungicide comparison - Updated 15 May 2007

The effectiveness of fungicide products/co-formulations for the control of *P. infestans* based on the **highest** rate registered in Europe. These ratings are the opinion of the Fungicides Sub-Group (independent scientists and representatives from the crop protection industry) at the Bologna late blight workshop, 2007 and are based on field experiments and experience of the products performance when used in commercial conditions.

Product [1]	Effectiveness				Mode of action			Rainfastness	Mobility in the plant
	Leaf blight	New growth	Stem blight	Tuber blight	Protectant	Curative	Anti sporulant		
copper	●	?	●	●	●◐	0	0	●	contact
dithiocarbamates [2]	●●	?	●	0	●●	0	0	●◐	contact
chlorothalonil	●●	?	◐	0	●●	0	0	●●◐	contact
cyazofamid	●●●	●●	●	●●●	●●●	0	0	●●●	contact
fluazinam	●●●	?	●	●●◐	●●●	0	0	●●◐	contact
zoxamide + **mancozeb**	●●●	?	● [4]	●●	●●●	0	0	●●◐	contact + **contact**
famoxadone + **cymoxanil**	●●	?	●◐	N/A	●●	●●	●	●●◐	contact + **translaminar**
benthiavalicarb + **mancozeb**	●●●	?	●◐ [4]	●◐	●●●	●◐	●	●●◐	translaminar + **contact**
cymoxanil + **mancozeb**	●●◐	?	●◐	0	●●	●●	●	●●	translaminar + **contact**
cymoxanil + **metiram**	●●◐	?	●◐	0	●●	●●	●	●●	translaminar + **contact**
cymoxanil + **copper**	●●◐	?	●◐	0	●●	●●	●	●●	translaminar + **contact**
dimethomorph + **mancozeb**	●●◐	?	●◐	●●	●●◐	●	●●	●●◐	translaminar + **contact**
fenamidone + **mancozeb**	●●◐	?	●◐ [4]	●●	●●◐	0	●◐ [4]	●●	translaminar + **contact**
benalaxyl + **mancozeb** [3]	●●	●●	●●	N/A	●●◐	●●◐	●●◐	●●●	systemic + **contact**
metalaxyl-M + **mancozeb** [3]	●●●	●●	●●	N/A	●●◐	●●◐	●●◐	●●●	systemic + **contact**
metalaxyl-M + **fluazinam** [3]	●●●	●●	●●	N/A	●●◐	●●◐	●●◐	●●●	systemic + **contact**
propamocarb-HCl + **mancozeb**	●●◐	●◐	●●	●●	●●◐	●●	●●	●●●	systemic + **contact**
propamocarb-HCl + **chlorothalonil**	●●◐	●◐	●●	●●	●●◐	●●	●●	●●●	systemic + **contact**
propamocarb-HCl + **fenamidone**	●●◐	●◐	●●	●●	●●◐	●●	●●	●●●	systemic + **translaminar**
propamocarb-HCl + **fluopicolide**	●●●	●●	●●	●●●	●●●	●●	●●◐	●●◐	systemic + **translaminar**

[1] The scores of individual products are based on the label recommendation and are NOT additive for mixtures of active ingredients. Inclusion of a product in the list is NOT indicative of its registration status either in the EU or elsewhere in Europe, [2] Includes maneb, mancozeb, propineb and metiram, [3] See proceedings for comments on phenylamide resistance, [4] Based on limited data

Key to ratings: 0 = no effect ; ● = reasonable effect ; ●● = good effect ; ●●● = very good effect ; N/A = not recommended for control of tuber blight; ? = no experience in trials and/or field conditions.

Whilst every effort has been made to ensure that the information is accurate, no liability can be accepted for any error or omission in the content of the tables or for any loss, damage or other accident arising from the use of the fungicides listed herein. Omission of a fungicide does not necessarily mean that it is not approved for use within one or more EU countries.

Fig. 1. The effectiveness of fungicide products/co-formulations for the control of *P. infestans* based on the highest rate registered in Europe. These ratings are the opinion of the Fungicides Sub-Group (independent scientists and representatives from the crop protection industry) at the Bologna late blight workshop, 2007 and are based on field experiments and experience of the products' performance when used in commercial conditions.