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The development and control of Late Blight (*Phytophthora infestans)* in Europe in 2012

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INTRODUCTION

The EuroBlight late blight country profile was launched in 2007 to keep track of the development of late blight and its control in Europe in individual countries and over years. This paper reports the development and control of late blight in Europe, 2012.

One important motivation for sharing data is that the results are analysed in a pan-European context. When data are available over several years it will be possible to analyse the data over years and across countries. This is especially interesting now that all countries in Europe have to adapt to the new EU pesticide package to be implemented by the end of 2013. Using the data we collect before and after 2013 might be used for impact assessment of this EU regulation. We will also use the data to stimulate to collaboration, harmonisation and coordination between institutions and across countries.

At the workshop in Limassol attention was drawn to major issues of relevance to policy making in Europe i.e. the rapid changes in *P. infestans* populations causing late blight in Europe, America and Asia, including the emergence of strains with altered pathogenicity or reduced fungicide sensitivity. Constant monitoring of populations and characterization of invasive genotypes in order to understand and predict changes is a prerequisite for the deployment of IPM strategies, as required by Directive 2009/128/EC on the sustainable use of plant protection products. It directly influences the development and deployment of resistant cultivars, the performance of disease warning systems and the efficacy of plant protection products. A coordinated and continuous monitoring effort was suggested and included in the EuroBlight statement produced after the meeting (see www.euroblight.net). Subsequently, an initiative was launched aiming to collect 1000-1500 late blight samples from the main potato growing regions in Europe. The goal is to capture as much genotypic variation as possible by sampling as many fields as possible. Samples are analysed using standardised 12 multiplex EuroBlight SSR genotyping. The results will provide insight in the international, national and regional structures of the *P. infestans* EU

population through e.g. the proportion (and dynamics) of the different currently known clonal lineages (e.g. Green33, Blue13, Pink6 etc.) and unique genotypes in the population. This paper reports the development and control of late blight in Europe, 2012 and thereby describe the foundation for the further insight in the structure and behaviour of the European *P. infestans* (meta) population.

METHODS

The country profiles have the following structure and content:

Summary

- Write a short summary (max 200 words) about late blight development, fungicide use and control of late blight in the country and year selected. This section will be used to generate a summary report covering all countries. Additionally, this will be the starting point for the summary report about late blight, fungicide use and effectiveness of control measures, published after each EuroBlight workshop.

Early outbreaks of potato late blight

- **Select the date of first observation of late blight in covered or very early planted potatoes**
- **Disease source for these attacks (**options: Seed, Cull pile, Volunteer plants, Covered crop, Waste pile, Oospores, Indications of Oospores, Other, Not known)
- **Select the date when first infections were reported in more than 5 conventional, normally planted potato fields.** This is the date when late blight is recorded in more than a few fields for the first time. After this event – and if the weather is continuously blight favourable - there will be a risk of epidemic developments in non-treated (and especially in susceptible) cultivars.
- **Disease source for these attacks (**options: Seed, Cull pile, Volunteer plants, Covered crop, Waste pile, Oospores, Indications of Oospores, Other, Not known)
- **Write a short text (max 100 words) about early attacks.** The report generator will include dates and disease sources in texts. Enter additional information in the text window.

Weather conditions and late blight development

- **Weather based risk of late blight.** Select whether the weather-based risk for late blight development was low, medium or high for the months May to September. Or, select 'Not known'.
- **Write a short text (max 100 words) about the weather conditions related to late blight development.** Mention if the information about weather conditions is general for the country, related to a specific region and if the risk is qualitative or based on calculations with a model or a DSS.

Use of fungicides and control strategies

- **Enter the number of fungicide applications used in ware potatoes.** What do the majority of conventional farmers do to control late blight in ware potatoes?
- **Enter the number of fungicide applications used in all potatoes.** Sometimes quantitative information is available as a mean of all types of potatoes e.g. in DK as calculated Treatment Frequency Index based on amounts of fungicide sold (normal dosage) and related to the total area of conventional grown potatoes

- Write a short text (max 100 words) about fungicide use and control of late blight.

Organic potatoes

- Select when outbreaks were recorded in fields with organic potatoes (Options: early, medium, late or not known compared to normal)
- **Select the level of attack (**Options: low, medium, high or not known compared to normal**).**
- **Select the mean yield level in organic potato fields (**Options: <20 t/ha, 20-30 t/ha, 30-40 t/ha, >40 t/ha or not known).
- Write a short text (max 100 words) about the situation in organic potatoes.

Tuber blight

- **Select the level of tuber blight attacks (**Options: low, medium, high or not known compared to normal**).**
- Write a short text (max 100 words) about tuber blight.

Alternaria spp.

- **Select when outbreaks were recorded (**Options: early, medium, late or not known compared to normal**).**
- **Select the level of attack (**Options: low, medium, high or not known compared to normal**).**
- Write a short text (max 100 words) about *Alternaria.*

Characteristics of Phytophthora infestans

- **Write a short text (max 100 words) about pathogen characteristics.** In the country reports graphs for mating type distribution and virulence pathotypes are automatically included based on available data from the Eucablight database.

Use of cultivars

- Write a short text (max 100 words) about use of cultivars.

Use of DSS

- Write a short text (max 100 words) about use of DSS in the country.

The reports per country published below are the abstracts of the country reports only slightly edited.

THE DEVELOPMENT AND CONTROL OF *PHYTOPHTHORA INFESTANS* IN EUROPE IN 2012

The abstracts of the country reports are provided by country in alphabetic order. General trends and observations on weather conditions, disease development etc. are discussed in the section of summary information. Information regarding "Date of first observation of late blight in covered or very early planted potatoes" and "Date when first infections were reported in more than five conventional, normally planted potato fields" for 2012 is shown for all European countries on maps in Fig. 1-2. The same data are combined into marker plots per year in Fig. 3. The weather based risk at selected stations in Europe is shown in Fig. 4. The level of tuber blight attach is given in Fig. 5 and problems with tuber blight is shown in Fig. 6.

Belgium 2012

About two thirds of the ware crop acreage was planted relatively early, between March 23 and April 8. Due to excessive rains during rest of April, the remaining third of the crop was planted relatively late, in the second half of May and the first week of June. These late planted potatoes were exposed to a high risk on late blight attacks. After all, early attacks were present on dump piles and very early crops fr om the second week of May, threatening the emerging and highly sensitive young plants. Moreover, the continuous changeable weather remained favourable for the disease. This was also the case during the very wet months of June (wettest since 1981) and July. Despite the short average spraying intervals – 6 days in June and only 5 days in July – late blight attacks became widespread in the fields. Dry and sunny weather from the beginning of August led to a considerable drop in disease pressure. Conditions became eventually too dry for harvesting and caused very high dry matter content. When the rain finally came, it brought a record wet month of October and difficult harvesting conditions. Nevertheless, the level of diseased tubers turned out to be very low.

Czech Republic 2012

Potato late blight had a very diverse development in the individual localities of the Czech Republic, based on weather progress and/or precipitation amounts; however, generally the disease occurrence could be considered as a moderate one. The year 2012 was characterized by delayed onset of epidemic disease spreading, moderate infection pressure and low tuber infection. First outbreaks were already found in the second decade of June; however, they were of a local character and late blight only spread in the surroundings of primary sources. Torrential rains with subsequent sunshine and rapid crop drying were not sufficient for intensive disease development and high temperatures in the end of July stopped further development. Precipitation in July, especially in the second half of the month, resulted in surface spreading of late blight and epidemic onset. It also continued in August; however, in the second decade of the month epidemic was broken by short drought and extreme high temperatures. Precipitation and temperature decline toward the end of the month and in September contributed to recovery of further disease spreading. Tuber infection occurred, but mostly only locally and to lower extent. Seed crops due to early vegetation ending were not significantly affected by late blight and tubers were not infected at all, when the infection was not caused through re-growths. In ware potatoes problems only arose, where last treatments were neglected, vegetation was not ended in time or foliage was in touch with active late blight at harvest. Generally, disease management in practice was relatively good. Fungicide control had lower yield effect than usually due to delayed epidemic onset and differences in efficacy of individual fungicides were relatively small.

Cyprus 2012

Potato cultivation in Cyprus is concentrated in two crops. The main one is the spring crop, planted during November/January and harvested during April/May and early June, and the winter crop that is planted in July/August and harvested in November/December. In October, November and partly in December of 2011 short showers made conditions favourable for blight infections of the winter crop that was close to harvest, thus that crop suffered moderately tuber blight. Since the conclusion of the winter crop is overlapping with the initiation of the spring crop, *P. infestans* inoculum has a continuum, mainly in escapes, since the production area is relatively concentrated. In 2012, the majority of the crops at the coastal line of the Kokkinochoria region were set in mid-November and the first blight hits were recorded in mid-February Nevertheless, the disease progression was slow, due to several dry spells the following

months. A short rainy period close to harvest caused some tuber blight problems. No DSS is available in Cyprus and the common practice for potato late blight management is the empirical application of fungicides, which may lead to up to twelve sprayings during the spring crop. Months from May until early October were very dry.

Denmark 2012

The spring 2012 was characterised by high amounts of precipitation, the planting of the potatoes was delayed until end of April and first days of May. The soil temperature remained low for an extended period and the potatoes stayed for a long time in the soil before germination. There were no indication of infection from oospores and the incidence and severity of blight remained low during most of the season due to low temperatures, despite the very humid conditions with relatively high risk indications. In the northern part of Jutland, there were some severely damaged fields in both ware and starch potatoes which were initiated from a potato cull pile and non-protected late, planted fields. The main control strategy was based on mancozeb, mandipropamid, cyazofamid and metalaxyl. Metalaxyl had limited effect in the Northern part of Denmark due to the widespread occurrence of the late blight isolates blue 13.

England & Wales 2012

Planting in 2012 was delayed in many regions due to poor weather. Cooler temperatures in April and May delayed crop emergence. Many regions received 50% more rainfall than the long term average in May, June and July. Waterlogging and flooding were common during the entire season and caused severe crop loss in some cases. Two hundred and fifty-four outbreaks of late blight were reported in 2012 as part of the Potato Council funded outbreak maps, with the earliest reported on 2 May in the South West (Cornwall). Five outbreaks were reported in May, 21 in June, 183 in July, 34 in August, 6 in September and 1 in October. Severe cases of late blight meant some crops were desiccated early. Agronomists were routinely finding lesions in commercial crops. Achieving complete control of late blight was difficult. Late planting and slow emergence meant some crops were infected as they emerged or soon after. According to the UK pesticide usage survey report 235 using 2010 figures, the most frequently applied active ingredients to ware crops were fluazinam, mancozeb/cymoxanil, cyazofamid, mandopropamid and fluopicolide/propamocarb-hydrochloride. For seed crops, the most frequently applied active ingredients were fluazinam, cyazofamid, cymoxanil, mandipropamid and mancozeb/cymoxanil.

Estonia 2012

Due to late spring there was only short time difference between planting, development and late blight infection of early and main-crop potatoes. After the very low incidence of late blight in the previous year, the late blight established very late in 2012. The dry weather in first half of growing season did not favour the development of late blight. The weather conditions were more favourable for development of early blight than for late blight. Also leaf blotch of potato, caused by *Botrytis cinerea* caused essential damages in potato foliage. The weather changed in mid-July, when intensive rains occurred in northern and western parts of Estonia and favoured infection. First late blight attacks were recorded on July 14. The weather in central and southern parts of Estonia remained dry until the end of first decade of August. Rains covering whole Estonia since mid-August created very favourable conditions for late blight. Infected potato foliage was destroyed within a week in these conditions. The new network consisting of 13 iMetos stations was established in collaboration of Jõgeva PBI and farmers' cooperative Talukartul for DSS in late blight control. Use of DSS saved 1-2 fungicide applications in average.

Finland 2012

First late blight observations in conventional crop were reported simultaneously at several sites in the middle of July. This is approximately two weeks later than in average during 2000s in Finland. From the end of July to the harvest there were very heavy rains and severe floods at certain regions. At those regions farmers were not able to spray against late blight and many fields were fully destroyed by blight, flood and bacterial rots. However in regions with more moderate rainfall late blight was in good control and majority of potato crop was not severely attacked. Tuber blight was no specific problem but at very rainy regions pink rot (*Phytophthora erythroseptica*) and bacterial rots caused considerable losses.

Germany 2012

Crops were planted in good conditions. The crop emergence was normal 15 to 25 May. The first outbreak of late blight in potatoes was end of April (very early) in plastic covered fields. Attacks in different regions and ware potatoes were found in June. The weather conditions for the development of late blight was high in the North and moderate in the South. The number of fungicide treatments was normal in 2012. All kind of products were used. Attacks of Alternaria seems to be an increasing problem in the east and southern part of Germany.

Republic of Ireland 2012

Following a warm and dry spring most crops were planted in good conditions. As the summer months were one of the wettest on record those planted later suffered as they were developing in epidemics. The extremely wet conditions led to high disease pressure being experienced throughout the country, with the highest experienced in the south-west where 600 mm of rain fell in between May and August. Under these conditions control was difficult and was reliant on routine fungicide applications, often involving mixtures of fungicides (including actives with good curativity) and with short intervals between applications. Although rainfall was well above average in June, due to the slightly colder weather disease epidemics did not occur until mid-July. Although there was high disease pressure and the presence of disease in crops no major problems with tuber blight were recorded. No information is available as to the genetic structure of the population in 2012.

Lithuania 2012

Overall weather conditions in 2012 were conducive to the spread and development of late blight disease in potato crop. Unusual warm and wet July had significant influence on very high potato crop yield. Most farmers without irrigation managed to obtain about 40.0 t/ha potato yield. By the average 4 - 6 fungicide application was needed for late blight control. Crop rotation and fungicide application are most popular tools for reducing outbreaks of the disease. Alternaria is still a very rare disease in Lithuania. Decision support systems are not used by farmers at all.

The Netherlands 2012

After a dry period in March potato were planted rather early at the end of March until the beginning of April. Crop emergence was not that early (half of May) because of moderate temperatures afterwards. The weather conditions after emergence were not very favourable for late blight. First outbreaks were reported between 20 and 25th of June in the south-east region of the country. The disease pressure during the months July and August was high because of the rainy weather conditions during these summer months. Thanks to a frequent use of fungicides there was hardly any infestation at harvest of the ware potatoes.

Northern Ireland 2012

After a slow start (April was unusually cold and both April and May had below average rainfall), the weather favoured blight from the third week in June and the first outbreak was confirmed on 22 June. Blight was subsequently identified in crops throughout Northern Ireland, but mostly at low levels. Despite conditions apparently very favourable to infection, blight was not as severe as might have been expected, possibly because crop growth was very poor due to the cool weather and lack of sunlight. Growers were mostly very diligent in applying fungicides using a wide range of products and blight was generally well-controlled in both foliage and tubers.

Norway 2012

A dry spring resulted in little late blight in the early potatoes; the first attacks came in the middle of June. The weather was late blight favourable form mid-June and onwards, this resulted in infections 2-3 weeks earlier than normal in the main crop. Infected seed tubers were probably the main cause of primary infections. On average the potato fields received eight fungicide applications. About 50 % of the fields had leaf blight in early August, but at low levels. The precipitation was very high during the whole season. However it was not reported much more tuber blight than normal. Typically one treatment with Ridomil or Tyfon is used early and then Ranman or Revus. 80 % of the treatments were carried out by these two products. In Norway the decision support system for potato late blight is available for free at www.vips-landbruk.no and consists of four parts - A map of the blight attacks found, the Negative prognosis to predict the first fungicide application and Førsund's rules and a new late blight model to predict days with high risk of blight infections. The system is used both by the advisory service and by farmers.

Poland 2012

The date of crop emergence was relatively early, 10-20 May, despite April and May were dry. Indications of oospores were found on a trial site (in the North) and in a few other fields (central Poland). First attacks of late blight were recorded on 10 June in central region. In many regions optimal conditions for the first appearance of *P. infestans* were observed in the first half of June (central and southern part of Poland) and in the second half of June (northern regions). Weather conditions in the next months didn't favour development of the disease and very often the total stopping its development was recorded. The second outbreak of late blight was observed in the second half of July. Weather conditions did not favour infection pressure and rate of the disease development wasn't very high. The active ingredients used on the largest areas were mancozeb, metalaxyl-M+mancozeb, fluopicolide+propamocarb-hydrochloride and fenamidone+propamo-carb-hydrochloride. The farmers applied 1-9 sprays, the most often 1-4. The yield in 2012 was relatively high and the level of tuber blight was very low. Alternaria was observed early in the season on 28th May in west-southern region of the country and caused some problems during all growing season.

Russian Federation 2012

A severe late blight development was observed on potato fields of the Kaliningrad, Pskov, Leningrad, Novgorod, Tver, and Smolensk regions (yield losses exceeded 20%). A moderate disease development was observed in Arkhangelsk, Vologda, Murmansk, Kirov, Moscow, and Bryansk regions. On the other territory of the European part of Russia, the disease development was rather weak. The main source of the primary infection was infected seed tubers. The most popular fungicides were Tanos, Shirlan, Infinito, Ridomil Gold MZ, and Acrobat MZ. The total number of treatments varied from 2 to 10. Owners of allotment gardens did not use any

fungicides. In Russia the DSS VNIIFBlight is available for free at www.kartofel.org. This system is used by some advisory services and the owners of small potato farms.

Scotland 2012

One hundred and twenty-five confirmed outbreaks in Scotland were reported on the Potato Council-funded blight outbreak maps up until the 26th of November. The progression of crop outbreaks (119 in number) was 0% in May, 1.7% in June, 70.6% in July, 26.1% more in August, 0.8% in September, 0% in October and 0.8% in November, up to the 26th. There were five confirmed outbreaks on outgrade piles of potatoes (30 May, 30 June (x 2), 11 and 12 July) and one outbreak on volunteers (23 August). 2012 was an exceptional season. Several factors combined to make blight control particularly difficult. Planting was late, with some growers still planting in July. Prolonged heavy rain in late June into early July made fungicide application difficult for many weeks with late starts to the fungicide programme and extended intervals. For many crops the prolonged wet weather coincided with rapid canopy development. The season was wet with 129, 120, 98, 103 and 135 mm of rain recorded in June, July, August, September and October at Auchincruive. During the growing season conditions were generally overcast and cooler than the average. The cost of the blight fungicide programme was considerably greater than normal. Application was more difficult, e.g. for some crops rows of potatoes were sacrificed to allow tractors/sprayers fitted with wider tyres to apply fungicides. Fungicides with curative activity were particularly effective in the cooler temperatures. Harvest was very difficult and protracted. Some crops were not harvested or parts of fields were left not harvested. A few crops were harvested in the spring of 2013.

Sweden 2012

The spring was warm and dry in most of Sweden 2012 resulting in good conditions for planting. The first blight reports in 2012 came 23rd of May from a covered early potato field on the South west coast. A few reports of attacks on dump piles and in organic potato fields came in late June. In July, attacks of late blight were reported from all over the country, but the situation was in most cases less severe than in 2011. The rainfall during 2012 was very unevenly distributed both geographically and over time. Some areas in the South had good or even dry conditions while other areas further north had difficulties getting out in the fields to spray resulting in difficulties to control late blight. I addition, the harvest conditions was very bad in these areas.

Switzerland 2012

Weather conditions during the potato growing season 2012 were very favourable for late blight. Though the onset of the season was rather dry during March and April, it started to rain at the beginning of May and several MISPs (main infection and sporulation period) were registered in all parts of Switzerland. Two first late blight attacks were observed early on May 9 and 11 in two potato fields covered with fleece in the south-western part of Switzerland. This part is isolated by high mountains and the Lake of Geneva, therefore these attacks were of no significance for all other potato growing regions. On May 18 and May 22 three further late blight attacks were observed. During the first two weeks of June, it was very rainy and our decision support system PhytoPRE registered up to seven consecutive MISPs for almost all MeteoSwiss weather stations. So, weather conditions were very favourable for the development of late blight and the number of observed late blight attacks almost exploded until the end of June. During the first two weeks of July and August, weather conditions were again very favourable for the development of late blight and late blight spread over the potato growing regions. Only the two last weeks of August were very warm and dry. Even though it was difficult to conduct fungicide applications accurately

timed, plant protection officers informed us, that farmers could control late blight well. As 2011, late blight attacks which were registered in our DSS PhytoPRE were mainly from untreated monitoring plots, potatoes planted in gardens or from fields with insufficient fungicide protection. Number of announced attacks was comparable to the year 2009 (2008: 224, 2009: 95, 2012: 102).

EARLY ATTACKS OF LATE BLIGHT

In North-West Europe, early attacks of late blight is often found on dump piles or in potatoes covered with plastic. In 2012 the first outbreak of late blight was recorded on the south of Germany end of April (very early) in plastic covered fields. Widespread attacks in Germany were found Mid-June. This is 1½ month later in the season, indicating that the very early attacks were not initiating widespread attacks in commercial fields. Early attacks in late April or early May was recorded in UK South West (Cornwall), Belgium, France, Germany and Switzerland. In Sweden the first blight reports in 2012 came 23rd of May from a covered early potato field on the South west coast. In most other regions of Europe early attacks were recorded in June (Fig. 1 and Fig 3). Widespread attacks in conventional fields in Europe were found in June in the central part of Europe and in July in the Northern part of Europe (Fig. 2 and Fig. 3). Oospores were mentioned as possible source of inoculums in the reports from Estonia and Poland.

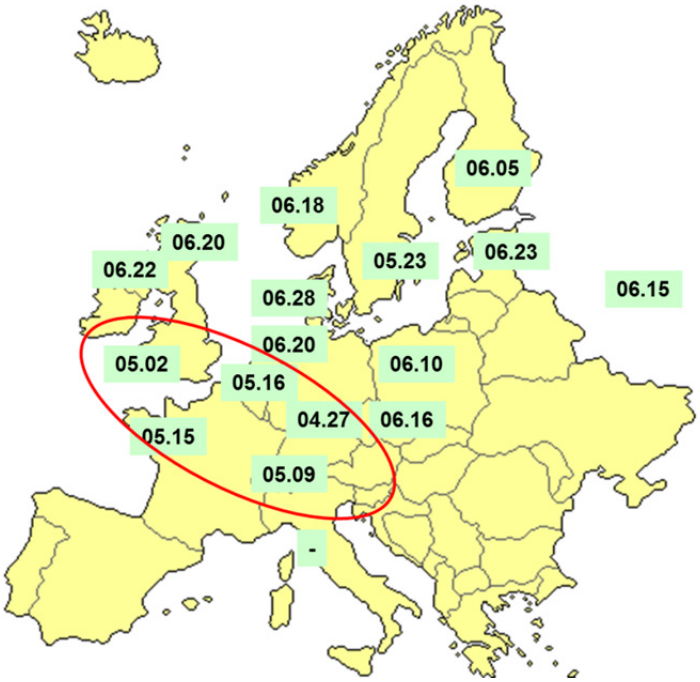

Figure 1. *Date of first observation of late blight in covered or very early planted potatoes, 2012*

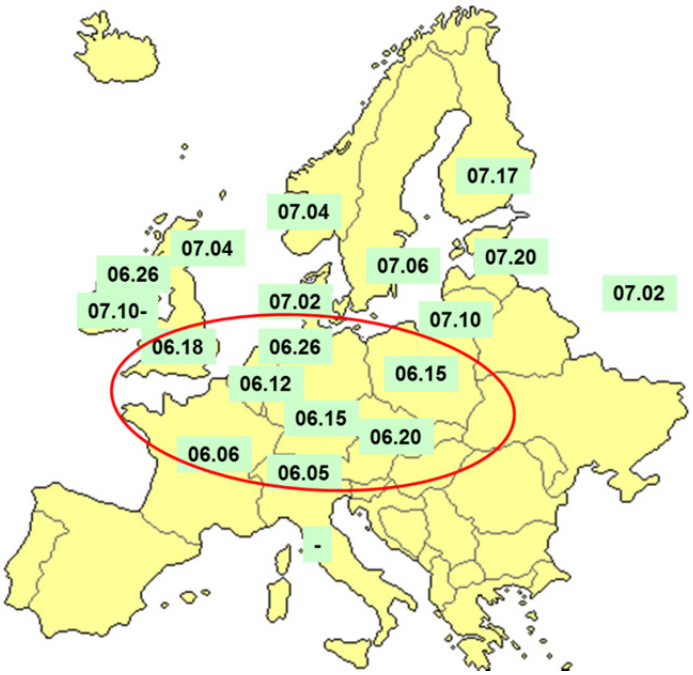

Figure 2. *Date when first infections were reported in more than 5 conventional, normally planted potato fields in 2012*

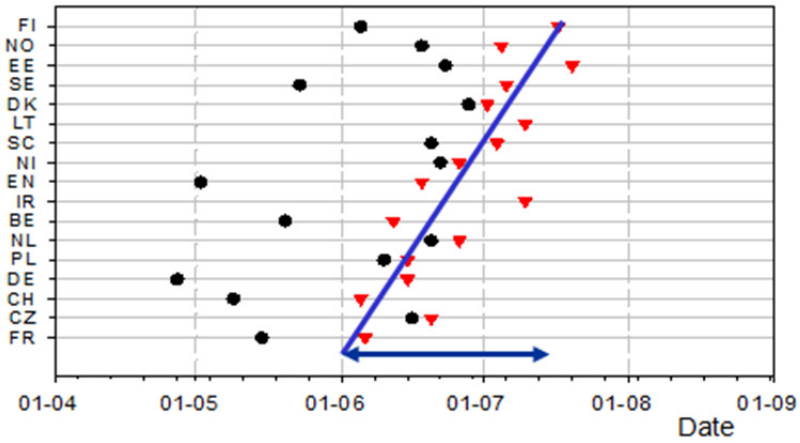

Figure 3. *Date of first observation of late blight in covered or very early planted potatoes (black dots) and Date when first infections were reported in more than five conventional, normally planted potato fields (red triangles), 2012. Distance from early attacks to late attacks in conventional fields is approximately 1½ month (FR & CH compared to Estonia and Finland*

WEATHER BASED RISK OF LATE BLIGHT DEVELOPMENT IN 2012

The weather based risk of late blight is estimated or calculated in Fig. 4. The late blight risk was not calculated by EuroBlight for 2012, as carried out during previous years. Instead the information is based on inputs from each of the country editors. In Ireland extremely wet conditions led to high disease pressure being experienced throughout the country, with the highest experienced in the south-west where 600 mm of rain fell in between May and August. In all other countries in Europe, the risk of late blight was low-medium in May. Unfavourable conditions for blight were also experienced in June in East Europe and in the Nordic / Baltic region (Fig. 4). Blight favourable spells in September in the North-East Europe resulted in medium to high levels of tuber blight as indicated from Finland, Estonia and Sweden. In the remaining Europe the risk of late blight in August and September were mostly medium resulting in low levels of tuber blight (Fig. 5)

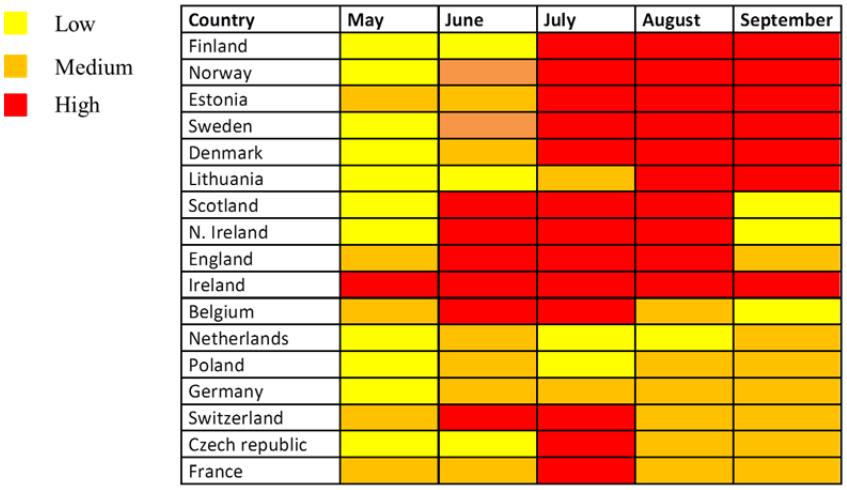

Figure 4. *The weather based risk of late blight in Europe from May-September, 2012*

TUBER BLIGHT IN 2012

The level of tuber blight was reported as low in all countries in Europe, except for Sweden, Finland and Estonia, probably due to a combination of effective leaf blight control and favourable weather conditions during harvest (Fig. 4 & 5).

Figure 5. *The level of tuber blight attacks (low, medium or high) in 2012 compared to normal*

ALTERNARIA 2012

The level of attack of Alternaria is shown for 2012 in Fig 6. Alternaria seems to be a minor problem in North/West Europe. Some countries stress that attacks of Altarnaria is an increasing problem, but severe attacks were only found in countries in Central Europe in 2012.

Figure 6. *Problems with Alternaria, 2012 in three classes compared to normal*

USE OF DSSs

Several decision support systems for late blight forecasting and control are used in Europe (Table 1). In **Germany** there are two decision support systems, PhytophthoraModel Weihenstephan (www.krautfaeule.de) and ISIP (www.isip.de). The majority of the potato growers are directly informed by fax or e-mail. In many regions the state advisory services inform the farmers by telephone or fax. In **Switzerland** Plot specific fungicide recommendations of PhytoPRE are used only by a small number (+/- 100) of farmers. But the PhytoPRE web pages with information on the weather based infection risk and maps with late blight attacks are visited intensively by many growers (approx. 200'000 clicks/growing season). In addition the PhytoPRE data sheet with LB-attacks is weekly published in farmer's newspapers. A lot of farmers have learned due to PhytoPRE to consider the critical facts/periods of late blight. For the coming season, a PhytoPRE Web App Service for mobile phones will be available. In **Estonia**, Jõgeva Plant Breeding Institute provided information on first outbreaks of late blight and recommendations for timing of fungicide applications on a web-platform. The network consisting of 13 iMetos stations was used in collaboration of Jõgeva PBI and farmers' cooperative Talukartul for DSS in late blight control. The advice of fungicide timing is based on negative prognosis and Fry model. The DSS recommended proper start of fungicide applications. Following applications were recommended on label intervals or for 1-2 days shorter interval than label intervals. In

Norway the decision support system for potato late blight is available for free at www.vips-landbruk.no and consists of four parts - A map of the blight attacks found, the Negative prognosis to predict the first fungicide application and Førsund's rules and a new late blight model to predict days with high risk of blight infections. The system is used both by the advisory service and by farmers. In **England** and **Wales**, Blightwatch, supported by Potato Council and industry sponsors, was available free to registered users in 2012 to give e-mail/SMS alerts to inform users of high-risk weather conditions and also provide information on late blight outbreaks in their selected postcode areas. Other decision support systems are available but less widely used, including Plant Plus. Information on weather-related blight risk was also available through BlightCAST and provided free to registered users by Syngenta Crop Protection. In **Belgium** approximately 2000 potato growers receive advice on late blight control from one of the two warning services, depending on the region (Flanders and Walloon Region). A network of more than 80 automatic weather stations in Belgium collects the necessary meteorological data. The disease models in use have their origin in the Guntz-Divoux model, but have been adapted and modified in the course of the past 20 years based on field trials and observations, new pathogen data etc. In the region of Flanders, extensions and sub models (e.g. spore formation, spread and survival, spore germination, infection efficiency and lesion growth) have been added, leading to a much more quantitative disease model. Additionally, the model has been integrated with GIS software and supplemented with a late blight attacks monitoring service. Advices are updated several times per day and communicated via internet, e-mail, fax or post. A separate advice for organic growers is available, pointing out critical days for preventative applications with copper fungicides. A web application is also available for field specific advice, where cultivar and the effect of fungicide sprayings are taken into account. In **the Netherlands** two commercial companies supplying DSS's, Dacom and Agrovision. Many growers get information on late blight by fax, online, telephone or via a PC Program. The use of DDS's hasn't changed a lot during the last years. New is the introduction of a Phytophthora App by Apps for Farming in 2012. The first release made it possible the get an region specific advice. In **Northern Ireland** growers and advisers make use of DARD Blight-Net (http://www.ruralni.gov.uk/index/crops/potatoes/blight_net.htm), which is based on Risk Hours analogous to Smith Periods and can sign up to receive Blight Warnings by SMS text message. Warnings of Infection Periods are also given on local radio and in the local farming press. In addition, growers can access Blightwatch (http://www.blightwatch.co.uk) based on Smith Periods. DSS e.g. Plant-Plus are mainly used by pre-packing suppliers to supermarkets to provide justification for fungicide applications. In **Poland** some farmers cooperate with Research Institutes using NegFry, some cooperate with Bayer Company using proPlant expert.com, a few cooperate with Syngenta using the DACOM system. In **Russia** A small number of Russian farmers used the Plant Plyus (Dacom) and VNIIFBlight DSSs. In the **Czech Republic,** national late blight forecasting is done by the State Phytosanitary Administration; the data are free-accessible on internet. It is based on negative prognosis of late blight. The Potato Research Institute Havlíčkův Brod, Ltd. provides contract-based Negative prognosis, NegFry and NoBlight of late blight and the advisory services do similar services for selected agricultural enterprises. In **Cyprus,** currently no late blight DSS is used by farmers. Several systems are tested by Cyprus University of Technology.

Table 1. *DSSs currently used in European countries in 2012*

Country	DSS in use in 2012
Belgium	Improved Guntz-Divoux, GIS + surveillance
Czech Republic	Negative prognosis, NegFry and NoBlight
Denmark	Blight Management on web + APP
England & Wales	Blight-Watch, Plant Plus and BlightCAST
Estonia	Jögeva PBI web system
France	Mileos (MilPV + MildiLIS)
Germany	PhytophthoraModel Weihenstephan, ISIP
Netherlands	ProPhy, Plant Plus and Phytophthora App
N. Ireland	DARD Blight-Net, and Plant Plus
Norway	VIPS (Försund, negative prognosis, New model)
Poland	Negative Prognosis, NegFry and ProPlant
Russia	Plant Plus, VNIIF-3 and SimCast+VNIIF-3
Sweden	Plant Plus , DK Blight Management and NO VIPS
Switzerland	PhytoPRE+2000, PhytoPRE Web App Service