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Epidemics and control of early & late blight, 2013 & 2014 in Europe

JENS GRØNBECH HANSEN (Denmark)[1], BJÖRN ANDERSSON, LINA SJÖHOLM, ERLING LILJEROTH & EVA EDIN (Sweden), RUAIRIDH BAIN & ALISON LEES (Scotland), FAYE RITCHIE (England & Wales), STEVEN KILDEA (Ireland), LOUISE COOKE & GILLIAN YOUNG (Northern Ireland), ALEXEY FILIPPOV (Russia), ASKO HANNUKKALA (Finland), HANS HAUSLADEN (Germany), ERVIN HAUSVATER (Czech Republic), ARNE HERMANSEN & RAGNHILD NÆRSTAD (Norway), JOZEFA KAPSA (Poland), EVE RUNNO-PAURSON & MATI KOPPEL (Estonia), TOMKE MUSA (Switzerland), GUNTIS GULBIS (Latvia), ANTANAS RONIS (Lithuania), KEES VOGELAAR, JAN SPOELDER & BERT EVENHUIS (The Netherlands), PIETER VANHAVERBEKE (Belgium), CATHERINE CHATOT (France)

[1] Aarhus University, Dept. of Agroecology, Research Centre Foulum, PO- Box 50, 8830 Tjele, DK

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, 2013 and 2014.

One important motivation for sharing data is that the single results in this way can be 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 implemented by 2014. Using the data we collect before and after 2014 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 different stakeholder groups.

At the workshop in Brasov special attention was drawn to the collaboration between global networks, and colleagues from North-America, South-America and Asia were invited to present their results and to participate in discussions how collaboration on a global scale can be strengthened. The parties' ultimate aim is to gain new knowledge about populations of *P. infestans,* how these populations evolve, how local strains are spread from one continent to another and how we most effectively can control *Phytophthora infestans* on the field level. The European monitoring initiative, which has been operating for two years now, has already given the parties a better understanding of the strains of *P. infestans* that are active in Europe. This information enables a more targeted use of crop protectors and helps growers to choose potato species with the right levels of resistance. A second area of concern in the workshop was the increasing problems with fungicide resistance related to the control of late blight and early blight. One answer from the EuroBlight consortium to this question was the recommendation of implementing IPM 2.0 – as expressed in the official statement from the workshop. This paper

reports the development and control of late blight in Europe, 2013 and 2014 and thereby describe the foundation for the further insight in the structure and behaviour of the European *P. infestans* (meta) population.

METHODS

A questionnaire about late blight and early blight development and control was answered by the EuroBlight country editors. The detailed questions can be found in previous proceedings. A new section will deal especially with Alternaria reflecting the initiation of the EuroBlight Alternaria group, headed by Hans Hausladen, TUM, Germany.

The reports per country published below are the abstracts of the country reports only slightly edited. The abstracts of the country reports are sorted according to regions in Europe. General trends and observations on disease development, fungicide use 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 2013 and 2014 is shown for all European countries on maps in Figures 1-2. The same data are combined into marker plots per year in Figure 3.

Estonia

2013: The first late blight outbreaks were recorded during the first days of July in allotment gardens. Dry and hot weather in July kept disease at low levels and major late blight epidemics developed later, in the second half of August. The growers started fungicide applications in late June.

2014: After a cold and rainy June late blight was detected in early July in early and main crop. After a dry July the disease progressed faster in August after heavy rains at the end of July. The growers started fungicide applications in last days of June. Systemic fungicides (Ridomil Gold, Tattoo) were used in first sprays to protect new leaves.

Four to six spays have been used in both years, the most commonly used active ingredients have been mancozeb, fluazinam and mandipropamid. One-two treatments with cyazofamid were used to protect tubers against blight. The potato growers´ cooperative Talukartul - in cooperation with the Estonian Crop Research Institute - used the Negative prognosis and Fry models provided by fieldclimate.com for timing of fungicide application. Together they run a network of 13 automatic weather stations located in major potato growing areas.

Latvia

2013: The crop emerged in the last week of May. June was warm, hot and dry, and the first observations of blight were on the 25th of June. The first protective application of fungicide (systemic or translaminar + contact) was made just before the infection period. After a dry July the epidemic development happened in untreated fields after 9 August. The control of LB was good to moderate in 2013 in Latvia.

2014: Spring of 2014 was early. April was warm and dry. Beginning of May was cold and rainy, but during the second half of May the air temperature reached 29°C. The first warning of *Phytophthora infestans* in 2014 was received earlier than in previous years – 12 June. July was hot and dry and heavy attacks were only found after 11 August. Weather conditions were

favourable for the development of tuber blight. During the last years *Colletotrichum coccodes* has become a major problem for potato growing – more important than late blight.

Lithuania

2013: The potato crop was planted late and the crop emerged in early June. A dry June prevented the establishment of late blight until mid-July in allotment gardens and in commercial fields one week later. Farmers started routine fungicide applications since the beginning to the middle of July. In total, 4 to 6 fungicide applications were enough to avoid late blight in the crop. Also, shorter (6-7 days) intervals between fungicide applications were more favourable for late blight control compared with longer intervals (from 10 to 14 days) in 2014.

2014: The spring of 2014 was dry and warm and crop development was very fast until the middle of June when average air temperature started to decrease. The first late blight symptoms were found late June in small-scale fields, but only later in mid-July in commercial fields. High temperatures in July and in the first part of August prevented disease epidemics but due to very dry and warm conditions the foliage started senescing relatively early. Late blight continued to spread in the potato crop but overall had little influence on final tuber yield. The potato crop was sprayed 4 to 6 times.

Russia

2013: A severe late blight development was observed on potato fields of the Kaliningrad, Leningrad, Vologda, Moscow, Bryansk, Novgorod, and Pskov regions. A moderate disease development was registered in the Orel, Tambov, Voronezh, Nizhni Novgorod, Kirov, and Arkhangelsk regions. The development of the late blight infection on the other territories of the European part of Russia was rather weak. Infected seed tubers represented the main source of the primary infection. The most popular fungicides were Abiga-Pic, Shirlan, Tanos, Acrobat MZ, Infinito, and Ridomil Gold MZ. The total number of treatments varied from 2 to 10. Owners of allotment gardens did not use any fungicides. The use of DSSes (Plant-Plus, VNIIFBlight) was rather rare. The most popular potato cultivars were: Rosara (31.7%), Red Scarlett (18.2%), Nevsky (13.1%), and Udacha. The volume of foreign and domestic cultivars used was 50 and 40%, respectively; the rest of the seed potato is unknown.

2014: A severe late blight development was observed on potato fields of the Republic of Bashkortostan and Kaliningrad, Leningrad, Pskov, and Novgorod regions. A moderate disease development was registered in the Smolensk, Moscow, Kirov, and Arkhangelsk regions. The development of the late blight infection on the other territories of the European part of Russia was rather weak. The main sources of the primary infection were infected seed tubers and, in some cases, allotment gardens with soil contaminated with oospores. The most popular fungicides were Abiga-Pic, Shirlan, Tanos, Acrobat MZ, and Infinito. The total number of treatments varied from 2 to 11. Owners of allotment gardens did not use any fungicides. The use of DSSes (Plant-Plus, VNIIFBlight) was rather rare.

Poland

2013: After a dry and warm spring the first outbreaks were reported on 7 June in the Łódzkie region and on 8 June in the Dolnośląskie region. After a week attacks were found widespread in commercial fields in central and western-south regions. The weather conditions in June- August was unfavourable for late blight. In the northern and eastern regions of the Poland the first outbreaks of blight were noted on 19 June – widespread attacks only after 15 July. Generally, in

the season 2013, weather conditions did not favor the late blight development. The farmers applied 1-6 sprays in 2013, most often 1-2. The active ingredients used on the largest areas were fluopicolide/propamocarb-hydrochloride and fenamidone/propamocarb-hydrochloride, metalaxyl-M+mzb, mandipropamid and cymoxanil +mzb. Level of tuber infection was on average 1,3% for tested fields. The first symptoms of early blight caused by *Alternaria* were observed on 5th June in the central region of Poland (Łódzkie region). During all growing season, up to harvest the disease caused some problems on potato fields, particularly on the cultivar Markies. *Alternaria* spp was recorded in 89,3% of observed crops in Poland.

2014: During a survey on 160 potato farms (131.8 hectares), late blight was observed on 95.6% of fields inspected. Stem blight was noticed only on 34.5 % and early blight on 82.7% of the inspected fields. The date of crop emergence was relatively early, 10-20 May, despite the fact that April and May were dry. Two periods of early outbreaks of late blight were observed during the growing season across the country. The first one occurred unusually early in the Dolnośląskie and Lodzkie regions, on the 19 May. In other provinces first infections emerged in June, mostly between the 11th and 20th June. In general, farmers applied 2-3 sprays on a ware potato due to drought and low infection pressure of the pathogen. The active ingredients used on the largest areas were: propamocarb-HCl and its mixtures, phenylamide (metalaxyl), cymoxanil, and a contact product – chlorothalonil. The first and the only, very early outbreak of the early blight was observed on the 21 May in the western part of Poland, in Podlaskie region. Generally, the disease appeared in the second half of June (late compared to normal) due to long drought and very limited rainfall. EB was recorded in 82,7% of the inspected fields but the infection pressure was very low on the majority of them. The final severity of early blight in unprotected plots reached 15-20%.

Czech Republic

2013: Infection pressure for the whole season is considered as medium compared to normal. LB was found in the crops in the beginning July. After a very dry July the epidemic spread of the disease was recorded in late August and in September. Re-grown parts of plants were particularly susceptible. The late onset of the disease did not cause important yield reduction, but tubers of susceptible varieties were severely infected in fields not desiccated timely. Therefore, problems with tuber blight also arose in the storage.

2014: Late blight was found early and with severe attacks in early potatoes due to widespread and high amount of rain in May. June was dry with unfavourable conditions for late blight development and the first occurrences of late blight in the normal potato production region were only focally found towards the end of June and in highly susceptible varieties in the first decade of July. Favourable conditions for late blight and its epidemic spreading were from the second decade of August and continued during September, when highly above-normal precipitation was recorded. Simultaneously, in the second decade of August extreme and very rapid development of early blight (*Alternaria solani, Alternaria alternata*) was recorded, which has not been previously found to such a great extent. Early blight dominated in the crop and overlapped signs of late blight. In many crops early blight highly limited or completely ended growth, and yields and starch contents were reduced.

Switzerland

2013: Due to rain and low temperatures in April and May many potatoes could only be planted very late, i.e. end of May. First late blight attack was registered on 21 May in South Germany in

1 km distance to the Swiss border. One week later, seven additional late blight attacks were registered in different major potato growing regions. In June, weather conditions were favourable for late blight and the epidemic spread easily. Over the entire season 2013, late blight played a rather secondary role as potatoes suffered more from the wet and cold start of the season, the dry period in July, early blight and aphids. Due to the weather conditions, yields were not according to the expectations.

2014: Most of the potatoes were planted during the first week of April. First late blight attack was observed early, i.e. first part of May in covered potato and gardens. In the central and eastern part of Switzerland, late blight pressure was higher than in the other regions. From July until mid of August, weather conditions were very favourable for late blight and several periods with up to 6 continuous days with MISPs were registered for all weather stations. Hence, late blight could spread very fast in all potato growing regions and the epidemic pressure was high. Due to wet soil conditions, it was very difficult to apply fungicide treatments in time. Harvest conditions were also difficult, as weather conditions stayed unstable.

Finland

2013: First blight attacks were recorded during the first week of July in unprotected potatoes. These outbreaks were probably launched by heavy rain showers at the end of June. The weather during July was mostly very dry and warm and the few blight outbreaks did not develop into epidemics. In unprotected potatoes blight progress was very rapid during the first weeks of August. In protected crops very little blight was present in the season 2013 and no tuber blight problems were reported. Typically four to six fungicide applications were done for blight control.

2014: The season 2014 was mostly very unfavourable for late blight development due to dry and relatively cool weather type. First late blight symptoms were detected during the latter half of July, which is exceptionally late compared to years during the past two decades. No severe blight outbreaks were reported in protected crops in 2014 and tuber blight was not a problem. Typically four to six fungicide applications were done for blight control. An increasing number of farmers started to add azoxystrobin in tank mixture with late blight fungicides to improve early blight control.

Norway

2013: There were a few days with high blight risk according to the Nærstad model on VIPS in the end of May and some in June in the south east part of Norway, which is the region with most potatoes. Late blight was wide-spread by the beginning of July. A dry period in July reduced the disease development, and the disease was kept under control in sprayed fields. In average the potato area was treated 7.8 times with late blight fungicides.

2014: In 2014 the blight risk was low during the whole season. According to the Nærstad model on VIPS there were only one day with moderate risk in May, two days in June, one day in July, five in August and four in September. Blight was not wide spread before August, and most potato lots had less tuber blight than normal.

Sweden

2013: The spring was cold and dry, but planting was done at normal time. In south Sweden, early attacks of late blight was observed in some places. Hot and dry weather during the summer gave a low risk of late blight outbreaks and many farmers prolonged their spraying

intervals. However, blight was found in some fields in August, and locally there were problems with tuber blight. Most organic potato crops could grow to full maturity with very little blight.

2014: A warm and dry spring resulted in early planting in South and Mid Sweden. In the South, the combination of the early planting and very blight conducive weather gave problems with early and heavy attacks of blight – often with stem lesions low in the crop. Some fields in the Southeast were desiccated in mid-June because it was impossible to control the blight despite very heavy use of fungicides. It was suspected that oospores could be the origin of the attacks, and analyses of samples taken in one field supports this. Already during June widespread attacks were reported from South Sweden but short spray intervals in combination with a change to hot and dry weather got the situation under control.

Denmark

2013: April was cold but dry and planting was normal, 10-20 April. The crop emerged at normal time for Danish conditions, 15-20 May. Blight was found first time 19 June and after a week in several conventional fields. There were no clear indications of attacks from oospores and all recordings of blight were after BBCH 31. In general, the growing season was medium blight favourable and farmers had no big problems regarding control. No blight in Fungicide and DSS field trials in three regions of the country.

2014: After a mild winter potato plantings started already in late March and most potato fields were planted 2-3 weeks earlier than normal. Crop emergence was relatively early, 5-15 May. During crop emergence a combination of heavy rain and high infection pressure resulted in the highest amount ever recorded of fields with attacks from oospores - for Central-South of Jutland in fields with narrow crop rotation. A week after blight was observed (25 May), several conventional fields were recorded with infections in the same region – at growth stages below BBCH 30. Due to intensive fungicide use and a shift in the weather to more unfavourable blight weather, most attacks were stopped. July turned out to be the second warmest in more than 100 years. The mean temperature was 19,5 °C and this is 3,9 °C above the normal temperature. Late blight was kept under control in August and September and yields were generally at medium level.

France

2013: Potato planting was only possible from the end of April and it lasted until May. A very exceptional cold season followed after planting in May, and crop development was delayed for 2 or 3 weeks. The overall late blight pressure started late in the season and remained average to low in all parts of the country and during the complete growing season. In Brittany, the far western part of the country, late blight pressure was constant for early potato production but manageable; for more continental main crop production, the weather conditions were not conducive to late blight outbreaks.

2014: Planting was possible early April in most Northern areas and weather was conducive for establishing the first infections as early as end of March. For the rest of the season and for all areas located in the North-eastern part of the country, mild temperatures and continuous rain falls was very favourable to high yield but as well very conducive to late blight pressure on all potato crops until harvest. In Brittany, covered crops had severe early late blight outbreaks just as early crops in open fields.

Belgium

2013: After a 'normal' winter with enough frost, and an exceptional cold spring season, disease pressure at the start of the potato season was low. Although prolonged wetness in a cold month of May caused some infection risk, the first sprayings could be carried out in good circumstances. From the beginning of June, and during the summer months July and August - remarkably sunny and with little rainy days - the weather was unfavourable for late blight most of the time. Nonetheless, few days with infection risk in August resulted in disease developments in untreated crops and in fields where the timing of sprayings was poor. An average of 14 applications (interval 8.7 days) were used in a susceptible ware crop variety (Bintje).

2014: The winter had no frost or winter days at all and the following spring season was very sunny, warm and dry, leading to an early planting of the potato crops. At the end of March, late blight was already detected on a dump pile; by the end of April, inoculum sources with diseased plants were widespread. It was only a matter of time - and weather - for an epidemic to start in the susceptible, fast growing young crops. Two infectious periods - 27 & 28 May and 4 & 5 June - did the job, with an explosion of late blight attacks in most fields as a result. The severity ranged from sporadic lesions to half of the crop affected, with a high level of stem blight. Some dry, sunny weeks in June, together with short spraying intervals, stopped further expansion of the disease. Nevertheless, late blight control was a problem during the rest of the season. All in all, 18 sprayings (average interval 6.4 days) were used in a susceptible ware crop variety to control the disease.

The Netherlands

2013: A cold spring resulted in a delayed crop emergence. May and June were cold so potato crops developed slowly. Only a few early outbreaks were reported from the starch potato area (North-east past of the Netherlands). The first late blight infestation in a field was on 2 June and Oospores were said to be the source of this attack. The summer months were rather dry and sunny without serious blight problems.

2014: The winter without frost was followed by an early and warm spring and the potatoes were planted in time. Due to the warm conditions in April crop emergence was early and the crop development in May was very fast. After early reports of blight on dumps in April, the first infections in fields were found in the third week of May, initially in the eastern part of the country, later-on all over in the potato growing areas. Thanks to a long period of stable dry and sunny weather in June, growers were able to get the disease under control. Fungicides as Infinito, Revus, Proxanil also proved their skills under these conditions. After this severe and difficult start of the crop protection season no big problems were encountered later on.

Germany

2013: Crops were planted in good conditions but the crop emergence was late 15 May to 5 June. The first outbreak of late blight in potatoes was recorded by end of May in plastic covered potatoes. Attacks in different regions and ware potatoes were found in June. The weather conditions for the development of late blight was moderate in the North and low in the South. The number of fungicide treatments was lower than normal. All kind of products were used. Attacks of early blight (*Alternaria solani*) seem to be an increasing problem in most of the German potato growing areas.

2014: The weather condition and the disease development were diverse across the country in 2014. The Northern and Western part of Germany had an early and severe late blight epidemic. In the Eastern and Southern part a normal late blight development was observed. The crop emergence was normal (5 -20 May). The first outbreak of late blight was recorded early May (very early) in plastic covered potatoes. Attacks in conventional fields were found late May to early June. The further development of late blight was completely different. In the Northern parts of Germany there were very favourable weather conditions for the late blight development. The disease pressure was very high till end of August. In the Southern part only few infection periods were observed in July and August. The use of fungicides was high in 2014. All kind of products were used; especially mixtures were used in the Northern part of Germany.

Scotland

2013: Late blight developed unusually late in the growing season. The first crop outbreak was in Tayside on 12 August. The number of outbreaks was low, only ten confirmed outbreaks reported on the Potato Council-funded blight outbreak maps for Scotland. The progression of crop outbreaks (7 in number) in Scotland was 0 in May, 0 in June, 0 in July, 6 in August and 1 in September There were no confirmed outbreaks on outgrade piles of potatoes but there were three outbreaks on volunteers (8 August, 4 and 14 September).

2014: This year was in sharp contrast to 2013. There were many outbreaks of late blight in Scotland. Unusually the first crop outbreak was on the 30 May in South Ayrshire. Ninety-nine confirmed outbreaks were reported until the 16th of September when the last sample was submitted. The progression of crop outbreaks (97 in number) in Scotland was 1.0% in May, 19.6% in June, 57.7% in July, 20.6% in August and 1.0% in September There was one confirmed outbreak on an outgrade pile of potatoes (24 June) and one outbreak on volunteers (28 July).

England & Wales

2013: Planting was delayed due to low temperatures in early April. Rainfall was close to average during the season in most areas, although eastern regions received below average rainfall in June and September. Higher than average temperatures in July meant that irrigation was a priority for many crops nationally. Most late blight outbreaks were reported in August and September in England and Wales. Fifty-three outbreaks of late blight were reported in 2013 as part of the Potato Council funded outbreak maps in England and Wales, with the earliest report from a volunteer on 6 July in Wales, nearly two months later than the first report of 2012. No outbreaks were reported in May or June, 7 in July, 21 in August and 25 in September.

2014: Planting progress was good in 2014, with temperatures above average from March to June. Favourable conditions for late blight development were reported in early May in the South West, however, favourable weather was reported nationally from late May onwards. Most late blight outbreaks were reported in June and July in England and Wales. One hundred and sixty-seven outbreaks of late blight were reported in 2014 as part of the Potato Council funded outbreak maps, with the earliest report from a discard pile on 9 May in Norfolk, nearly two months earlier than the first report of 2013. Twelve outbreaks were reported in May, 84 in June, 48 in July, 24 in August and 9 in September.

Northern Ireland

2013: Dry weather early in the season (late May-June) prevented primary infection development and the first field outbreak of late blight was not reported until 17 July (the latest 1st report since 1981 apart from 2010 which was 2 days later). Although weather suitable for the spread of blight occurred in July and August, there was little inoculum to spread and few outbreaks were reported. Blight was well controlled in commercial crops with growers as usual making use of a wide range of active ingredients.

2014: This year the weather was more conducive to late blight with mild night temperatures and more rainfall early in the season. The first field outbreak was reported relatively early on 9 June and subsequently blight was reported in all potato-growing areas. Blight was controlled well in most crops. A few cases of more severe foliar infection were reported, but there were few reports of tuber blight. Growers used a wide range of active ingredients.

Ireland

2013: The weather conditions during 2013 did not favour late blight development. Most potato crops were planted in good conditions, however as temperatures were below average crop emergence and development was slightly delayed. During the summer months (June, July and August) temperatures were above long term averages while rainfall was below. This prevented epidemics of late blight from getting established. When conditions did favour late blight as conditions prior to these generally favoured application of fungicides no major outbreaks of late blight were reported. In response to the weather conditions hampering late blight development the applications of fungicides were altered to reflect this. This included number of applications and choice of products. The good conditions ensured low levels of tuber blight.

2014: The weather conditions during 2014 were generally more favourable to late blight development than 2013. Both the rainfall and temperatures in spring were above average and this resulted in early outbreaks of late blight being reported. From mid-June through to early August dry and warm conditions dominated which slowed the progress of any epidemics which had developed. In early August extremely heavy rain was recorded throughout Ireland which initiated further epidemics. In most commercial crops the application of fungicides protected crops, however where timings or choice of product were poor late blight did develop. The frequency and choice of fungicide product changed throughout the season reflecting the variability of weather conditions. Although weather conditions during August favoured late blight development low levels of tuber blight were reported.

EARLY ATTACKS OF LATE BLIGHT

In North-West Europe, early attacks of late blight are often found on dump piles or in potatoes covered with plastic. In 2013 dry and cold weather in May and early June prevented primary infection development from those inoculum sources and the first outbreaks of late blight in conventional fields were only reported by Mid-June in the Netherlands and Denmark, in July in France, Belgium Norway, Sweden, Finland or even late July or August in the UK and Ireland. In the Baltic countries and the European part of Russia LB was recorded in conventional fields in mid to late July. In conclusion, the year 2013 was not a blight year in Europe, early attacks from oospores were reported for Estonia, Sweden, Lithuania and the Netherlands.

The 2014 season was in sharp contrast to 2013. Mild winter, good conditions for early planting resulted in early crop emergence, and very early attacks (compared to normal) were recorded in England, Wales, Netherlands, Denmark and Sweden. In Denmark and Sweden early epidemics were driven by oospores as inoculum source. Oospores were also recorded in the reports from Estonia, Lithuania and Poland (Fig 5).

In 2014 attacks were extremely late in Norway and Finland compared to the other two Nordic countries and compared to previous years (Fig. 2).

Comparing the date when attacks were recorded in 5 or more conventional fields for 2013 and 2014, in 16 out of 20 countries attacks were earlier in 2014 than in 2013 (Fig. 3). This difference was 1½ -2 months in the UK and some regions in France. Only in Norway, Finland, Poland and Czech Republic late blight was found later in 2014 than in 2013 in conventional fields.

In the Baltic countries first recordings of blight was 10-20 days earlier in 2014 than in 2013 – early July compared to late July the previous year.

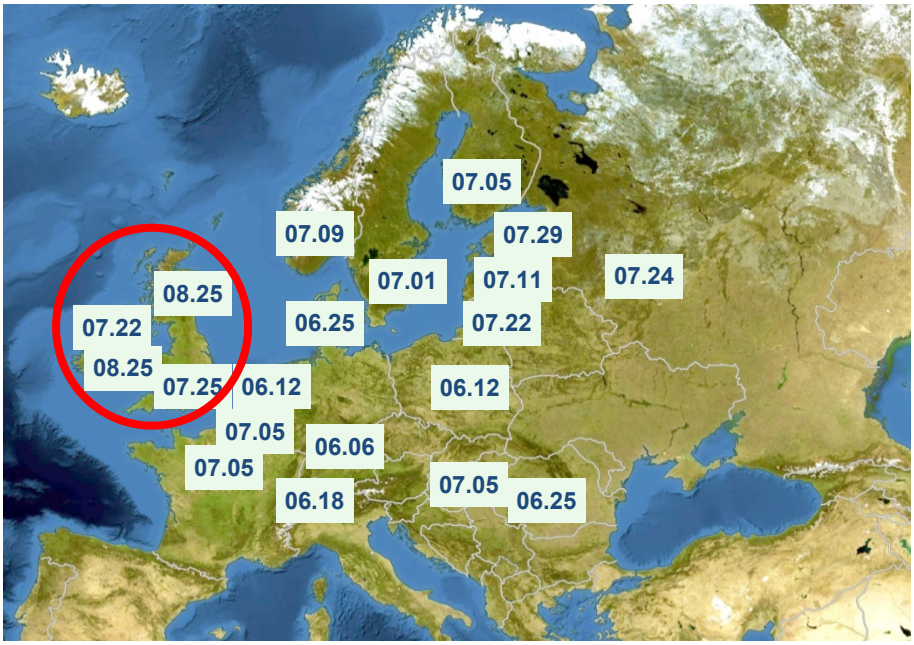

Figure 1. *Date of first observation of late blight in more than 5 conventional, normally planted potato fields, 2013*

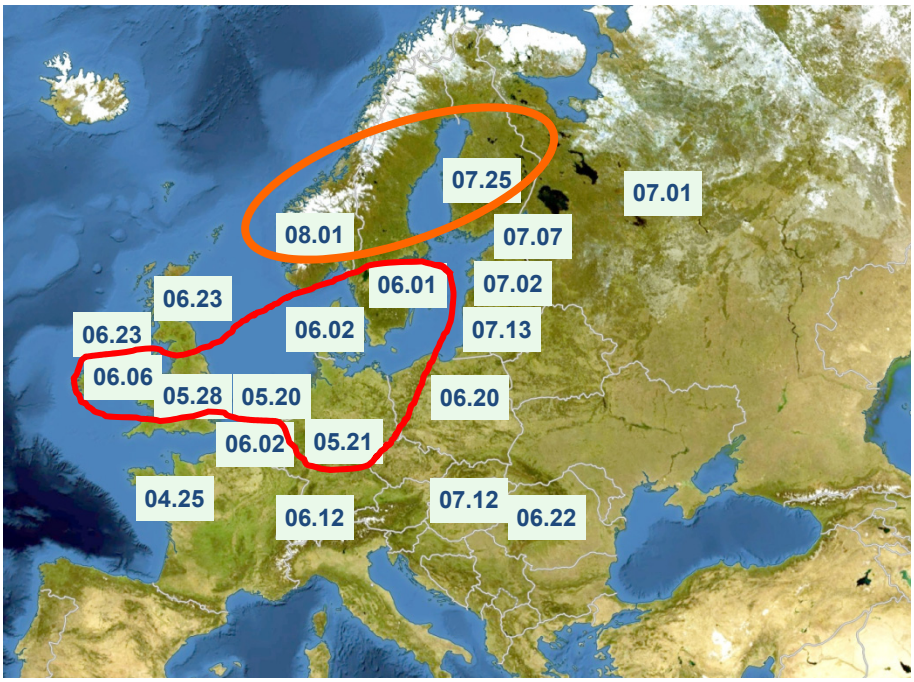

Figure 2. *Date when first infections were reported in more than 5 conventional, normally planted potato fields in 2014*

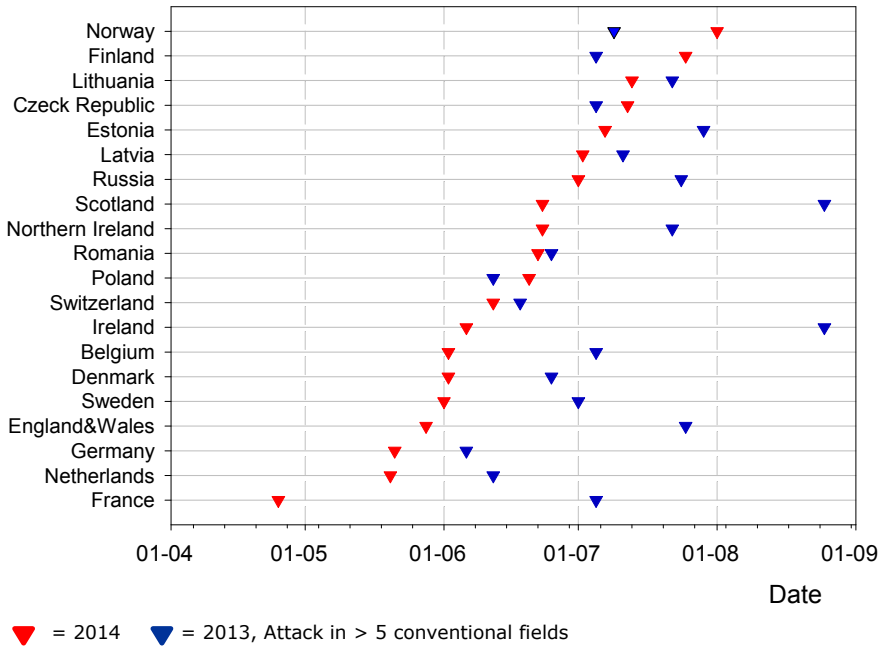

Figure 3. *Date when attacks were recorded in 5 or more conventional fields in 2013 (blue triangles) and in 2014 (red triangles)*

TUBER BLIGHT IN 2013 AND 2014

The level of tuber blight was reported as low in all countries in Europe, except for some regions and some type of potatoes in Russia, Latvia and Poland and Switzerland (Fig. 4).

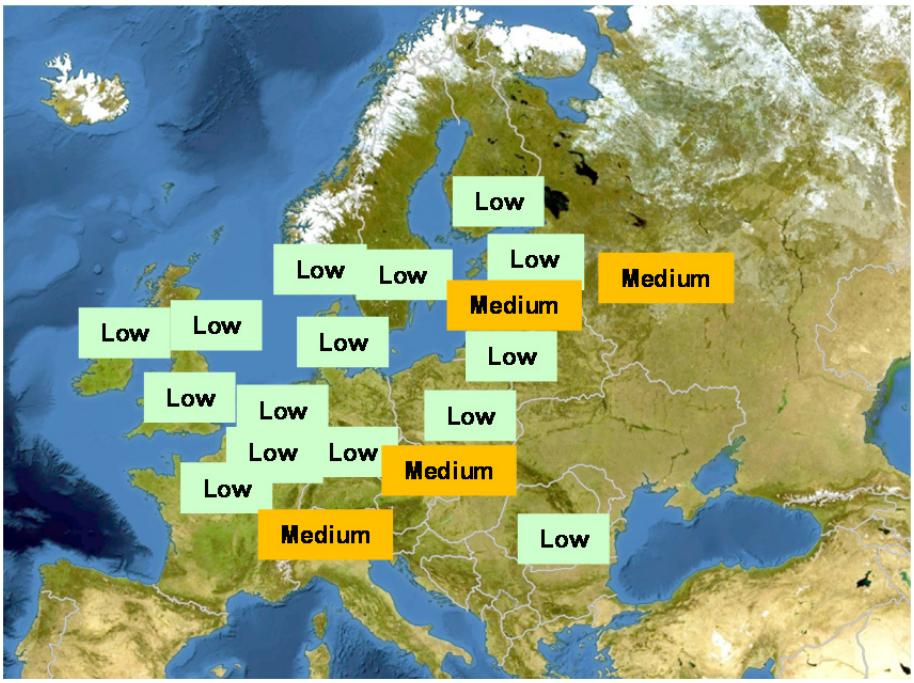

Figure 4. *The level of tuber blight attacks (low, medium or high) in 2014 compared to normal*

INDICATIONS OF OOSPORES

Infections from oospores were reported from Denmark, Sweden, Estonia, Lithuania and Poland in 2014 (Fig. 5).

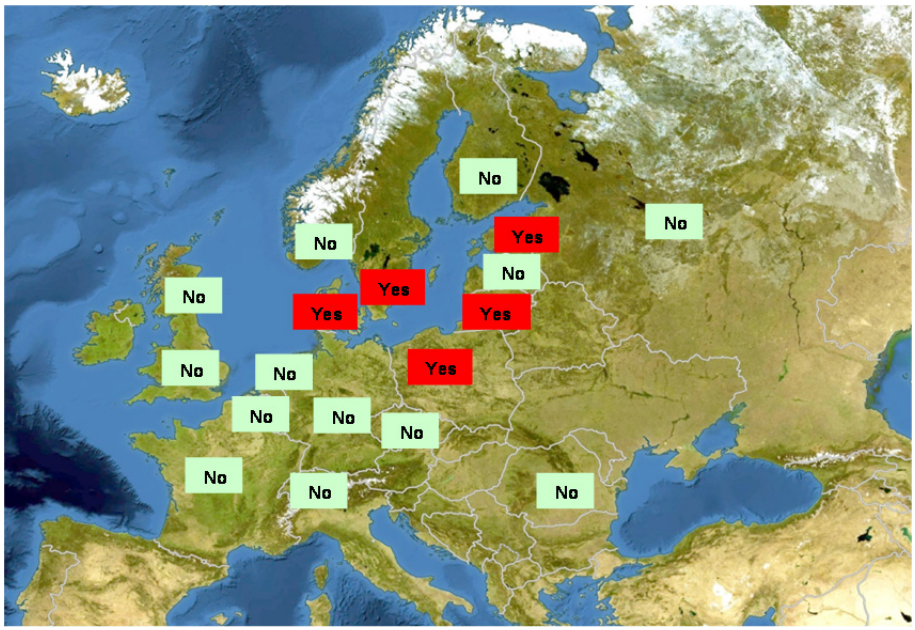

Figure 5. *Indications of oospores in Europe in 2014*

FUNGICIDES AND CONTROL STRATEGIES

In **Estonia**, systemic fungicides like Ridomil Gold and Tattoo were used in the first sprays to protect actively growing plants. Four to six spays were used in both years, the most commonly used active ingredients were mancozeb, fluazinam and mandipropamid, 1-2 treatments with cyazofamid were used at the end of the season to protect against tuber blight. In **Latvia**, the mean number of fungicide applications applied in ware potatoes 2013-14 was 3-8. The most frequently used active ingredients were: mancozeb, mefenoxam, propamocarb, dimethomorph, fluazinam, fluopicolide, mandipropamid, cyazofamid. In **Lithuania**, in average 4-6 fungicide applications is common practice. The first 1-2 applications are done with a contact fungicide, then two applications with systemic fungicides, and finally one or two applications with contact or translaminar fungicides. In **Russia,** 2013, according to the VNIIFBlight DSS, the calculated number of fungicide treatments was 3 (central regions), 2-3 (northwestern regions), 2-4 (southeastern regions), and ≤1 (eastern regions). In 2014 1-2 applications more recommended than in 2013, 2-5 applications per a season for all types of potato. In **Poland**, the farmers applied 1-6 sprays, most often 1-2. The active ingredients used on the largest areas were fluopicolide/propamocarb-hydrochloride and fenamidone/propamocarb-hydrochloride, metalaxyl -M+mzb, mandipropamid and cymoxanil+mzb. Farms producing potato for chips use fungicide applications more frequently than other potato-growing farms. The owners of allotment gardens

use no fungicides. In **Switzerland**, farmers control late blight at the beginning of the season with systemic fungicides, subsequently with protective or translaminar fungicides depending on the weather conditions and the late blight epidemic pressure. Farmers obtain such recommendations by using our DSS PhytoPRE, from their plant protection officer or from the newspaper. In organic potato production, copper products are often used to control late blight (max. 4 kg/ha^{1}year^{-1}). There is also a PhytoPRE version for organic potato production available, but it is rather seldom used. In general, farmers are aware of the possible infection sources and avoid waste piles and volunteer plants. In **Finland** the fungicide use against late blight was moderate, typically 4 to 6 sprays started during the first half of July. The use of mancozeb and fluazinam containing fungicides is steadily decreasing. The use of Revus, Ranman and Consento has increased especially during the rapid growth of potato. Infinito was registered at the end of 2014. In the **Czech Republic** conventional potato growers usually do 2 – 8 applications depending on maturity group and susceptibility of grown varieties. Early potatoes (1-2 applications), other ware potatoes (5–8 applications) and seed crops (4 – 5 applications). First applications mostly with Ridomil Gold MZ Pepite (mancozeb, metalaxyl M), Consento (fenamidone, propamocarb-hydrochloride), Dithane DG (mancozeb) and Galben M (mancozeb, benalaxyl). For further applications fungicides Curzate (cymoxanil, mancozeb), Revus (mandipropamid), Revus Top (mandipropamid, difenoconazole), Acrobat (dimethomorph) were used. Applications in the latter half of growing season were done with Infinito (fluopicolide, propamocarb-hydrochloride), Altima (fluazinam) and Ranman Top (cyazofamid). The highest efficacy was found in spraying schedules involving locally systemic fungicides with active ingredients cymoxanil, valifenalate, fenamidone, mandipropamid and fluopicolide and contact fungicides fluazinam and cyazofamid. In the Czech Republic 27 active ingredients in 64 fungicides are registered against late blight at present. Out of this number 28 fungicides contain mancozeb single or combined with an other active ingredient, the second most used active ingredient is cymoxanil, which is present in 17 fungicides. In **Norway**, 2013, the potatoes was treated 7.8 times with fungicides to control late blight, calculated as total amount of late blight fungicides sold divided by total potato area. In 2014 less blight fungicides were sold. Most potato farmers are members of the Norwegian extension service system and get their blight warnings through them from the VIPS system. However it is still common to apply fungicides on a weekly schedule, only slightly modified for the blight risk. In **Sweden,** contacts or translaminars are the main products, sometimes complimented with one or two treatments with a metalaxyl fungicide in the beginning of the spraying season. The number of sprays used in ware potatoes varies from south to north, with substantially more fungicide applications in the south. In 2014 the early attacks of late blight in the South gave a higher number of sprays compared to normal, but in other parts of the country the blight was controlled with normal or lower spraying intensity. In **Denmark,** Ridomil Gold is no longer allowed from 2014. Alternatively many farmers use a combination of Proxanil and Ranman/Revus. Due to the tax policy in Denmark, Dithane NT containing Mancozeb is not relevant to use anymore due to a relatively high price. More than half of the Danish farmers used Dithane as their first priority contact compound for many years. A change to alternatives seems to increase attacks of early blight. Therefore farmers now combine LB fungicides with fungicides especially targeted towards *Alternaria spp*. Good effects were experienced with strategies using Signum and Amistar. The Danish Blight Management decision support system is used by most farmers. Compared to a conventional strategy, this reduces the fungicide use by 10-30 % (as found in field trials). In **France**, 2013, due to a low to medium late blight pressure, growers achieved a fair control right after emergence with protectant products. Later on, because the disease pressure was diminishing, growers were able to return to normal and, occasionally, longer delay between

fungicide applications of simple protectant products. Very few translaminar and curative products have been used. The 2014 season was dramatically different since late blight pressure was high starting at emergence. Short intervals of 5 to 6 days, with protectant fungicides and products with efficient rain fastness were needed. Later in the season translaminar and curative activities of the fungicide applications were looked for in order to protect the crop. In **Belgium,** 2013, the average number of fungicide applications (susceptible variety, mainly cv. Bintje) was 14, which corresponds with an average interval of 8.7 days (from min. 6 to max. 13 days interval). In contrast 18 applications were needed in 2014, which corresponds with an average interval of 6.4 days (from min. 3 to max. 8 days interval). In the **Netherlands** the use of fluazinam solo is greatly diminished because of the problems with Green 33 in 2011. Most growers are using three or four different fungicides during the season, starting with Acrobat, Curzate, Valbon or Revus followed by Infinito, Banjo, Canvas and Ranman Top. In 2014 the use of fungicides was significantly higher than in 2013. Average last many years is appr. 14 sprays. In 2014 many growers spayed two times more. In **Germany**, a normal strategy is to start with a systemic or local systemic fungicide, then local systemic products (e.g. Revus, Infinito, Acrobat Plus, Valbon) and finally after flowering Ranman, Shirlan and fungicides containing Mancozeb. In **Scotland**, the main fungicide a.i.s used were fluazinam, cymoxanil + mancozeb, cyazofamid, cymoxanil and mandipropamid. In **England & Wales,** according to the UK pesticide usage survey report 250 published by DEFRA using 2012 figures (most recent published data), the average ware crop received 11 fungicide applications. This is an increase from 2010 where 10 applications on average were applied. Seed crops were treated with an average of 9 applications, the same as reported in 2010. Advisers are recommending that fungicides are applied at intervals no greater than 7 days apart. The three most frequently applied active ingredients were mancozeb/cymoxanil, fluazinam and cyazofamid for ware crops and cymoxanil, cyazofamid and fluazinam for seed crops. In **Northern Ireland,** the mean number of fungicide applications was about 10 in both years (ranging from 6 to 14). Growers made use of a wide range of fungicides. Fluazinam (Shirlan) was the most widely used active ingredient (used by 69% of seed growers). Growers also made significant use of Infinito (fluopicolide + propamocarb), Invader (dimethomorph + mancozeb), cymoxanil + mancozeb products, Dithane (mancozeb), Revus (mandipropamid), Merlin (propamocarb + chlorothalonil), Consento (fenamidone + propamocarb), Proxanil (propamocarb + cymoxanil) and Ranman (cyazofamid). Fubol Gold (metalaxyl-M + mancozeb) was used by a few growers. There were few blight outbreaks and these were well controlled (all <5% foliar infection). In **Ireland** the unfavorable blight weather influenced the choice of products. This included reduced numbers of applications and decreased usage of curative products. Where blight was seen the use of curative products ensured that no major epidemics were observed. More blight in 2014 increased frequencies of applications and the inclusion of curative fungicides in most applications early in the season. In response to dry spells growers did change fungicide products and frequency of applications. In some instances these were changed too quickly and epidemics were reported. The use of curative products, particularly cymoxanil was prevalent, especially early in the season and later following the heavy rain in August.

POPULATION CHARACTERISTICS

In **Estonia**, during the period 2010–2013, the A2 mating type frequency among the population of *P. infestans* was on average 40%. Both mating types were present in most of fields inspected (80%) where more than one isolate was tested. Metalaxyl-sensitive isolates prevailed (in average 66.3%) in the research period. The race structure was diverse and complex (the

average number of virulence factors per isolate was 6.4). Most pathotypes were unique, appearing only once. In **Lithuania**, a test of 93 *P. infestans* isolates, collected from all over Lithuania in 2010-2012 indicated a high and stable frequency of A2 mating type. On 45% of all studied potato fields, both mating types were recorded, suggesting sexual reproduction of *P. infestans* and possible oospore production in Lithuanian potato fields. Fourteen metalaxyl-resistant isolates were found among 71 isolates in the current study period, and sensitive isolates prevailed in all three years. Amongst 70 isolates studied, 38 avirulence pathotypes were found. The Lithuanian race structure was highly diverse and complex (the average number of virulence factors per isolate was 7.2). Most pathotypes were unique, appearing only once, and the four most common pathotypes comprised only 34% of the population (results of E. Runno-Paurson et al, 2015). In **Russia** the mating type, in the majority of the studied *P. infestans* isolates, collected from potato fields, were of the A1 type; the A2 type was reported only for single isolates. All isolates were identified as of complex races (5-11 virulence genes). In the Czech republic in 2013 the ratio of mating types A1:A2 was 40:60. In tests of resistance to fungicide active ingredients 33 % of isolates were found to be resistant to metalaxyl M. Resistance to dimethomorph was not detected. Resistance to propamocarb-hydrochloride was determined in 97 % of isolates in the central potato production region. In a similar test in 2014, the ratio of mating types A1:A2 was 27:73. In resistance tests, 20 % isolates were found to be resistant to metalaxyl M. Resistance to dimethomorph was not detected. 93% of tested isolates were resistant to propamocarb-hydrochloride. In **Sweden** the population of *P. infestans* shows a very high genotypic diversity with the biggest part of the variation found on the field or disease foci level. There are indications that the oospores as inoculum source are very important. In **Denmark** the *P. infestans* population is very diverse. Genotype Blue13 was found in 2011 and 2012 not in 2013 and at low level in 2014. None of the other named genotypes have been found yet in Denmark. In **Norway** the *P. infestans* population is diverse, with no dominant clones. SSR-fingerprinting of early attacks shows that genotypes clusters like families within fields. In **Finland**, no sampling was carried out in 2013 and 2014. In **France** the population has been monitored in collaboration with the EuroBlight network. With the easy-to-handle *P. infestans* collecting device, the Whatman FTA card, a thorough collection of samples has been possible with the help of professional partners, extension and technical institutes, breeders and advisors. The 2014 season has yielded some 200 samples, originating from most potato producing areas. The overall genotypic analysis confirms a balanced ratio of the 2 mating types A1/A2 and a predominance of the EU_13_A2 clone followed by the EU_6_A1 and EU_1_A1. The diverse clonal structure of the population tends to confirm that the asexual reproduction of *P. infestans* is still prevalent in the country. In **the Netherlands** the late blight population is a mix of different types. The Green 33 type hasn't been found last year. In Germany the genotype map show 25% EU-13-A2 and 75 % other genotypes. A Research project indicates that most of the *P. infestans* populations have a latent period between 48 to 72 hours. In **England & Wales** the predominant genotypes identified from field samples collected by advisers in 2013 were 13_A2 and 6_A1. A total of 53 isolates from 14 crops across **Northern Ireland** were obtained and characterised. Of these, 52 (98%) were A1 and all but one were 8_A1 (51), one was probably 6_A1. The only A2 isolate was 13_A2. Overall, 5% of isolates were phenylamide-resistant and this included the A2 isolate. In 2014 a total of 57 isolates from 29 crops across Northern Ireland were tested for mating type, of which 54 (95%) were A1 and 3 were A2. Of isolates tested for phenylamide sensitivity, 31% (of 61 isolates) proved to be resistant. Genotyping (using samples collected on FTA cards) is still in progress. To date this has shown that 8_A1 is the most frequent A1 genotype (43% of total), but 6_A1 and 12_A1 have also been detected. Genotype

13_A2 was present in 32% of samples. Results indicate that 13_A2 has been detected more frequently in FTA samples than among isolates.

USE OF DSSs

Several decision support systems for late blight forecasting and control are used in Europe but no major changes since the last reporting (Hansen *et al.* 2013) was noted.

ALTERNARIA 2013 & 2014

For long time *Alternaria* spp was a minor problem in North/West Europe. Some countries report that attacks of *Alternaria* spp is an increasing problem, and severe attacks were found also in countries beyond Central Europe in 2013 and 2014.

EB disease observation and EB disease progress

The date of first observation of early blight is shown for 2014 in Fig 6. The epidemic started mid of July (Germany) to end of August (Denmark). In 2013 the EB situation was similar to 2014.

In Table 1 the EB specific disease development in different countries is shown. Until the end of July 2014 the disease severity in the fields was lower than 20% in most European countries. Only in England, Wales and Germany the disease severity was between 20 and 50% at this time. In several countries the EB disease progressed in August and reached in Finland, Sweden, Germany and Czech Republic more than 50% EB disease.

EB: Identified Alternaria species

In most countries both Alternaria species *Alternaria solani* and *Altenaria alternata* were identified on infected potato leaves (Tab. 2). In June *Alternaria alternata* was the dominant species found in the central European countries. In Estonia only *Alternaria alternata* was identified in 2014 where else in England and Wales only *Alternaria solani* was found in 2014. Based on this data there is no correlation between the observed *Alternaria* species and the disease progression.

Fungicide usage and fungicide resistance

The following active ingredients were used in different countries to control EB: mancozeb, azoxystrobin (QoI), chlorothalonil, boscalid, pyraclostrobin (QoI) and difenoconazol. According to the regional registration also mixtures of these active ingredients are registered. QoI´s have a specific single-site mode of action and possess a high risk to the evolution of fungicide resistance due to point mutations. Loss of sensitivity to QoIs has been reported for *A. solani* in potato (Pasche *et al*. 2004) and for *A. alternata.* The monitoring data from 2014 indicate that in Germany, Belgium, Netherlands and Sweden the F129L mutation in *Alternaria solani* occurred. The G143A mutation in *Alternaria alternata* was identified in isolates from Germany, Netherlands and Sweden.

At the moment only limited DSS models are existing (PhytophthoraModel Weihenstephan in Germany, DACOM in Netherlands, Sweden and Poland) to optimise the control of EB.

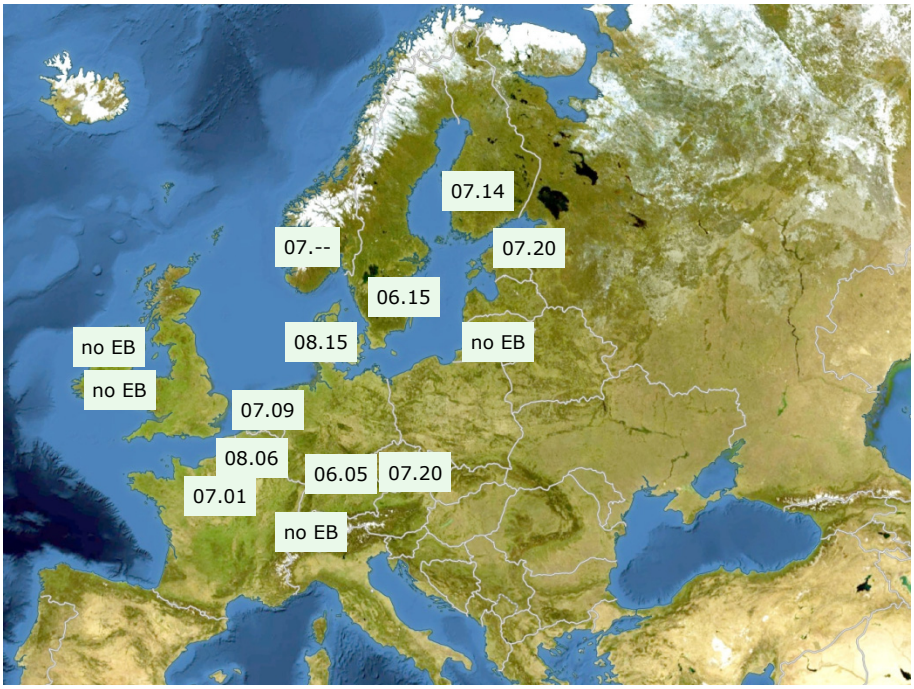

Figure 6. *First observation of early blight in 2014 in Europe*

Table 1. *EB specific disease severity in 2014 (2013) in different European countries*

	disease severity				
	May	June	July	August	September
Finland (2013)					
Finland (2014)					
Norway					
Sweden					
Denmark					
Estonia					
Lithuania					
Scotland					
Northern Ireland					
England and Wales					
Belgium					
Netherlands					
Germany					
Poland					
Switzerland					
Czech republic (2014)					
France					
		disease severity			
		< 20%			
		20-50%			
		> 50%			

Table 2. *Identified Alternaria species (Alternaria solani / Alternaria alternata) in different European countries*

	A. solani	Jun	Jul	Aug	Sep	remark	A. alternata	Jun	Jul	Aug	Sep	remark
Finland	√		√	√	√		√		√	√	√	
Norway	√			√	√		√			√	√	
Sweden	√	√	√	√	√		√	√	√	√	√	with low frequency
Denmark	√			√	√		not found					
Estonia	not found						√		√	√		
Lithuania												
Scotland												
Northern Ireland												
Ireland												
England & Wales	√	no data										
Belgium	√		√	√	√	dominating species	√	√	√	√	√	
Netherlands	√		√	√	√		√	√	√	√	√	
Germany	√		√	√	√		√	√	√	√	√	
Poland	√	no data					√	no data				3 times more than A. solani
Switzerland												
Czech republic												
France												

LITERATURE

Hansen *et al.,* 2013. The development and control of Late Blight (*Phytophthora infestans*) in Europe in 2012 EuroBlight workshop Limassol, Cyprus, 12-15 May 2013. PPO-Special report no. 16, 11-25.

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