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The development and control of Late Blight (*Phytophthora infestans)* in Europe in 2009

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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. The profile information for 2006 was presented at the workshop in Bologna, Italy in May 2007. Information for 2007 and 2008 was presented at the workshop in Hamar, Norway in November 2008 and the results for 2009 were presented in Arras on the 4 May, 2010. This paper reports the development and control of late blight in Europe, 2009.

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 among countries.

Currently we are rebuilding the web version of this tool and for 2009, results was reported via word form and e-mail and then imported into the database.

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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 taken directly from the database with only slight editing.

THE DEVELOPMENT AND CONTROL OF *PHYTOPHTHORA INFESTANS* IN EUROPE IN 2009

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 2009 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 and 4. The weather based risk of late blight development in Europe is shown in Table 1 and Fig. 5. The level of tuber blight attack is given in Figure 6.

Belgium

The weather in the month of May was favourable for a swift emergence of the potato crop. For late blight on the other hand, conditions were less advantageous for development. Although diseased plants had been found on dump piles towards the end of April, a small amount of lesions in field crops was observed only after the first week of June. A rainy infection period from the 10th to the 15th of June, in combination with high levels of new growth, led to an increase of lesions during the third week of this month. Further spread however was again hampered by the sunny weather with high temperatures during the last decade of June. The month of July brought favourable growing weather: alternately rain with summery days, but without heat. Because the sequence of the disease cycles interfered nicely with the sequence of rainy days, late blight had the opportunity to develop strongly; attacks in field crops remained low however, because of good spraying conditions allowing for timely applications. From the beginning of August, weather turned into dry conditions and this lasted until the first week of October. Under these circumstances and spraying intervals until harvest increased to 12 – 14 days or more.

Czech Republic

Potato late blight had very favourable conditions for crop infection, epidemic spreading in foliage and tuber infection in 2009. Amounts of rainfall in most potato production regions were mostly above long-term normal between May and August. Weather progress was not quite typical for the disease (i.e. warm fronts with long-lasting cloudiness, relatively mild, but constant rainfall), but durable leaf wetting and favourable microclimate were provided by frequent and heavy rains, many

times of rainstorm character. The first crop infections in the potato production region occurred very early, already from the end of the second decade of June. Beginnings of epidemic and spreading of the disease in the foliage were recorded in the beginning of July. Intensive rainfall also supported tuber infection that already occurred in July, especially in very early and early varieties. Protection required intensive applications of fungicides and recovery of fungicide cover after stormy rainfalls. Considering tuber protection setting of term and way of vegetation ending was also decisive, especially for varieties susceptible to tuber blight. Potato late blight significantly influenced mainly yields, which reflected not only foliage infection, but also early tuber infection. The most favourable conditions for tuber infection were recorded in the second half of July. Therefore most infected tubers decayed in the soil, already before harvest and this displayed as yield losses; however, presence of infected tubers in the store was mostly mild. Markedly more appropriate situation for the disease was recorded in early potato production regions, where due to differential weather progress infection pressure was milder and conditions for tuber infection were absent.

Denmark

The total area with potatoes was 38.800 ha. About half of this area is grown for starch production. Planting was possible in first part of April due to warm weather. Soil temperature exceeded 8 °C on 7-10 April. The month of May was normal regarding temperature, but it was dry. The date of crop emergence was normal, 20-25 May, and only few (3) fields were found with indications of early attacks from oospores. This was during 3-10 June. Two of these attacks were on experimental stations. Widespread attacks in conventional fields were found only after 22 June. Early blight was a considerable problem in 2009. The levels of attacks were not very high but attacks were much more widespread in the country compared to normal. Early blight seems to be an increasing problem in DK, maybe due to warmer climate. Other indications on climate change are overwintering Colorado beetles in the south of Denmark, never happening before. Many days with optimal conditions for harvest in September resulted in good quality of stored potatoes. Tuber yield was relatively high as well as the starch content.

England & Wales

Early planting was delayed in January and February due to heavy rainfall and cold, wet weather. These conditions continued until mid-March, where conditions became more favourable and the majority of the crop was planted by mid-May. There were 152 confirmed incidents of late blight in GB in 2009, 100 of which were in England and Wales. Most reported outbreaks were in crops with 2 originating from outgrade piles and 13 from volunteers. Only 14% of outbreaks were reported in May, June and September, with the majority reported in July (40%) and August (46%). Growers used a wide range of products to control late blight. Most advisers were recommending intervals between fungicide applications to be no more than 7 days.

Estonia

The potatoes were planted in mid of May, which was dry and colder than usual. The potatoes emerged in normal time in the first decade of June. Dry and colder than normal weather delayed further potato development and did not favour the late blight in June. The first late blight outbreaks were recorded in home gardens where potatoes had been cultivated in the same soil for several years in July 8. These outbreaks had clear character of soil borne infection - lesions on lower leaves and many plants. Late blight infection in conventional fields was recorded in several places over the whole Estonia in July 15-20 after a rainy period in July 7-12 with 30-60 mm of precipitation. The time of first outbreaks was approximately one week later than normal of last ten years. Established late blight progressed extremely fast in the second half of July. The blight favourable warm, rainy and moist weather continued until the mid of September. Fungicides had to be applied at shortened

treatment intervals throughout the whole season to provide adequate blight control. Tuber blight was a problem for those growers who were unable to control the foliage blight in rainy conditions. Fast developing late blight caused serious yield reduction in organic production. Reasonable yield was harvested only from organic fields of most resistant varieties.

Finland
In 2009 weather in general in Finland was not conductive for blight development. The precipitation was relatively normal but most nights during June and July were too cold for blight development. There was only one two week risk period at the end of July and beginning of August and most blight epidemics were reported during that period. First blight attacks probably derived from oospores were reported in the middle of July, which is approximately 3 weeks later than usually during 2000s. In spite of low blight risk most farmers sprayed normally starting at the first half of July and spraying 4 – 6 times. In practice blight was not present in fields where fungicides were applied.

France
The season 2009 was marked by a very heterogeneous epidemic during the season. In general for France, the risk of blight in 2009 was lower than in 2007 and 2008. Periods with high risk for disease development were recorded during the season, but the use of the models such as MILEOS ® recognized these periods effectively and the control of blight was successful.

Germany
Planting of potatoes in Germany took place during end of March and mid of April. It is a normal planting date. Very warm conditions after planting resulted in an early emergence of potato plants (beginning of May= 4-14 days earlier than normal). The first outbreak of late blight in potatoes was in the mid of May in the early potato growing area. One week later we found late blight attacks in covered potato fields. In the second week of June late blight was observed in the southern potato growing region. The weather conditions for the development of late blight was low in May, low (northern part) to high (Southern part) in June, high to very high in July and moderate in August. The number of fungicide treatments was normal in 2009. All kind of products were used. The new product REVUS was registered and introduced this year. Very late in the season the Alternaria-fungicide SIGNUM was registered.

Republic of Ireland
Unfavourable weather conditions during April and early May delayed planting of most potato crops, with the subsequent planting continuing into early June. By mid June minor outbreaks of blight were recorded in crops, with foliar and stem blight reported. Following approximately two weeks of extreme disease pressure in early July more severe outbreaks were reported, particularly in the South-East and East of the country. Intensive fungicide programmes (tight spray intervals of seven days or less) were required to halt the spread of disease. A period of relatively dry weather at the latter end of July helped control the disease. Disease pressure during the month of August was again high, however the severity of disease was not as great as during the month of July. Although high levels of foliar disease were reported during the summer months, limited amounts of tuber blight have been observed. Unprecedented amounts of potato crops were left in the ground due to severe weather conditions from November through to late January (flooding followed by extreme frost).

Italy
Planting of potatoes in the north of Italy took place during half March and first week of April. Potato normally emerged starting from half of April onwards. Tomato is commonly transplanted from the last week of April until the second week of May. In the north of Italy late blight was not

very aggressive in 2009 on potato. Climate was not blight conducive in May, usually considered historically the month "at risk" due to the spring showers, since very few rainy period occurred in coincidence with susceptible crop. Rainy periods occurred at the end of April – first week of May only. Therefore the weather conditions for the development of late blight was low in May, moderate in June, low in July and moderate to medium in August and September. Blight occurred on outdoor tomato grown in the growing areas near the Adriatic Sea, in June due to infection events of the first week of June. Late blight on potato was easily controlled with the common disease control strategy due to the low disease pressure, while on tomato some control problems occurred during the season. No late blight occurred on tubers while some yield losses occurred on outdoor tomatoes. The number of fungicide treatments was normal in 2009. All kinds of products listed in the Integrated Production Guidelines were used (see table 1). In central and south of Italy, heavy attacks of late blight occurred in Central Italy (Abruzzo Region) due to a prolonged rainy period in the first two week of June. The disease infected the stem in majority of the commercial plots. In some cases damages reached 100% of yield although tuber blight has been rare. The prolonged rainy period made it difficult for farmers to enter into the field in time to protect the crop. Early blight does not cause problems on potato in North of Italy while some problems were registered in the central Italy during the end of the season. On tomatoes, early blight rarely occurred in the north of Italy. Among the product used to control it, QoI are the most used at the end of the season.

Latvia

Crop emergence was completed by the end of May. Cool weather conditions (average temperature of 8-10 ºC) delayed the crop growth and development of late blight, therefore the first warning of the development of late blight was received on the 26th of June when the temperature and humidity conditions were favourable for the development of the disease. Also the first warning of the development of *Alternaria solani* was received in this period. In June 95 mm of rainfall was recorded in western part of Latvia, but in the northern part - 135 mm of rainfall.

The first protective application of fungicide (systemic or translaminar + contact) was made before the infectious period. Temperature and humidity conditions were favourable for the development of both diseases. The second warning of the development of late blight was received on the 3th of July. The second protective application with fungicide (systemic or translaminar + contact) was made. The first symptoms of *Phytophthora infestans* were recorded on the 8th of July on unprotected crops. In July the infection pressure on unprotected crops was very high due to frequent precipitation and optimal temperatures. In July 136 mm of rainfall was recorded in western part of Latvia with average temperature of 15 – 19 ºC for the most of July. The following applications in July were made with translaminar + contact fungicides and in August - with contact fungicides, mostly with mancozeb and fluazinam.

Unprotected crops and those that were the most susceptible were totally killed in two weeks in the beginning of August. *Phytophthora infestans* and *Alternaria solani* progressed also in August. 101 mm of rainfall was recorded in northern part of Latvia in August and weather conditions were favourable for the development of tuber blight. The use of fungicides resulted in excellent control in all farms when the first protective application with systemic + contact fungicide was made at the end of June/ beginning of July. Control of late blight was very good to moderate in the 2009 season.

Lithuania

Unfavourable weather conditions during April delayed potato planting in many regions. In some places ware potatoes were planted until the middle of May while usually it ends in the first days of May. Throughout the country the specialist of State Plant Protection Service monitored situation in

the majority of crops including potato. First late blight symptoms by Service specialist were detected on 29 of June. After one-two week period the disease was detected in most regions. July and August were rainy with relatively high temperature and consequently late blight spread very fast. In central part of the country, first symptoms of late blight were detected in the middle of July and over 3 weeks its severity reached nearly 80.0% and after one more week – 100%. Late blight in this year affected both yield amount and tuber quality. Intensive fungicide treatments increased yield by 76 %.

The Netherlands

Planting of ware and starch potatoes in the Netherlands took place during the first decade of April. It is a normal planting date. Emergence of potato plants was normal, second half of May. The first outbreak of late blight in potatoes was at the end of May in starch growing area, probably caused by oospores after a few heavy rain showers in that region. In the first decade of June late blight was reported in more parts of the country. The weather conditions for the development of late blight in June were poor, so the disease pressure stayed at a low level. The first weeks of July precipitation was high all over the country and at the end of this month new outbreaks of late blight were reported in potato fields.

The second part of August and September were dry. So the disease pressure declined, especially in the southern part of the country. In this area there were problems to keep the level of tuber damage during harvest acceptable. In 2009 there were hardly any Alternaria problems reported. Due to the favourable growing conditions for potatoes the crop didn't seem to be vulnerable.

The number of fungicide treatments was normal to low in 2009. All kinds of products were used. The new products Infinito, Revus and Valbon are used more and more at the expense of Shirlan and Curzate M.

Northern Ireland

Some crops were planted early (March – early April) in good conditions, grew well and matured before blight pressure became severe. However, planting of the majority of crops was delayed by wet weather from mid-April-May and these then grew poorly. Rainfall in April and May was c. 150% of the 30-y average and although only 82% of the average in June, rainfall in both July and August was c. 180% of the 30-y average. The wet conditions made it difficult to maintain fungicide spray programmes and most crops had some blight by the end of the season, although relatively few were severely infected. Growers made use of a very wide range of fungicides, often in tank-mixes. Drier weather in September allowed harvesting in reasonable conditions. Yields were generally low because of the poor growing condition. However, relatively little tuber blight has been seen in store either because of good tuber protection by some products and also because blighted tubers rotted before harvest.

Norway

In May and June the weather was unfavourable for late blight and the first infections was a bit later than normal. In the main potato growing areas a long period of late blight favourable weather started in the first part of July and lasted until late August. During this period the precipitation was very high and that caused problems with late blight control. A lot of fields had some late blight attacks, but most farmers were able to spray their fields without getting heavy losses. More fields than normal got tuber blight and also pink rot was a big problem in 2009. Ranman and Revus were introduced in 2009 and more than 70 % of the treatments were carried out by these two products at the expense of Shirlan. The number of treatments was about the same as normal for the last years. Late blight was not found in the northern part of Norway in 2009.

Poland

The spring of 2009 was generally warm and relatively dry and resulted in early potato planting. Due to the spring weather conditions most of crops emerged in the period May 15-30. The first late blight infection was found only in two fields on May 10th and 26th. Disease did not spread out very much during May due to low disease pressure. Heavy rains in June and July were very favourable for late blight development. The most of outbreaks were observed in Poland between June 15th and July 15th. In that period disease pressure was very high. In several of the crops infections were found on small plants (BBCH 35-37) which indicated soil borne infections. In August the weather based risk of late blight development was moderate In September the disease pressure was low. In general the yield was good and there were little problems with tuber blight. Polish farmers started early with applications of fungicides. Average 2-6 sprays were carried out to control the disease. The most commonly used active ingredients were metalaxyl M, fluopicolid, fenamidon, cymoxanil. The first outbreak of early blight was detected on May 29th. In the most of the monitoring fields (26) early blight appeared in June and first days of July (21 crops). Only 4 infections were recorded at the end of July. Generally weather conditions in 2009 were moderately favourable for early blight development.

Russian Federation

According to our data and information, obtained from the regional Plant Protection Services of the European part of Russia, the severe late blight development (yield losses exceeded 20%) was observed in Kaliningrad and Vologda regions, the northern part of the Kirov region, and on the most part of the Komi Republic. The late blight development in other regions was rather weak or moderate. The first appearance of late blight symptoms was registered on July 6 (at the crop emergence phase) in the Komi Republic. In this day the disease was registered on many potato fields of this region. The most popular fungicides were Shirlan, Ridomil Gold MC, Acrobat MC, Penncoceb, Tanos, and Sectin Fenomen. The average number of fungicidal treatments in agricultural companies and private farms was 3; the maximum number was 10. Owners of small private gardens did not use any fungicides. In recent years some companies and farms used the Plant Plus (Dacom) and VNIIFBlight DSSs for the LB control. A high level of the early blight development was registered in the eastern part of the European Russia, mainly on potato fields, which were not treated with fungicides and have a shortage of nitrogen compounds.

Scotland

The 2009 weather in Scotland was less favourable for foliar blight development than that of 2008. There were fewer Smith Periods and the averages across seven Scottish sites in May, June, July, August and September were 0, 3.3, 2.3, 1.9 and 0.7 respectively. Sixty-two confirmed outbreaks were reported on the Potato Council-funded blight outbreak maps up until mid-September. The first outbreaks were not reported until July but the largest percentage was reported in that month. The progression of crop outbreaks was 56.5 % in July, 35.5 % more in August and 8.1 % in September. There were no outbreaks reported on dumps of potatoes but six outbreaks on volunteers (two in July and four in August). Most agronomists were recommending a maximum spray interval of 7 days unless there were extended periods of low risk. This was prompted by concerns regarding the change in the UK blight population to predominantly the more aggressive 13_A2 genotype.

Slovakia

Very early potatoes were planted in Southern part of country on the end of March. Very early potatoes were sprayed with fungicide only once or twice within vegetation period. Harvest of very early potatoes started earlier than the first observation of late blight was recorded. Ware and seed potatoes were planted in all other regions in the end of April and beginning of May 2009. Drought and warm weather lasted from April until the end of May. Lot of rainfalls and moderate temperature

was recorded in June. Good weather formed suitable conditions for late blight development in the end of June. The first manifestation of late blight infection was recorded on dumps: 29-06-2009, in the ware potato fields: 04-07-2009. Infection pressure decreased in July and progressively increased during August. Good conditions for late blight development on leaves were recorded in the end of August and in the beginning of September. Late blight infections on tubers did not overcome incidence in previous years.

Sweden
The spring was warm and dry in most of Sweden 2009 resulting in good conditions for planting. In 2009, the first blight report came 22 June from an uncovered field on the South coast. This is later than normal. Until mid July there were only sporadic reports of blight in south Sweden and mid Sweden. More widespread attacks in these areas were reported in early to mid July. All in all, 2009 can be considered as a year with relatively minor problems with late blight.

Switzerland
Compared to 2007 and 2008 with first late blight attacks on May 14 and May 19, the first late blight attack in 2009, was observed rather early, namely on 30 April on a covered potato field in the southern part of Switzerland (canton TI). There the weather based infection risk was very high during the last two weeks of April 2009. Mid of May, the weather conditions were very favourable for the development of late blight in many other regions of Switzerland. However, only one new attack was indicated until May 20. From May 28 until June 4, the so called "Bise", a cold and dry wind from the North, delayed the LB-epidemic. Then the weather changed and during the rest of June weather based infection risk was rather high. Several days with continuous main infection and sporulation periods (MISP) were registered for all weather stations. So, late blight epidemic started in all potato growing regions; but did not reach a high level, though the weather was still conducive during the rest of July. In summary, the spread of late blight started late and epidemic could spread during June and July, but the epidemic was weaker than during the two years before. Tuber blight was hardly found in 2009.

EARLY ATTACKS OF LATE BLIGHT

In **Denmark**, first attacks were found on 3 June in an experimental field in the North of Jutland with clear indications of oospores. A week later, 9 June, two conventional fields were recorded with attack probably also from oospores. Only after 22 June attacks were found widespread in the country due to a cold and dry June compared to normal. In **Norway**, the first attacks were generally relative late both in covered and the main crops in the main potato areas in the South. In the Trøndelag area in the Middle part of Norway the first attack was 22 of June (in covered crop), which is early for this region. Late blight was not found in Troms in Northern Norway in 2009. In **Sweden**, 2009, there were no reports of late blight from the early potato districts. It was earlier not uncommon to find blight infected fields originating from soil borne oospores in these areas in Mid May. During later years early attacks of late blight in the early potato have become rarer, mainly due to earlier removal of the fleece in combination with a fungicide application. In 2009, the first blight report came 22 June from an uncovered field on the South coast, which can be considered as 1 - 2 weeks later than normal. In **Finland**, the first late blight attack in conventional open field potato was reported on 12 July and the second on 20 July. The first report came from a potato field with long history of continuous potato growing and the second from an experimental field at Jokioinen used for oospore studies. Early attacks in 2009 were approximately 3 weeks later than usually during 2000s.

In **Estonia** first outbreaks on early potatoes were recorded during 8-10 July in allotment gardens where potatoes are cultivated without crop rotation. First symptoms were detected on lower leaves of plants on entire potato cultivation area. First outbreaks on conventional field were detected during 15-20 July several places all over Estonia. The outbreaks followed the prolonged rainy period of July 7-12 with 30-60 mm of rain. In **Latvia** the first symptoms of late blight were recorded on the 8th of July on unprotected crops. In July the infection pressure on unprotected crops was very high due to frequent precipitation and optimal temperatures. In Lithuania, first late blight symptoms by Service specialist were detected on 29 June. After one-two week period the disease was detected in most regions.

In **Russia**, the first appearance of late blight symptoms was registered on July 6 (at the crop emergence phase) in the Komi Republic. On this day the disease was registered on many potato fields of this region. In **Poland** crop protection services monitored 101 potato fields for the occurrence of late blight. Only two early outbreaks were recorded in crops during May (10 May in West region and 26 May in Southwest part of Poland). A few early outbreaks were recorded in potato fields (4) at the beginning of June. The first infections (6 fields) were reported in normally planted potato fields on 15th June, mainly in West region of the country. The most of late blight infections were observed in the second part of June and the first decade of July (in 68 fields). In **Slovakia,** the first manifestation of late blight infection was recorded on dumps on 29 June, in the ware potato fields on 4 July. Infection pressure decreased during July and progressively increased during August.

Following late planting of most crops in **Republic of Ireland**, the first serious outbreak of potato blight on normally planted crops was reported in early June on a seed crop. No further outbreaks were reported until late June. By mid July outbreaks were reported throughout the country, with severe outbreaks being reported in the South-East and East. In **Northern Ireland** blight was first seen on a dump in Co. Down on 1 June. The first field infection was found on 8 June on a single plant of the second early cultivar British Queen, grown near Broughshane, Co. Antrim. By 30 June, blight had been seen in a further six crops of second early or maincrops cultivars in Counties Antrim, Down and Londonderry; A total of 34 reports of blight had been received by the end of July from all potato-growing areas. In **Scotland**, the 2009 weather was less favourable for foliar blight development than that of 2008. The first outbreaks were not reported until July but the largest percentage was reported in that month. In **England and Wales**, there were few reports of early outbreaks of late blight with the majority reported during July and August.

As in the previous years, the first attacks were recorded on dump piles in **Belgium**. Throughout the early stages of the season however, it became obvious that the level of primary inoculum – both from dump piles or volunteers – was much lower than the previous years. It was believed that the exceptionally cold winter, and particularly the cold wave during the first decade of January, had decimated the potential sources of inoculum. In **the Netherlands**, the first attack was reported last week of May. This infection was found in a starch potato field after a few heavy rain showers. Oospores were most probably the source for this early attack. In 2009 there were very few reports of late blight on waste piles. Due to the unfavourable blight conditions during the early months of the growing season the disease pressure stayed low for a long time. So the first weeks of the season, it was fairly easy to control blight. In **Switzerland**, first attack was registered very early on 30 April in the southern part of Switzerland in a covered potato field. As this is a rather "isolated" region, this LB-attack was not so important for the other potato growing regions. On 20 May a second attack was indicated in the central plateau of Switzerland in normal planted potatoes. This year, even 4 of the 6 first registered LB-attacks were indicated as secondary infections. In Italy, Emilia Romagna, first outbreak both in commercial and organic potato growing was from 12 to 20 May. Disease development was very slow in May due to unfavourable weather conditions for disease development.

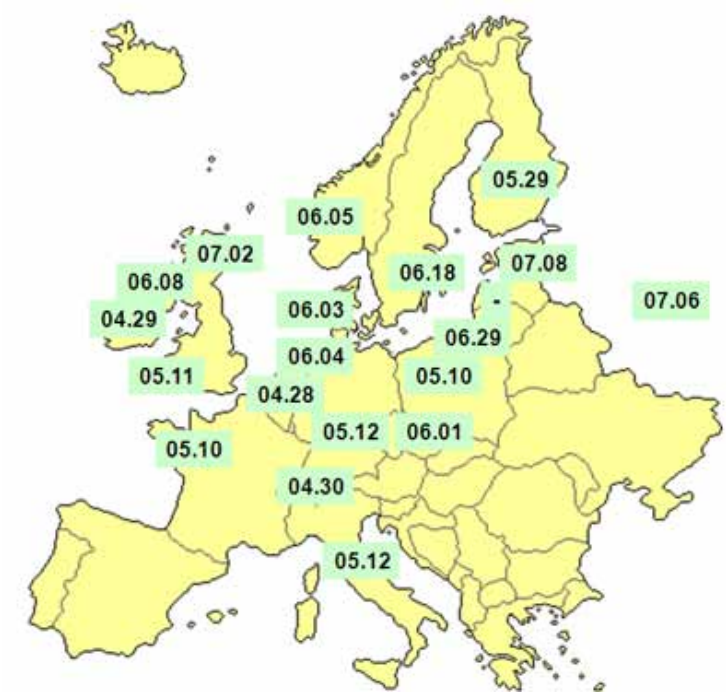

Figure 1. *Date of first observation of late blight in covered or very early planted potatoes, 2009*

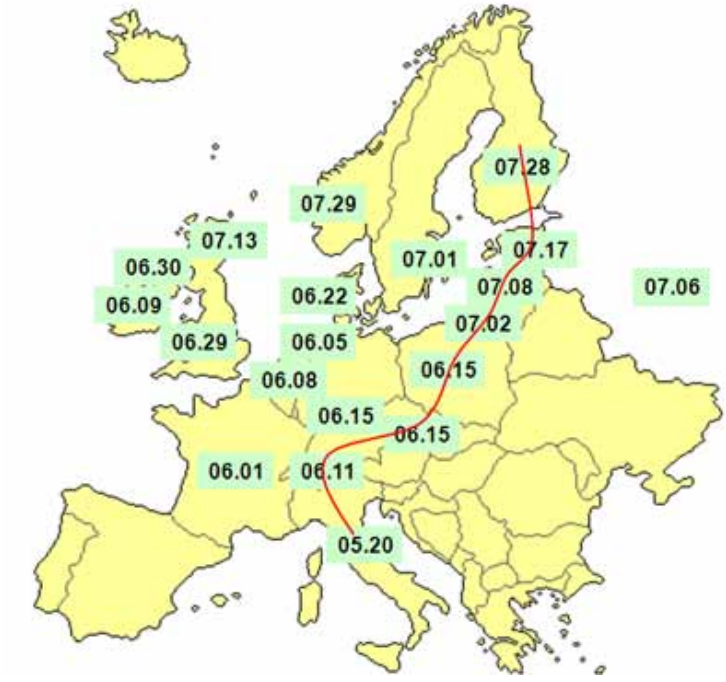

Figure 2. *Date when first infections were reported in more than five conventional, normally planted potato fields, 2009.*

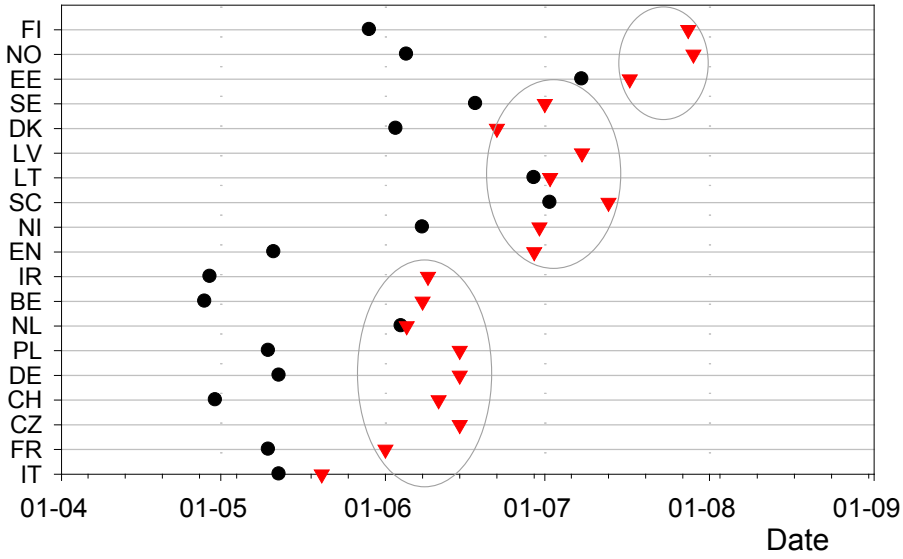

Figure 3. *Date of first observation of late blight in covered or very early planted potatoes (dots) and Date when first infections were reported in more than five conventional, normally planted potato fields (triangles), 2009*

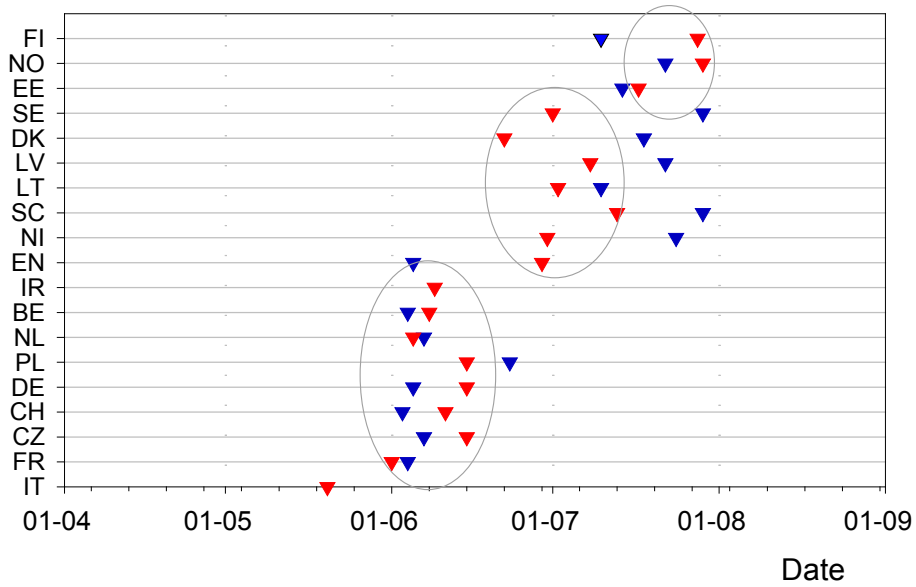

Figure 4. *Date when first infections were reported in more than 5 conventional, normally planted potato fields in 2009 (red triangles) compared to 2008 (blue triangles)*

WEATHER BASED RISK OF INFECTIONS AT SELECTED STATIONS, 2009

In the most recent country report it was concluded that there is a need for a harmonised European approach for calculating blight weather to replace the current method used in EuroBlight (Hansen *et al.*, 2009). With support from ENDURE, we have now created a freely available platform that allows users to test and compare weather-based sub-models for late blight development (Hansen *et al.* this proceedings). For the country report 2009, the risk of infections from *P. infestans* was calculated with the WURCP sub-model for critical periods and summarized as number of critical days per month at selected stations, Ranked according to season sum of critical days (Table 1). WURCP calculates critical periods, i.e. days with a very high risk of infection of the potato crop. WURCP assumes the presence of latently infected tissue in the surroundings of, but outside your field. For a critical period to occur, three sub-processes of the infection cycle have to be fully completed in sequence: formation of sporangia, dispersal of sporangia and infection. The algorithms calculating development rates for each of these processes are based on Crosier 1934.

Table 1. *The number of critical days for infection of P. infestans at selected stations in Europe, 2009, May, June, July, August & September.*

Location	May	June	July	August	September	Season sum
St Eloy (FR)	5	13	13	21	12	64
Tylstrup (DK)	0	5	17	14	10	46
Lindloh (DE)	4	5	15	16	6	46
Valthermond (NL)	2	4	12	15	9	42
Belfast (NI)	3	6	12	11	8	40
Reckenholz (CH)	7	5	6	9	13	40
Mathau (DE)	4	9	6	8	6	33
Dundee (SC)	1	5	8	14	3	31
Ås (NO)	0	0	9	13	3	25
Særheim (NO)	0	0	9	11	5	25
Payerne (CH)	4	2	3	4	12	25
Skara (SE)	0	3	15	5	0	23
Flakkebjerg (DK)	0	0	7	6	9	22
Bonin (PL)	0	1	8	3	7	19
Lelystad (NL)	1	3	5	3	3	15
Capofiume (IT)	2	2	0	0	6	10
Riposto (IT)	1	2	0	0	2	5
Average	2	3,8	8,5	9	6,7	30

The same data are presented on a map and the critical days are indicated per month with a coloured code: 0 days with infection risk per month = green (very low), 1 – 4 days = yellow (Low), 5-9 = light orange (moderate), 10 – 14 = dark orange (high) and 15 – 31= red (very high)

For Tylstrup, DK, the coloured code would be like this - each box representing a month from May - September:

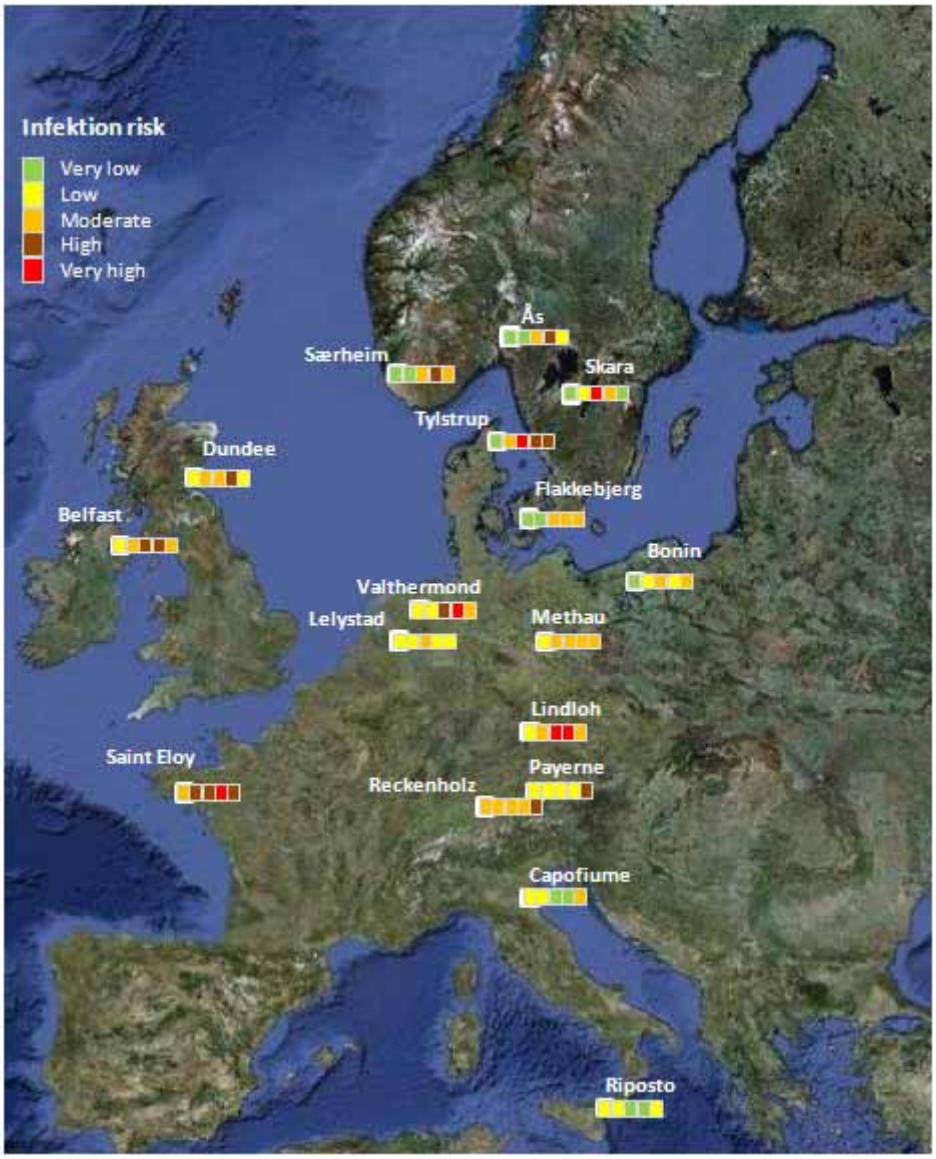

Figure 5. *The weather-based risks of late blight development in Europe in 2009 at selected stations. Calculations are critical days for infection (WURCP) from 1 May to 30 September.*

The number of days (average for all stations) with infection risk was highest in August – increasing during the season: 2 days with infection risk in May, 3,8 days in June, 8,5 days in July, 9 days in August and 6,7 days in September. The station with the highest risk was Saint Eloy in Brittany in France. The lowest risk for the season as a whole was at the two Italian stations. A similar pattern was found for 2008 (not shown). The difference in blight risk was sometimes high for stations in the same country i.e. Tylstrup (46 infection risk days/season) and Flakkebjerg (22 days/ season) in Denmark and Valthermond (42 days /season) and Lelystad (15 days /season) in the Netherlands. A similar but less pronounced pattern was found for the 2008 season.

TUBER BLIGHT IN 2009

The level of tuber blight was low to medium in 2009, due to a combination of effective leaf blight control and favourable weather conditions during harvest (Fig. 6)

Figure 6. *The level of tuber blight attacks (low, medium or high) in 2009 compared to normal*

USE OF DECISION SUPPORT SYSTEMS

A full list of DSS in use in Europe and associated contact information is available at http://www,euroblight.net

In **Northern Ireland** growers and advisers can 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 also sign up to receive Blight Warnings by SMS. Warnings of Infection Periods are also given on the Blightline recorded phone message and via local radio. Growers can also 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 **Scotland** - in response to the population change most growers of conventional crops applied fungicide sprays at short, fixed intervals and therefore there was relatively little use of DSSs. The main blight risk model used in Scotland continues to be the Smith Period, but there is widespread speculation that the Smith Period criteria of temperature and relative humidity may no longer apply to the new genotypes of *P. infestans* that currently dominate the Scottish population. A new source of information on high-risk weather, called BlightCAST, was made available in 2009 by Syngenta Crop Protection. This continues to be available free on the internet to registered users. High-risk periods are forecast Smith Periods. Plant Plus and Forecast Extra are also available to subscribers. In **Italy** situation is different in each region. DSS are used in Emilia-Romagna region as a routine tool to better time the spray applications. Information of DSS elaboration, about the blight risk and the moment when to start spray to control late blight are used to prepare weekly IPM bulletins. Moreover, in some cases, warning is also send by SMS. IPI negative prognoses model and MISP are currently used. However in many Italian regions, no DSS are so far used. More than 2000 potato growers in **Belgium** receive advice on late blight control from one of the three warning services, depending on the region. A network of more than 70 automatic weather stations collects the necessary meteorological data. The disease models used are historically based on 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, lesion growth) have been added, leading to a much more quantitative disease model. Additionally, the model has been integrated with GIS software and linked with a late blight attacks monitoring service. Advices are updated several times per week and communicated via internet, e-mail, fax or post. A separate advice for organic growers is drafted. In **Norway** VIPS is a national system for plant protection forecasts including late blight on internet and is run in cooperation with Bioforsk and the advisory service. From 2009 a new late blight model developed by Ragnhild Nærstad et. al. was implemented. This model is run in addition to the Negative prognosis for timing the first sprays and the Førsund Model for timing the consecutive sprays. Late blight forecasts on VIPS are used by several farmers often via local advisors which "digest" the forecasts for local use. There are two decision support systems (PhytophthoraModel Weihenstephan, ISIP) for the control of late blight running in **Germany.** The informations of the DSS`s are also on the internet (www.krautfaeule.de; www.isip.de) The majority of the potato growers are directly informed by fax or e-mail. In many regions the state advisory service 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 two application offers (weather based infection risk and map with late blight attacks) is used very regularly (ca. 200'000 clicks/growing season). In addition PhytoPRE list of LB-attacks is weakly published in farmer's newspapers. A lot of farmers have learned due to PhytoPRE to mind the critical facts/periods of late blight.

ALTERNARIA REPORT, 2009

Early blight (*Alternaria spp.*) has not been considered as a problem in potato in **Norway** during at least the last 40 years. In 2009 classical symptoms of early blight was reported in the cultivar "Ramos" in Vestfold County, and *Alternaria solani* was isolated from these plants. In **Sweden**, the incidence of early blight in starch potato in Southern Sweden was high in the beginning of August

suggesting that the outbreaks of early blight started in the later part of July. In mid to late August a large proportion of the starch potato area was affected by early blight, even if treated with fungicides. July was drier than normal in southern Sweden, which enhanced the chances of development of early blight. In mid Sweden July and August was wet and the incidence of early blight was rather low. The incidence of early blight has increased during the past ten years, which could be an effect of reduction in use of fungicides based on mancozeb. In Sweden only two fungicides based on strobilurins are approved against *A. solani* in potato crops. Alternaria is not yet a problem in **Finland**, but individual lesions can easily be found at the end of season. Probably also a frequent use of mancozeb containing products against late blight keep levels of Alternaria low. Early blight was a considerable problem in 2009 in **Denmark**. The severities of attacks were not very high but much more widespread than normal. Early blight seems to be an increasing problem in DK, maybe due to a warmer climate.

In **Estonia**, the weather conditions were unfavourable for Alternaria, and infection took place only in a limited number of fields, where disease severity remained at low levels. In **Lithuania**, 2009, *Alternaria spp* was very rare. Only one fungicide Signum (active ingredients pyraclostrobin + boscalid) is registered specifically to control early blight. Dose rate of this product is 0,2 l/ha. In **Latvia**, The level of *Alternaria spp.* attacks was low. The first symptoms of early blight were observed at the beginning of July.

A number of early blight outbreaks were confirmed from the South-West and South-East of the **Republic of Ireland**. In most instances these were initially mistaken as late blight. The significance of these outbreaks is unknown. Early blight is not a problem on potatoes in **Northern Ireland**. Alternaria sp. is not considered to be a major disease of potatoes in **England and Wales**, although it was reported in 2009 on cv. Markies. First symptoms were reported to have appeared in mid- to late July.

In **Germany**, the outbreak of early blight was normal (2-4 weeks after the crop emergence). The start of the early blight epidemic depends on the cultivar, crop emergence (plant age), weather condition and inoculum. Therefore in some regions early blight has been a destructive disease and caused yield losses due to premature defoliation. Fungicide used to control early blight in Germany: Mancozeb-containing products, Ortiva (Azoxystrobin) and Signum (Boscalid + F500). There were very few reports of Alternaria attacks in **the Netherlands** 2009. At the end of the season a little infection was found in some susceptible varieties. In **Belgium**, in general, Alternaria outbreaks were only recorded late, or not at all; the level of attack was also very low, with the exception of a few cultivars e.g. Markies.

In **Poland** the first outbreak of early blight was detected on May 29th. In the most of the monitoring fields (26) early blight appeared in June and first days of July (21 crops). Only 4 infections were recorded at the end of July. Generally weather conditions in 2009 were moderately favourable for early blight development in Poland. Early blight is not a serious problem in the **Czech Republic**. More important occurrences were found in susceptible varieties in early potato production regions.

Early blight does not cause problems on potato in North of **Italy** while some problems were registered in the central Italy during the end of the season. On tomatoes, early blight rarely occurred in the north of Italy. Among the product used to control it, QoI are the most used at the end of the season.

DISCUSSION AND CONCLUSIONS

In 2009, very early attacks occurring in April were only reported in Belgium on dump piles and in Ireland and Switzerland in covered crops. The first serious outbreaks of potato blight on normally planted crops were reported in Belgium on 8 June, in Ireland on 9 June and in Switzerland on 11 June (Figure 2 and 3). In several countries (i.e. Finland Norway, England, Ireland, Belgium and Switzerland) there was a long gap between date of first attacks in early potatoes and the date when infections were reported in more than five conventionally, normally planted potato. The early attacks are found on dumps (Belgium, in covered crops (Ireland, Norway and Switzerland), in fields infected early from oospores Finland, Denmark, and the Netherlands) or in home gardens with potato after potato - oospores indications, in Estonia.

In Central – and Western Europe (zone 1) attacks in conventional fields were recorded in the first half of June, 14 days later, approximately 1 July in a zone from Great Britain, Denmark, Sweden, Latvia and Lithuania (zone 2) and finally mid until late July in Estonia, Norway and Finland (zone 3). Compared to the year 2008, the dates of attacks were the same for countries in zone 1 and 3, but earlier in 2009 than in 2008 for countries in zone 2 (figure 3). The date of first attack in conventional fields appears in a row (red line in Fig. 2) from Italy in the south of Europe (20 May) to Finland in the North (29 July). This might well represent the differences in the combined date of planting and rate of crop growth - earlier and faster in the south – and that late blight on average is found at the same growth stage shortly after row closing.

In the article about the comparison of blight weather sub-models, Hansen *et al.* (2010b) identified the year 2009 as a relatively low risk year compared to the years 2006-2009.

In most countries the chemical control strategies were reported to be effective in 2009 – despite rainy periods in July and August causing some problems. Problems with tuber blight in 2009 have been reported to be low in Central and West Europe and medium in some countries in the Nordic and Baltic countries (Fig. 6)

The survey and use of DSS show that most countries build their own DSSs based on known model components. The most widespread single DSS seems to be Plant-Plus from Dacom in the Netherlands.

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