Fireblight a Spreading Disease in the Mediterranean Area: a Short Literature Review

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Introduction

Fireblight, caused by the bacterium *Erwinia amylovora* is a noxious bacterial disease, especially for pome fruits and certain Rosaceous ornamental trees and shrubs. It spread in the sixties of last century from Northern America to Northern Europe. From there spread was in the eighties towards southern Europe, but it seems that also from the middle east the disease spread towards Mediterranean and central-European countries. See also list with countries (Table 1).

Control is very difficult and mostly only preventive. Once the infection is present and weather conditions and growth stage of the host plants are suitable spreading is epidemically and disease progress very fast. Orchards can be destroyed in one-year time. In Italy first infections were found in the south. Birds possibly spread bacteria. Later also in the North infections occurred (Table 1), also in epidemic forms. Origin of infections is less clear. Again birds (from east- southern France could have played a role, but also slower spread by insects in the mountain areas or spread by planting material can have played a role). A more or less similar situation is present in Spain where several outbreaks in different parts of the country occurred (Lopez *et al.*, 1999).

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The exact significance of planting material is not known. There is an epiphytic stage in the life cycle, but that is relatively short and infected plants should be present. In a recent discussion in the Standing Committee in Brussels and in a mini-symposium held in Wageningen it was noted that it is not known whether latent infections of fireblight occur without the development of visible symptoms. Moreover not much is known about survival of such latent populations during winter and/or cold storage. In the literature a negative effect of cold storage is described (Hale *et al.*, 1998). At the University of Bologna, Institute of Plant Pathology, it has been found that after artificial inoculation mutant, labelled strains of *E. amylovora* could survive in young apple trees for one year. They were unable to detect bacteria in pear trees after this period. Apple appears to present a higher risk in this case. Survival on wood or in calyxes of pear fruits showed a decreasing curve, and living cells were detected up to 2-3 months. Two types of spread are discriminated: *mid-to long range spread* (100 m to at least 17 km, wind, birds, insects, found in Italy under circumstances of stringent eradication in Italy (Battilani *et al.*, 1999) and in the Netherlands, initiates new focal points, and: *short range spread*, up to 100 m, insects, birds and wind driven rain (McManus and Jones, 1994), within fields and adjacent fields, enlargement of foci.

Table 1. Occurrence of fireblight in different countries

Albania	1995	Cariddi *et al.*, 1999
Armenia	1990	
Austria		1993
	1998	Voralberg, all districts in Tirol, except Landeck, Lienz (Juen and Bechter, 1999)
Bosnia		1989
Bulgaria	1989	Bobev *et al.*, 1999
Cyprus		1984
France, SW	1978	
Germany, S	1981	
Greece	1986	
Hungary	1996	
Israel		1985
Italy, S		1990

	Sicily	1991
	N. Italy	1994
	Campania	1992, 1994 (Griffo *et al.*, 1998), pear
	Emilia-Romagna and neighbouring areas, epidemic in 1997 in pear (Palara, 1998) Gossensass/Sterzing,	1999 (Scartezzini, 1999)
Jordan	1990	quince, apple , pear S. Jordan (Tehabsim *et al.*, 1992
Croatia	1995	
Lebanon	1988	Saad *et al.*, 1999
Macedonia	1986	
Romania	1991	Severin *et al.*, 1999
Serbia	1989	Babovic, 1998
Spain	1995	
Switzerland	1989	NE of country (Grimm *et al.*, 1993)
	2000	epidemic in E.Switserland, Hasler *et al.*, 2000
Turkey	1985	Central and western Anatolia
	2000	widely spread (Demir and Gundogdu, 1995)

Essential in control are 1) early detection and identification of the pathogen, 2) absence or removal of susceptible hosts near production areas, 3) use of healthy planting material and use of resistant or less susceptible varieties of host plants. The best way again seems to be integrated control, as practised e.g. in France (Paulin *et al*, 1999). Testing for latency can be performed by plating on (semi)selective media, serological tests (immuno-fluorescence) and DNA based methods. PCR methods have seen development of quite specific primers, but a correlation between the other methods and PCR has been insufficiently investigated. PCR could become a good detection method but it needs to be developed and validated further before it can be used for official purposes. A new development is the chemiluminiscent immunoenzymatic determination of PCR products (Bereswill *et al.*, 1992;Gorris *et al.*, 1996; Maes *et al.*, 1996; Merighi *et al.*, 2000; Anonymous, 1998, Lopez, 1999; Llop, 2000; Zaccardelli and Bazzi, 1997).

In the following some examples of control, epidemiology and detection/identification are given relevant to the Mediterranean area, including literature references.

Hosts

Main hosts in the Mediterrenean area and Central Europe are: Pear, apple, quince (Cydonia), medlar (Mespilus germanica), hawthorn (Crataegus spp., incl. laevigata, azarolus), wild pear (Pyrus syriaca, P. bovei), Pyracantha, Cotoneaster, Eriobotrya japonica.

Monitoring

In Italy a monitoring network of c. 3600 points at 5 km intervals and divided over 3 interregional and 2 island networks has been created (Mazzucchi, 1994).

Resistance

Studies have shown that most Central European cultivars from apple and pear are highly susceptible to fireblight. Some (new) cvs (e.g. Robusta 5 and Florina) obtained in resistance breeding show resistance (Keck *et al.*, 1997, Momol and Yegen, 1993; Fischer *et al.*, 1999). However varieties may react differently from year to year depending on climatic conditions and type of artificial inoculation (Lezec, 1998).

Epidemiology

In artificial inoculation experiments it has been observed that the bacterium may spread in a latent form to rootstock from the scion and in shoots (Crepel *et al.*, 1996; Momol *et al.*, 1998; Hickey *et al.*, 1999; Richter *et al.*, 1999), in how far this is a real problem in practice is still largely unknown but cannot be excluded. It seems that in Italy three types of strains: Pt1 (Central European, eastern France and England), Pt3 found in NE Italy (northern France and Pt2 (Balkan, Hungary, Mediterranean) respectively on basis of Pulse Field Gel Electrophoresis of genomic DNA after Xba1 digest. However also deviating strains were found (Bazzi *et al.*, 1999; Zhang *et al.*, 1998; Geider *et al.*, 1999).

Control

For Italian control strategies, including destruction of infected material and monitoring: see Calzolari *et al.*, 1999.

Heat treatment of plant propagation material (3h at 45°C) might be promising (Keck *et al.*, 1995, Bazzi, 1998).

In control of fireblight heavy metals (copper compounds) and antibiotics are effective, but do not give complete control. The latter have especially the problem of resistance development and phytotoxicity. Flumequine (Firestop) is a promising compound as well as fosetyl-Al (Aliette). Only copper compounds and fosetyl-Al (aliette) are registered in Italy (Bazzi, 1998; Cvetkovic *et al.*, 1999; Miglio *et al.*, 1999).

Streptomycin resistance

Streptomycin resistance has been observed in Israel (Manulis *et al.*, 1998)

In Hungary the Maryblight TM prediction program and streptomycin applications appeared to be effective in forecasting and controlling the disease (Kovacs and Nemeth, 1999). Maryblight TM and other forecasting systems like Billing's and Firescreen have been used successfully in the Mediterranean area (Tsiantos *et al.*, 1999; Xu *et al.*, 1999).

Erwinia herbicola and Pseudomonas strains have been used with different degrees of success in biocontrol (Ulke *et al.*, 1999).

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References

Anonimous, 1998. Phytosanitary procedure. Erwinia amylovora. Sampling and test methods. *EPPO Standard*, Paris.

Battilani, P. P., Giosue, S., Racca, P., Rossi, V. 1999. Diagnosis and identification of plant pathogens *Acta Horticulturae* 489: 93-97.

Bazzi C. Burr, T.J., Sule, S., Otten, L. 1998. Crown gall of grape: biology of Agrobacterium vitis and the development of disease control strategies. *Plant disease* [St. Paul, Minn., American Phytopathological Society] 82: 1288-1297.

Bazzi C, Meriggi M., Lopez M.M., Zhang Y., Jock S., Geiger K., Momol M.T., Saygili H. 1999. Differentiation of Erwinia amylovora strains isolated in Southern Europe by PFGE analysis. *Acta Horticulturae* 489: 197-2000.

Bereswill S., Pahl A., Bellemann P., Zeller W., Geider K. 1992. Sensitive and species-specific detection of Erwinia amylovora by polymerase chain reaction analysis. Appl Environ Microbiol. Washington, D.C. : *American Society for Microbiology* 58: 3522-3526.

Bobev S., Garbeva P., Crepel C., Maes M., Hauben L., Momol M.T., Saygili H. 1999. Fire blight in Bulgaria - characteristics of E. amylovora isolates. *Acta Horticulturae* 489: 121-126.

Calzolari A., Finelli F., Ponti I., Mazzoli G.L. 1999. Experiments on the control of fire blight in Emilia Romagna. *Informatore Agrario* 55: 65-67.

Cariddi C., Pace H., Myrta A. 1999. Monitoring of fire bligth in Albania [Malus pumila Mill. - Pyrus communis L. - Cydonia oblonga Mill.]. *Informatore Fitopatologico* 49: 40-44.

Crepel C., Geenen J., Maes M. 1996. The latent survival of Erwinia amylovora in hibernating shoots. *Acta Horticulturae* 411: 21-25.

Cvetkovic B., Halupecki E., Spolijaric J., Momol M.T., Saygili H. 1999. The occurrence and control of fire blight in Croatia. *Acta Horticulturae* 489: 71-77.

Demir G., Gundogdu M. 1993. Fireblight of pome fruit trees in Turkey: distribution of the disease, chemical control of blossom infections and susceptibility of some cultivars. *Acta Horticulturae* 338: 67-74.

Fischer C., Richter K., Momol M.T., Saygili H. 1999. Results on fire blight resistance in the Pillnitz apple breeding programme. *Acta Horticulturae* 489: 279-285.

Geider K, Bazzi C., Lopez M.M., Jock S., Kim W.S., Zhang Y. 1999. Molecular differentiation of Erwinia amylovora strains from Europe and the Mediterranean region. *Beitrage zur Zuchtungsforschung Bundesanstalt fur Zuchtungsforschung an Kulturpflanzen* 5 (1): 7-9.

Gorris M.T., Cambra M., Llop P., Lopez M.M., Lecomte P., Chartier R., Paulin J.P. 1996. A sensitive and specific detection of Erwinia amylovora based on the ELISA-DASI enrichment method with monoclonal antibodies. *Acta Horticolturae* 411: 41-46.

Griffo R., Tartaglia A., Capriolo F., Adamo F. 1998. The fire blight in Campania Pyrus communis L. Erwinia amylovora. *Informatore Agrario* 54 (29): 73-75.

Grimm R., Vogelsanger J., Schoch B., Mani E. 1993. Fire blight in Switzerland situation, monitoring and risks. *Acta Horticolturae* 338: 41-48.

Hale C.N., Taylor R.K., Momol M.T., Saygili H. 1999. Effect of cool storage on survival of Erwinia amylovora in apple calyxes. *Acta Horticulturae* 489: 139-143.

Hassler T. , Scharer H.J., Vogelsanger J., Schoch B., Vignutelli A. 2000. Massive outbreak of fire blight in East Switzerland. *Obst und Weinbau* 136: 16, 387-392.

Hickey K.D. , Orolaza Halbrendt N., Zwet T van der, van der Zwet T, Momol M.T., Saygili H. 1999.The presence of endophytic Erwinia amylovora bacteria in symptomless apple tissue on orchard trees. *Acta Horticulturae* 489: 453-458.

Juen W., Bechter G. 1999.Fireblight reaches Tyrol and Vorarlberg. *Obstbau Weinbau* 36: 4, 131-132.

Keck M. Chartier R., Lecomte P., Reich H., Paulin J.P. 1997 First characterization of Erwinia amylovora isolates from Austria and fire blight susceptibility of some apple genotypes from Central Europe. *Zeitschrift fur Pflanzenkrankheiten und Pflanzenschutz* 104: 1, 17-22.

Keck M., Chartier R., Zislavsky W., Lecomte P., Paulin J.P. 1995. Heat treatment of plant propagation material for the control of fire blight. *Plant Pathology* 44 (1): 124-129.

Kovacs A. and Nemeth, J. 1999. Experiences obtained in 1997-1998 in forecasting fireblight caused by Erwinia amylovora. *Novenyvedelem* 35: 89-96.

Lezec M. le, Laurens F., Michelesi J.C., Lecomte P., Le Lezec M. 1998. Varietal susceptibility of apple and pear to fire blight. *Rivista di Frutticoltura e di Ortofloricoltura* 60 (3): 9-14.

Llop, Bonaterra A., Penalver J., Lopez M.M. 2000. Development of a highly sensitive nested PCR procedure using a single closed tube for detection of Erwinia amylovora in Asymptomatic plant material. *Applenviron microbiol* Washington 66 (5): 2071-2078.

Lopez M.M., Gorris M.T., Llop P., Cambra M., Rosello M., Berra D., Borruel M., Plaza B., Garcia P., Palomo J.L., Momol M.T., Saygili H. 1999. Fire blight in Spain: situation and monitoring. *Acta Horticulturae* 489: 187-191.

Maes M., Garbeva P., Crepel C. 1996. Identification and sensitive endophytic detection of the fire blight pathogen Erwinia amylovora with 23S ribosomal DNA sequences and the polymerase chain reac-

tion. *Plant Pathology* (United Kingdom) 45 (6): 1139-1149.

Manulis S., Zutra D., Kleitman F., Dror O., David I., Zilberstaine M., Shabi E. 1998. Distribution of streptomycin resistant strains of Erwinia amylovora in Israel and occurrence of blossom blight in the autumn. *Phytoparasitica* 26 (3): 223-230.

Mazzucchi, U. 1994. The fireblight monitoring network in northern Italy: origin and development. *Bulletin EPPO* 24: 783-791.

McManus, P.S. and Jones, A.L. 1999. Role of wind driven rain, aerosols, and contaminated budwood in incidence and spatial pattern of fire blight in an apple nursery. *Plant Disease* (USA) 78: 1059-1066.

Miglio G., Gamberini O., Alexandrova M., Bazzi C. 1999. Pear fire blight. Comparison among fungicides [Pyrus communis L.]. *Informatore Agrario* 55 (34): 89-92.

Merighi, M., Sandrini A., Landini S., Ghini S., Girotti S., Malaguti S., Bazzi C. 2000. Chemiluminescent and colorimetric detection of Erwinia amylovora by immunoenzymatic determination of PCR amplicons from plasmid pEA29. *Plant Disease* 84 (1): 49-54.

Momol M.T. and Yegen O. 1993. Fire blight in Turkey: 1985-1992. *Acta Horticolturae* 338: 37-39.

Momol M.T., Norelli J.L., Piccioni D.E., Momol E.A., Gustafson H.L., Cummins J.N., Aldwinckle, H.S. 1998. Internal movement of Erwinia amylovora through symptomless apple scion tissues into the rootstock. *Plant Disease* 82 (6): 646-650.

Palara U., Fornaciari M., Missere D. 1998. The fire blight of pear after one year [Pyrus communis L. - Emilia Romagna] *Rivista di Frutticoltura e di Ortofloricoltura* 60 (9): 22-26.

Paulin, J.P., Chartier R., Brisset M.N., Lecomte P. 1999. Integrated control of fire blight. The French experience [Rosaceae]. *Informatore Fitopatologico* 49 (12): 19-23.

Richter K., Momol M.T., Saygili H. 1999. Detection of Erwinia amylovora cells in apple shoots. *Acta Horticulturae* 489: 511-514.

Saad A.T., Hanna L., Asly O.J., Choueiri E., Momol M.T., Saygili H. 1999 The distribution and host range of the first serious outbreak of fire blight in Lebanon. *Acta Horticulturae* 489: 65-69.

Scartezzini H. 1999. Fireblight crosses the Brenner pass. *Obstbau Weinbau* 36: 219-220.

Severin V., Constantinescu F., Jianu F., Momol M.T., Saygili H. 1999. Appearance, expansion and chemical control of fire blight (Erwinia amylovora) in Romania. *Acta Horticulturae* 489: 79-84.

Tehabsim, A., Masannat K., Janse J.D. 1992. Fire-blight (Erwinia amylovora) on pome fruits in Jordan. *Phytopathologia Mediterranea* 31(2): 117-118.

Tsiantos J., Psallidas P.G., Momol M.T., Saygili H. 1999. Comparison of different fireblight prediction systems under greek climatic conditions. *Acta Horticulturae* 489: 491-494.

Ulke G., Cinar O., Momol M.T., Saygili H. 1999. Biological control studies on fire blight caused by Erwinia amylovora (Burr.) Winslow et al. *Acta Horticulturae* 489: 611-614.

Xu X.M., Billing E., Momol M.T., Saygili H. 1999. Effects of temperature on the length of the incubation period of fire blight on apple, pear and hawthorn. *Acta Horticulturae* 489: 475-481.

Zaccardelli M. and Bazzi C. 1997. Reliability of PCR with primers from plasmid pEA 29 for the detection of Erwinia amylovora. *Phytopathologia Mediterranea* 36: 116-120.

Zang Y., Geider K., Merighi M., Bazzi C. 1998. Genomic analysis by pulsed field gel electrophoresis of Erwinia amylovora strains from the Mediterranean region including Italy [pome fruit trees - fire blight]. *Journal of Plant Pathology* 80 (3): 225-232.