

Regulatory measures against *Erwinia amylovora* in Switzerland*

B. Duffy¹, H.-J. Schärer^{2,3}, M. Bünter², A. Klay⁴ and E. Holliger¹

¹Swiss National Competence Centre for Fire Blight, Agroscope FAW Wädenswil, CH-8820 Wädenswil (Switzerland)

²Plant Inspectorate, Agroscope FAW Wädenswil, Swiss Federal Research Centre for Horticulture CH-8820 Wädenswil (Switzerland); e-mail: markus.buenter@faw.admin.ch

³Research Institute of Organic Agriculture (FiBL), CH-5070 Frick (Switzerland)

⁴Plant Inspection Service, Swiss Federal Office for Agriculture (BLW), CH-3003 Bern (Switzerland)

Switzerland joined the list of fireblight-affected European countries in 1989. Vigorous and systematic steps were taken to limit the impact of the disease on fruit production and amenity plants. These efforts are codified in a Swiss law detailing prevention, eradication, control measures and issues of compensation. As with many Swiss legal directives, there is a defined coordination of federal and cantonal responsibilities and, in the case of fireblight, there is also an emphasis at all levels on personal responsibility of owners of susceptible objects (e.g. nurseries, orchards, host plants). Extension activities have been a key component in achieving compliance with disease management regulations and in obtaining public support for control efforts. Agroscope FAW Wädenswil has taken a leading role in this respect through its website <http://www.feuerbrand.ch>.

Introduction

Fireblight (*Erwinia amylovora*) was first observed in northern Switzerland (Schaffhausen canton) in 1989. The initial observation was made on isolated infected plants of *Cotoneaster salicifolius* and *Cotoneaster dammeri*. Appropriate phytosanitary measures and eradication procedures were put in place immediately. In the following years, the disease was sporadically observed on *Cotoneaster*, *Crataegus* and other wild and ornamental host species. The first outbreak on pome fruit occurred in 1991 (Holliger, 2002). Fireblight has since become established throughout the north-east and central areas of the country, but with isolated occurrences confirmed in nearly every canton. Figure 1 shows spread through Switzerland in chronological order of first infestation observed in each of the 26 Swiss cantons, while Fig. 2 shows spread by commune for particular years. Because the disease poses a sustained threat, Switzerland continues to advocate a control strategy relying heavily on containment and eradication. This article presents the regulatory system underlying the Swiss control effort, which may serve as a useful model for newly affected countries and provide guidance for a pre-emptive strategy to be followed in regions in the advancing path of the disease (Eastern Europe, Central Asia).

General strategy, legal basis and responsibilities in fireblight control

The general strategy that has been developed in Switzerland for the prevention and control of fire blight has three components:

(1) preventing entry into disease-free zones for as long as possible, (2) eradication of disease foci whenever success seems likely and (3) limiting epidemic potential through stringent sanitation measures for the rapid removal of infected plant material that could serve as a reservoir of inoculum. Because *E. amylovora* remains on the federal list of quarantine pests for Switzerland, there is a legal obligation to control the disease even in regions where it has established.

The basis for the Swiss legal regulations concerning the control of quarantine pests is codified in several articles of the Federal Law on agriculture, forestry and environmental protection. In turn, these laws provide the basis for the Plant Health Order that has been in force since 2001. The Swiss Plant Health Order basically follows EU Directive 2000/29, with the general aim of harmonizing phytosanitary measures. In Part 1/Chapter 5 of the Swiss Plant Health Order (SR 916.20), the measures for prevention and control of especially dangerous organisms (quarantine pests) are defined. Several articles together provide the key rules for fireblight. Article 26 prohibits the holding of quarantine pests. Article 27 obliges producers, importers or dealers of host material susceptible to quarantine pests to prevent infestation to the best of their ability and to report suspected or observed infestations. Article 28 directs each canton to organize pest monitoring within its borders. Article 29 specifies the control measures that can be used against quarantine pests, and gives the cantons power to place plants in quarantine, to destroy suspect plant material, to prohibit the planting of host plant species and to enforce preventative removal of host plant species. Article 29 also places legal responsibility on the owner of a plant that could be or is attacked by a quarantine pest. Article 30 allows for the establishment of fireblight-infested regions; and Articles 31 and 32 provide authority for confiscation and destruction of infested plant material.

*Paper presented at the EPPO Conference on Fireblight, Budapest, 2003-10-07/09.

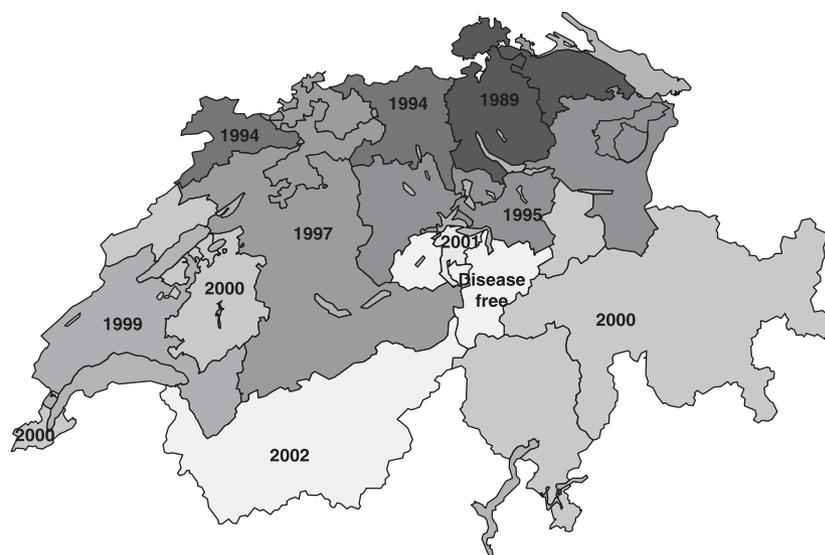


Fig. 1 Fireblight invasion in Switzerland in 1989/2004: year in which cantons first registered an infestation.

Table 1 Responsibilities for control expenses and compensation payments

| | |
|----------------------|--|
| Federal authorities | Establish financial limits Determine exclusions for insignificant damage, private persons Sliding scale of Federal compensation (75–50%) to cantons Repay canton directly |
| Cantonal authorities | Provide experts, consultants and inspectors Decide the extent of controls required (e.g. how drastically to rogue or prune) Determine what qualifies for compensation and at what level Issue payments to growers |

The ultimate legal authority rests with the Swiss Federal Office for Agriculture (Bundesamt für Landwirtschaft, BLW), which issues the rules, guidelines and directions (Table 1). BLW controls the movement of plant material, including plants for planting for nurseries, by means of plant passports, import permits and phytosanitary certificates. The Swiss NPPO has two officers primarily responsible for fireblight activities stationed at Wädenswil in Zürich canton (<http://www.faw.ch>) and at Nyon in Vaud canton (<http://www.rac.ch>). They work together with the BLW to coordinate the supervision of the plant passport system with input from the producer and immediate users of plants for planting. The next level of authority comprises the plant protection entities of the cantons, which issue directives for monitoring and control measures required within their borders. The cantons are actually responsible for the specific implementation of the Swiss plant protection strategy (Schaub *et al.*, 2002), and there are thus differences within Switzerland in how to deal with the threat of fireblight and how to compensate affected producers. Ultimately, Switzerland emphasizes the personal responsibility of producers, plant handlers and proprietors of fireblight host plants, particularly nurseries and orchards but also to a lesser degree private

individuals, to monitor routinely for fireblight and to implement timely control measures when infestations are detected.

Regulatory control measures: prevention, eradication and containment

Quarantine

The first preventive measures applied in Switzerland were import regulations and inspections, with compulsory quarantine of imported host plants (Holliger *et al.*, 2003). Intensive information about the disease, its symptoms and hygiene measures was continuously provided to vulnerable nurserymen and fruit growers. A programme for the preventive destruction of highly susceptible host plants started in 1997, after the first extensive fireblight outbreaks in Switzerland (Bünter *et al.*, 2002; Hasler *et al.*, 2000; Schärer & Hasler, 2000; Schärer *et al.*, 1999). It was observed for several years that, in every region with new occurrences of fireblight, late-flowering high-growing *Cotoneaster salicifolius* was nearly always attacked as the first fireblight host. Destroying these plants had the result of stopping further outbreaks. This was enhanced by public awareness campaigns for the removal and monitoring of susceptible host plants. In any case, movement of host plants for planting was regulated by the European Plant Passport system.

Protected zones

Parts of Switzerland retain the status of protected zones for fireblight (Fig. 3). After each season, each protected zone is re-evaluated to see if it is still necessary and worthwhile to maintain it. A decision scheme for the re-evaluation has been developed. It takes into account the cases of fireblight detected during the previous season (Fig. 4), the effectiveness and seriousness of eradication efforts in the region and the importance of fruit growing in the region. 'Protected Zone'

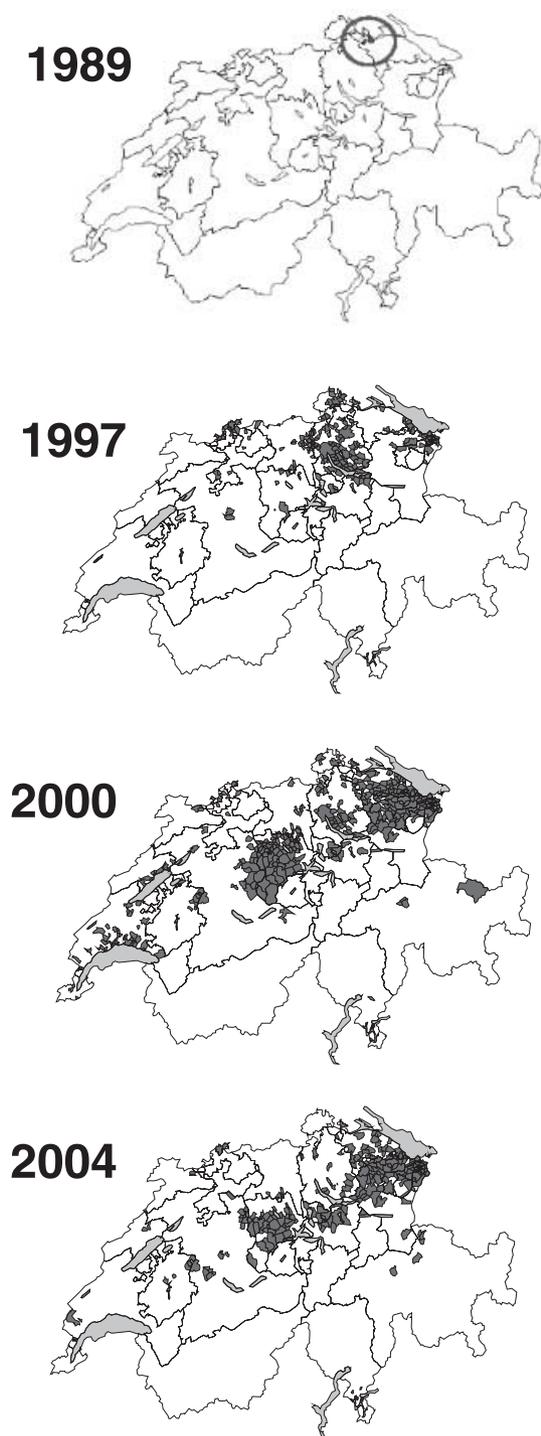


Fig. 2 Spread of fireblight in Switzerland 1989/2004. Shaded communes are those with confirmed infestations in the indicated year. The commune with the first isolated incidence in Switzerland is circled.

status has an impact on the movement of plant material. Plants for planting can only be brought into a protected zone if they originate from a protected zone, or from a nursery with a surrounding buffer zone of at least 50 km².

Whereas the status of protected vs. non-protected zone concerns only the movement of plants of planting, the difference between a 'single focus' and a 'contaminated area' has practical implications for disease control measures. Cases of fireblight at commune level are handled as single foci with the aim of eradication. Intensive control is obligatory around protected objects such as nurseries, orchards and other objects with high-value host plantings (with ecological and/or economic value). If an area has too many cases of fireblight (10 independent incidences), or if fire blight regularly occurs over several years despite eradication efforts (two independent incidences in the past three seasons), a commune is designated as a 'contaminated area'. In a contaminated area, total eradication ceases to be the main aim although removal of blighted shoots or branches is required to minimize inoculum build-up and lessen outbreak severity. The principal difference is that it is not obligatory to destroy entire diseased plants. In contaminated areas, governmental financial support for eradication efforts, and compensation, is generally restricted to protected objects and their vicinity.

Protected objects

The protection of 'objects' is a strategy in contaminated areas to minimize severe outbreaks near nurseries, orchards or other host plant stands with specific importance. Around such specific objects (radius of 500 m), more intensive measures are applied for prevention and control of fireblight. These measures are partly supported by the Federal Government, in contrast to measures in the rest of the contaminated area. It is largely the responsibility of the interested party to register a protected object and to notify authorities of any infringement of regulations (e.g. prohibition of certain plantings within the stated radius of protected objects).

Prohibition of certain plants

Certain susceptible host species have been prohibited in Switzerland. Nationwide, this applies to new plantings of *Cotoneaster* spp. and *Photinia* (*Stranvaesia*) *daurica*. New plantings of *Crataegus* and *Sorbus* spp. are also prohibited within a 500 m radius of registered protected objects in certain cantons. Additional species are prohibited in other cantons (Table 2). To facilitate public acceptance of, and thus compliance with, the prohibitions, Agroscope FAW Wädenswil and collaborators published a pictorial guidebook that offers ecologically suitable alternative species to replace susceptible hosts in gardens and elsewhere (Grimm *et al.*, 2002). Information on availability can be found at www.feuerbrand.ch. This kind of advisory activity for the public has been extremely useful in obtaining broad support for fireblight control efforts, particularly from persons little concerned with the matter.

Beehive movement

Regulations restricting the movement of beehives have been designed to prevent inadvertent long-distance dissemination of



Fig. 3 Protected zones officially designated each year, on the basis of updated information such as presented in Fig. 2.



Fig. 4 Infested communes (shaded) officially designated each year, on the basis of updated information such as presented in Fig. 2 for 2004.

Table 2 Restricted or prohibited species (applicable to new plantings) in Switzerland

| Plant species | Canton | Restrictions |
|--|--|--|
| <i>Cotoneaster</i> spp. and <i>Photinia davidiana</i> | Nationwide | Banned throughout |
| <i>Crataegus</i> spp. and <i>Sorbus</i> spp. | Several cantons | Banned within 500 m of a registered protected object |
| <i>Chaenomeles</i> , <i>Mespilus</i> , <i>Eriobotrya</i> , <i>Pyracantha</i> | Aargau (AG) | Banned throughout |
| <i>Crataegus</i> | Appenzell (AR) | Banned throughout |
| All fire blight hosts except apple, pear, quince | Fribourg (FR), Genève (GE), Schaffhausen (SH), Thurgau (TG) | Banned throughout |

the pathogen by bees, from affected regions to regions considered free from fireblight (Mani, 2002; Mani *et al.*, 1996). At the end of each winter, an annual map delimiting restricted movement zones is issued based on the previous year's data from our monitoring network and diagnostic clinic (Fig. 5). Beekeeper support has been actively sought through advisory programmes explaining the impact of fireblight and the role

of bees in disease epidemiology and by involving beekeeper groups in discussions on this contentious issue.

Monitoring network and prognosis modelling

Monitoring and surveillance for early symptoms are key elements for effective eradication and sanitation strategies. In

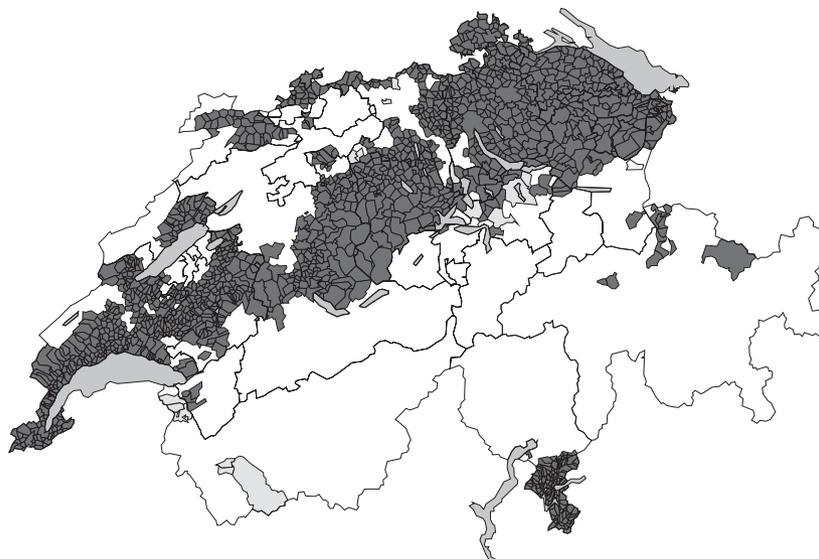


Fig. 5 Officially designated communes where beehive movement is restricted (shaded) as determined each year on the basis of updated information such as presented in Fig. 2 for the upcoming 2005 season.

Switzerland, we have developed an extensive network of monitors enlisting cantonal and communal authorities, growers, pensioners and other volunteers. Regular training for fireblight recognition, and appropriate reporting and sampling procedures, are offered. Cantonal authorities are ultimately responsible for enforcement and implementation of control strategies. We have applied fireblight forecasting models (e.g. Billings and Maryblyt) to determine the probable time frame for symptoms to appear after occurrence of favourable weather conditions for infection. During the flowering period for apple, pear and other host species, local data on flowering and weather are collected from informants and a web of remote weather stations throughout Switzerland, and this information is processed at Agroscope FAW Wädenswil. Predictions from the forecasting models are computed and posted on-line daily for public access (www.feuerbrand.ch). An additional application of prognosis modelling is optimization of biocontrol applications (Johnson *et al.*, 2004). In our 2004 field trials in Berneck (CH) the Maryblyt model was used to alert for favourable infection conditions and ensure timely application of the biocontrol product Serenade (*Bacillus subtilis*) resulting in significant control of blossom blight in a commercial orchard (Holliger *et al.*, 2004).

Fireblight diagnostic clinic

Reliable, sensitive and rapid diagnosis of suspected samples is essential for successful implementation of control measures. A central fireblight diagnostic clinic has been established at Agroscope FAW Wädenswil where samples from all parts of Switzerland are sent (some samples from the French and Italian speaking regions are processed at Agroscope RAC Changins). Diagnosis is offered free of charge for cantonal and local inspectors. Routinely, samples are processed on the same day as they arrive.

The process is as follows: samples are observed and rated for the likelihood of fireblight; potential diseased tissues are removed

with a sterile knife and small pieces (a few g) are placed in tubes with sterile saline solution and shaken at 500 rev min⁻¹ for 15 min; a sterile platinum inoculating loop is dipped in the sample and streaked onto plates of nutrient sucrose agar and King's B medium; after 24–48 h incubation at 27°C, plates are evaluated for typical colonies of *E. amylovora*; suspect colonies are further tested with serum agglutination or nested PCR. These simple plating methods that are used for most samples may not be technologically impressive but their sensitivity and reliability has been affirmed by a recent European-wide ring-test (<http://www.csl.gov.uk/science/organ/ph/diagpro/Erwinia.pdf>). Annually, 3000–5000 samples are processed, the peak period being July–August and samples coming from orchards, nurseries, old overgrown trees, gardens and wild species. Epidemiological data (host, likelihood of infection based on visual observation of sample, collection location, collector identity) is digitally collated and diagnostic results (plating, agglutination, PCR) are transmitted via E-mail: within 72 h to the responsible local authority for implementation of appropriate action. Rapid diagnosis and rapid transmission of the diagnostic results facilitates timely implementation, and the centralization of diagnostics reinforces their credibility. The central databank on collection, location and affected hosts is useful for epidemiological review, and the comparison of visual symptoms with diagnostic results is useful for training purposes.

Economic impact of fireblight and control efforts in Switzerland

The financial burden of these effective control measures (from quarantine to diagnostics), as well as for compensation payments for destroyed plants, are shared by various partners: the Federal authorities, cantonal authorities and owners of host plants). Estimated Federal financial costs of fireblight control efforts in Switzerland were 4.5 million EUR in 1989/1997, 26.5 million EUR in 1998/2002, over 4 million EUR in 2003.

Current focus in the Swiss fireblight strategy is being given to improved diagnostics, biological control (Broggini *et al.*, 2005), screening for fireblight-tolerant apple and pear cultivars (Höhn & Leumann, 2004) and host resistance breeding.

Acknowledgements

An extensive network of coworkers at Agroscope FAW Wädenswil, Agroscope RAC Changins, cantonal authorities, producer and nursery groups, and numerous individuals have contributed to the day-to-day prevention, eradication, containment and control of fire blight. Our common efforts are the only way to ensure the long-term security of domestic fruit production and the Swiss environment.

Les mesures réglementaires contre le feu bactérien en Suisse

La Suisse a rejoint la liste des pays européens affectés par le feu bactérien en 1989. Des pas vigoureux et systématiques ont été faits pour limiter l'impact de cette maladie sur la production de fruits et sur le paysage. Ces efforts sont codifiés dans la loi suisse qui détaille les mesures de prévention, d'éradication et de lutte ainsi que les questions de compensation financière. Comme pour de nombreuses directives réglementaires en Suisse, il existe une définition de la coordination des responsabilités fédérales et cantonales, et dans le cas du feu bactérien, l'accent est mis à tous les niveaux sur la responsabilité personnelle des propriétaires de matériel sensible (par ex. pépinières, vergers, plantes-hôtes). Le travail de proximité a joué un rôle majeur pour arriver à être en conformité avec les réglementations de gestion de la maladie et recueillir des soutiens locaux pour les efforts de lutte. Agroscope FAW Wädenswil a joué un rôle primordial dans ce travail de proximité et maintient l'outil <http://www.feuerbrand.ch>.

Регламентирующие меры против *Erwinia amylovora* в Швейцарии

В 1989 г. Швейцария присоединилась к списку европейских стран, зараженных бактериальным ожогом плодовых. Для ограничения воздействия этой болезни на плодовые и декоративные растения были приняты энергичные систематические меры. Эти усилия оформлены швейцарским законом, определяющим меры по предотвращению, уничтожению, борьбе, а также вопросы финансовой компенсации. Как и во многих швейцарских правовых директивах, здесь предусмотрена

координация федерального и кантонального уровней ответственности и в случае бактериального ожога плодовых на всех уровнях делается упор на личную ответственность владельцев чувствительного материала (например, питомников, садов, растений-хозяев). Консультативная работа стала ключевым компонентом в достижении соответствия инструкциям по управлению болезнью и общественной поддержки усилий по борьбе. Агроскоп FAW Wädenswil взял на себя ведущую роль в этом отношении через свой вебсайт <http://www.feuerbrand.ch>.

References

- Broggini GAL, Duffy B, Holliger E, Schärer HJ, Gessler C & Patocchi A (2005) Detection of the fire blight biocontrol agent *Bacillus subtilis* BD170 (Biopro) in a Swiss apple orchard. *European Journal of Plant Pathology* **111**, 93–100.
- Bünter M, Popow G & Schärer HJ (2002) [Methods for elimination of *Cotoneaster dammeri* after fireblight attack.] *Schweizerische Zeitschrift für Obst- und Weinbau* **138**, 290–294 (in German).
- Grimm R, Jakob F, Monod A, Schärer HJ & Vögeli M (2002) [Alternatives to Fireblight Hosts.] Flugschrift F136, Eidgenössische Forschungsanstalt Wädenswil, Wädenswil (CH) (in German).
- Hasler T, Schärer HJ, Vogelsanger J, Vignutelli A & Schoch B (2000) [Massive outbreak of fireblight in Switzerland – results and measures.] *Schweizerische Zeitschrift für Obst- und Weinbau* **136**, 387–392 (in German).
- Höhn E & Leumann R (2004) [Recommendations for juicing cultivars of fruit crops, from planting to juice quality.] *Schweizerische Zeitschrift für Obst- und Weinbau* **140**, 4–7 (in German).
- Holliger E (2002) [14 years of fireblight in Switzerland.] *Obstbau Weinbau* **39**, 319–322 (in German).
- Holliger E, Schärer HJ, Vogelsanger J, Schoch B & Duffy B (2003) [15 years of fireblight in Switzerland – results and measures.] *Schweizerische Zeitschrift für Obst- und Weinbau* **139**, 8–13 (in German).
- Holliger E, Vogelsanger J, Schoch B, Duffy B & Bünter M (2004) [The fireblight year 2004.] *Schweizerische Zeitschrift für Obst- und Weinbau* **140**, 6–9 (in German).
- Johnson KB, Stockwell VO & Sawyer TL (2004) Adaptation of fire blight forecasting to optimize the use of biological controls. *Plant Disease* **88**, 41–48.
- Mani E (2002) [Stonefruit growing and bee keeping in regions with fireblight.] *Obstbau Weinbau* **39**, 334–335 (in German).
- Mani E, Hasler T & Charrière JD (1996) [To what extent do bees contribute to spread of fireblight?] *Schweizerische Bienen-Zeitung* **119**, 134–139 (in German).
- Schärer HJ & Hasler T (2000) [Fireblight, a slow burner.] *Agrarforschung* **7**, 404–409 (in German).
- Schärer HJ, Hasler T & Vogelsanger J (1999) [Fireblight control: we are entering the next phase.] *Schweizerische Zeitschrift für Obst- und Weinbau* **135**, 343–344 (in German).
- Schaub L, Cazelles O, Beuret B, Colombi L, Emmenegger J, Gemini M, Keimer C, Mayor P, Poitry R, Schärer HJ & Klay A (2002) Les cantons latins luttent contre le feu bactérien. *Revue Suisse de Viticulture, Arboriculture et Horticulture* **34**, 85–91.