CHAPTER THIRTEEN

THE MANAGEMENT OF FIRE BLIGHT

Introduction

13.1 This chapter initially considers the range of management controls used internationally against fire blight, together with the management of fire blight specifically in New Zealand. While the evidence suggests that there is a range of well-developed and successful techniques for its management, fire blight nevertheless remains a dangerous pathogen.

13.2 In turn, the chapter also considers the management of fire blight should it reach Australia. Importantly, streptomycin, the principal antibiotic used against fire blight internationally, is not currently registered for spraying here in Australia. Were it to be so, it raises issues for organic growers and human health.

Alternative Fire Blight Management Practices

13.3 There are a range of controls of fire blight employed internationally, including the use of copper and antibiotic sprays, cultural controls, biological controls, and the use of particular fire blight resistant rootstocks. These are discussed below.

Copper Sprays

13.4 Copper sprays are applied before bud break at the beginning of each season to create a hostile environment for the *Erwinia amylovora* bacterium, making colonisation less likely.[1]

Antibiotic Sprays

13.5 Antibiotic sprays are best applied the day before a blight-occurring event (eg rainfall), since it is unlikely that an antibiotic will have a significant effect when applied more than 24 hours post-infection. [2]

13.6 Accordingly, antibiotic sprays are used in conjunction with a wide range of computer models which have been developed to predict outbreaks of fire blight. They include the Mean Temperature Line Model, MaryBlight and more recently CougarBlight in the USA, the Billing's Integrated System 95, and FireWork in New Zealand.

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1 Submission 42A, p 9

2 Submission 42A, p 9

13.7 Various studies have shown that these models are reasonably accurate in predicting fire blight infection periods, facilitating antibiotic spraying ahead of them in time to prevent outbreaks.[3] For example, using computer modelling, Gouk (1996)[4] predicted four fire blight events in Hawke's Bay and five in Waikato orchards in November 1994. All of these predictions were accurate, with symptoms of fire blight occurring either on the day, or within a day of the dates they were expected to appear.

13.8 The primary antibiotic used against fire blight is streptomycin. The Committee notes however that increasing resistance to streptomycin has been reported around the world. Longstroth writes:

> Streptomycin has been the single bullet for fire blight control and it will be several years before chemicals in the registration pipeline will be available to replace it. Streptomycin resistant fire blight was found in the Michigan county of Van Buren in 1990 and had spread country-wide by 1999.[5]

13.9 Similarly, the Gippsland Fruitgrowers' Association cited research by Matthews in *The Orchardist* in New Zealand in March 1997:

> Streptomycin resistant strains of *Erwinia amylovora* (the causal agent of fire blight) have been found in the USA and other countries since 1972. In New Zealand, some resistant strains have been found in Hawke's Bay.[6]

13.10 In addition, research in Israel over a four-year period from 1994-98 recovered streptomycin-resistant strains of fire blight from 25 locations including the Sharon, Galilee and the Golan Heights. Accordingly, since 1997, streptomycin has been withdrawn from fire blight control programs in Israel and replaced with oxoninic acid (Starner). The research continued:

> The presence of resistant strains during the autumn in pear and loquat orchards may form a continuous source of inoculum for the spring blossom.[7]

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3 See for example B.A.Holtz, B.Teviotdale and T.Turini, 'Comparison of Models to Predict the Occurrence of Fire Blight in the San Joaquin Valley of California' in M.T.Momol & H Saygili, *Proceedings of the Eighth International Workshop on Fire Blight*, (Acta Horticulturae No 489, International Society of Horticultural Science, 1999), p 437. See also G.Demir & N.Ustun, 'Comparison of Different Prediction Systems for Blossom Blight Risk Assessment on Pear and Apple in the Aegean Region of Turkey' in M.T.Momol & H Saygili, *Proceedings of the Eighth International Workshop on Fire Blight*, (Acta Horticulturae No 489, International Society of Horticultural Science, 1999), p 413

4 S.C.Gouk, 'HortResearch Publication - Computerised Weather Monitoring and Disease Predictive Systems to Predict Fire Blight Outbreaks on Pipfruit', HortResearch, Ruakura Research Centre, Hamilton. http://www.hortnet.co.nz/publications/science/cgouk.htm (1996).

5 Cited in Submission 22, p 15

6 C.Matthews, Fire Blight – Biological Control under Study, *The Orchardist*, (March 1997)

7 S.Manulis, D.Zutra, F.Kleitman, O.Dror, E.Shabi, I.David & M.Zilberstaine, 'Streptomycin Resistance of *Erwinia Amylovora* in Israel and Occurrence of Fire Blight in Pear Orchards in the Autumn', in M.T.Momol and H.Saygili (eds), *Proceedings of the 8th International Workshop on Fire Blight*, (1999), p 85.

13.11 In evidence, Prof Aldwinckle indicated to the Committee that resistance to streptomycin by *Erwinia amylovora* builds up most rapidly in areas where the bloom period is long, and several applications of streptomycin are required each season to control fire blight. Accordingly, streptomycin resistance is widespread in the western states of the United States, where the bloom period is longer, whereas streptomycin resistance has not been reported in New York state, where the bloom is short and fewer sprays of streptomycin are used each year.[8]

13.12 In western states of the US where *Erwinia amylovora* has developed a resistance to streptomycin, terramycin is used as an alternative. However, terramycin is generally less effective than streptomycin. The United States Department of Agriculture states in *Fire Blight – Its Nature, Prevention and Control: A Practical Guide to Integrated Disease Management*:

> In some apple and pear orchards in the West and Midwest, as well as in some Middle Eastern countries, strains of *E. amylovora* that are resistant to streptomycin have been recovered. In these orchards, the antibiotic is ineffective, and oxytetracycline of copper compounds must be used to control fire blight. Oxytetracycline (terramycin), recommended at 200 ppm, is effective against the streptomycin-resistant strains, but is generally less effective than streptomycin against streptomycin-sensitive strains of *E. amylovora*. Kasugamycin is a third antibiotic used for fire blight control in some countries.[9]

13.13 In evidence to the Committee, Dr Zoller indicated however that terramycin is not available for use on orchards in California, with the result that growers have faced considerable difficulties during certain years.[10]

13.14 Given the increasing resistance of *Erwinia amylovora* to streptomycin, the Committee notes research by Bocker *et al* (1998), reported at the proceedings of the 8th International Workshop on Fire Blight, on the development of a new water-soluble agent for the control of *Erwinia amylovora* called nourseothricin. Bocker *et al* indicated that nourseothricin is about as effective as streptomycin in the control of *Erwinia amylovora*, and has only a low degree of toxicity, with no signs of damage to other flora, fauna and soil:

> We are inclined to believe the antimicrobial effective nourseothricin provides a favourable alternative to streptomycin for control of fire blight …[11]

8 Evidence, RRAT, 29 March 2001, p 373

9 United States Department of Agriculture, *Fire Blight –Its Nature, Prevention and Control: A Practical Guide to Integrated Disease Management*, Agriculture Information Bulletin No 631, p 78

10 Evidence, RRAT, 29 March 2001, p 398

Biological Controls

13.15 There is a range of biological controls for *Erwinia amylovora*. The biological agent BlightBan is a bacterium that can be introduced to pome fruit early in the season to protect newly opened flowers from subsequent infection by *Erwinia amylovora*. While BlightBan has been successful in reducing fire blight infections by up to 50 per cent in field tests, the evidence on its widespread use is at present limited.[12]

13.16 Dr Wimalajeewa also indicated in hearings that scientists in New Zealand have identified an organism similar to *Erwinia amylovora*, *Erwinia herbicola*, the genes of which can be substituted into *Erwinia amylovora* to render it less harmful. This work is still ongoing.[13]

13.17 Research has also been published by Thomson *et al* (1996) on the treatment of apple and pear tree seedlings with the chemical agent benzo [1,2,3] thiadiazole-7-carbonothioic acid-S-methyl ester (BHT), to induce systemic acquired resistance to fire blight. It found that:

> Control by BHT was usually equal to or better than streptomycin on apple seedlings but not as effective as streptomycin on pear seedlings.[14]

13.18 Finally, Professor Aldwinckle informed the Committee in hearings on 29 March 2001 of the development of other biological control agents such as Messenger, which induces a natural resistance to *Erwinia amylovora*, or Aperchi, which is a growth regulator used to control infection of the shoots. As stated by Professor Aldwinckle:

> There are other materials beside streptomycin that are coming along. I would not say that you should base controls in the future on streptomycin.[15]

Cultural Control

13.19 As discussed elsewhere in this report, pruning is widely used to limit the extent of damage of *Erwinia amylovora* to individual trees and to remove sources of

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11 H.Bocker, A.Prokop, M.Hilliger, P.J.Muller, K.Naumann, M Natchigall, K.Richter and H.Bergmann, 'Nourseothricin – A New Agent for Control of Fire Blight' in M.T.Momol & H Saygili, *Proceedings of the Eighth International Workshop on Fire Blight*, (Acta Horticulturae No 489, International Society of Horticultural Science, 1999), p 541-544

12 M.T.Momol, J.L.Norelli & H.S.Aldwinckle, 'Evaluation of Neological Control Agents, Systemic Acquired Resistance Inducers and Bactericides for the Control of Fire Blight on Apple Blossom' in M.T.Momol & H Saygili, *Proceedings of the Eighth International Workshop on Fire Blight*, (Acta Horticulturae No 489, International Society of Horticultural Science, 1999), p 553

13 Evidence, RRAT, 13 February 2001, p 145

14 S.V.Thomson, M.N.Brisset, R.Chartier and J.P.Paulin, 'Induced Resistance in Apple and Pear Seelings to Fire Blight by Bion® and Correlation with some Defence-Related Enzymes' in M.T.Momol & H Saygili, *Proceedings of the Eighth International Workshop on Fire Blight*, (Acta Horticulturae No 489, International Society of Horticultural Science, 1999), p 583

15 Evidence, RRAT, 29 March 2001, p 377

inoculum that might lead to further distribution of the bacterium. The Western Australian Fruit Growers' Association claimed that aggressive pruning programs can greatly reduce fire blight incidence.[16]

13.20 At the same time, the Committee notes research by Norelli *et al* (1999) evaluating the effectiveness of pruning in the USA during the growing season between 1995 and 1997. They found that pruning appeared to have no effect on the eventual fate of the rootstock (ie whether or not it died), but that 2-3 years of consecutive pruning appeared to reduce fruit yield by over 60 per cent.[17]

13.21 In addition, research by Wilton (AgFirst Consultant with Hawke's Bay Ltd in New Zealand) published in *The Orchardist* in 1998 states that:

> With the level of infection experienced on many orchards last season it's not practical or even possible to prune out all over-wintering fire blight cankers.

13.22 Finally, reducing humidity in orchards can also help to manage fire blight. This is because moisture on blossoms aids the infection process. Humidity can be reduced by reducing irrigation during critical infection periods.

Fire Blight Resistant Rootstocks

13.23 The Committee notes research by Borejsza-Wysocka *et al* (1999), reported at the proceedings of the 8th International Workshop on Fire Blight, into increasing the resistance of rootstocks to fire blight, notably the M26 variety. Borejsza-Wysocka *et al* (1999) reported that they had successfully transformed the M26 rootstock with a lytic protein, attacin E, which they are currently evaluating for resistance to fire blight by inoculation with *Erwinia amylovora.*[18]

13.24 However, in hearings, Mr Green from the South Australian Pome Fruit Improvement Committee suggested that the availability of fire blight resistant root stock is still about 15 to 20 years away.[19] A similar timeframe was nominated by Professor Aldwinckle during hearings on 29 March 2001.[20]

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16 Submission 42A, p 9

17 J.L.Norelli, H.S.Aldwinckle, M.T.Momol & A.De Maree, 'Effect of Pruning and other Orchard Factors on the Rootstock Phase of Fire Blight' in M.T.Momol & H Saygili, *Proceedings of the Eighth International Workshop on Fire Blight*, (Acta Horticulturae No 489, International Society of Horticultural Science, 1999), p 509

18 E.E.Borejsza-Wysocka, J.L.Norelli & K.Ko, 'Transformation of Authentic M26 Apple Rootstock for Enhanced Resistance to Fire Blight' in M.T.Momol & H Saygili, *Proceedings of the Eighth International Workshop on Fire Blight*, (Acta Horticulturae No 489, International Society of Horticultural Science, 1999), p 259

19 Evidence, RRAT, 15 February 2001, p 226

20 Evidence, RRAT, 29 March 2001, p 372

The Management of Fire Blight in New Zealand

13.25 Fire blight is controlled in New Zealand through a range of management processes, including pruning, the use of copper sprays in early spring or after leaf fall, and the application of streptomycin based on computer models for predicting fire blight infection periods. As discussed above, some streptomycin resistant strains of *Erwinia amylovora* have now been detected in certain areas in Hawke's Bay.[21]

13.26 During the Committee's visit to New Zealand, the Horticulture and Food Research Institute of New Zealand presented the Committee with data on the average number of streptomycin applications in a season. The Committee cites the research presented by HortResearch in Table 13.1 below.

Table 13.1: Average Number of Annual Streptomycin Applications by Region of NZ

No of Applications	1996-97		1998-99		1999-00	
	Apple	Pear	Apple	Pear	Apple	Pear
Auckland	0.01	-	0.08	-	0.03	-
Gisborne	0.49	1.69	1.18	-	0.51	1.50
Hawke's Bay	0.16	1.03	0.36	1.43	0.38	1.23
Marl	0.10	-	0.18	0.32	0.10	0.14
Nelson	0.02	0.19	0.04	0.27	0.03	0.15
Otago	0.02	1.04	0.04	0.50	0.04	0.53

Source: D.Mankteolw & G.Tate, *Fire Blight Management and Beyond*, tabled document

13.27 In the draft IRA, BA cited research suggesting that fire blight is no longer considered a major problem associated with apples in New Zealand. In some areas, minor localised damage due to fire blight occurs almost annually, however significant disease outbreaks only occur approximately once a decade.[22] In support, BA cited Hale *et al* (1996)[23] from the Horticulture and Food Research Institute of New Zealand:

> Fire blight, caused by *Erwinia amylovora* (Burrell) Winslow *et al*, is of little significance in apple production but occasionally causes loss of flowers in some areas of New Zealand.[24]

13.28 Similarly, the New Zealand Government argued in its written submission that the management of fire blight is not difficult:

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21 Biosecurity Australia, Draft Import Risk Analysis on the Importation of Apples from New Zealand, October 2000, pp 110-111

22 *Ibid*, p 110

23 C.N.Hale, R.K.Taylor & R.G.Clark, 'Ecology and Epidemiology of Fire Blight in New Zealand', *Acta Horticulturae*, (Vol 411, 1996), pp 79-85

24 C.N.Hale, R.K.Taylor and R.G.Clark, 'Ecology and Epidemiology of Fire Blight in New Zealand' in W.G.Bonn (ed), *Seventh International Workshop on Fire Blight*, (Acta Horticulturae No 411, International Society of Horticultural Science, 1996), p 79

> Fire blight is a recurrent nuisance that is kept under control by effective orchard management techniques and which has little impact on the production of New Zealand's high quality fruit. Some parts of the country are barely affected at all because of climatic conditions.[25]

13.29 The Committee was also presented with evidence by Mr Ivess from MAFNZ during its visit to Wellington that fire blight is regarded as a relatively unimportant disease of apples in New Zealand.[26]

The Management of Fire Blight should it reach Australia

The Availability of Streptomycin

13.30 Responsibility for the registration of antibiotics for use in Australia rests with the National Registration Authority (NRA). At present however, the NRA does not register any antibiotics for spraying in Australia against a potential fire blight outbreak, including streptomycin and terramycin.[27] The AAPGA stated in its written submission that:

> The industry is concerned that if a fire blight outbreak did occur and the disease were to become established, there would be very little opportunity to obtain a registration for a chemical of fundamental importance to apple growers in New Zealand. New Zealand growers would have a competitive advantage compared to their Australian counterparts.[28]

13.31 The Committee notes that during the outbreak of fire blight in the Royal Botanic Gardens in Melbourne, the NRA made an emergency registration of streptomycin. In hearings, JA & BM Bowden & Sons cited a fax from Mr Raphael of the NRA to Mr Johnson Bowden, dated 21 November 2000. Mr Raphael indicates that the NRA was prepared to make an emergency issue of streptomycin at the time of the outbreak of fire blight in the Melbourne Botanic Gardens, but that

> The question of registration of streptomycin for regular and on-going use against fire blight is a quite different matter. A significant issue to be considered would be the possibility of development of resistance to streptomycin among bacteria, and the transfer of such resistance to humans. Extensive data and evaluation would be required to address this issue, and the NRA could not forecast what advice on the matter we might receive or what our decision would be.[29]

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25 Submission 24, p 1

26 Meeting between the Committee and officials from MAFNZ and MFATNZ, Wellington, 15 May 2001

27 Evidence, RRAT, 11 May 2001, p 463

28 Submission 33, p 52

29 P.Raphael, Fax to Mr J.Bowden, 21 November 2000. Cited in J.Bowden, Tabled Documents, 9 March 2001

Organic Growers

13.32 In its written submission, the Organic Federation of Australia, the peak industry body representing organic farmers, argued that if *Erwinia amylovora* were to reach Australian orchards, use of antibiotics to combat it would be contrary to the requirements of the Australian National Standard for Organic and Biodynamic Production:

> A fire blight infection in an organic orchard would pose a significant problem that may necessitate the orchard using chemicals banned under organic certification, thereby losing organic status and price premiums.[30]

13.33 The Committee heard from Mr Banks on behalf of the Organic Federation of Australia at its hearing in Wagga Wagga on Friday, 9 March 2001. Mr Banks reiterated that organic growers forced to use streptomycin would immediately lose their organic status.[31]

13.34 The Committee also received a number of submissions from individual Australian growers. In its written submission, YV Fruit indicated that as an organic grower, YV Fruit relies on pest management techniques such as mating disruption and predators to control pests, rather than insecticides:

> Leaders in horticulture around the world are seeking ways to minimise chemical inputs, thereby minimising off target impacts (spray drift, eutrophication, contamination of water resources), but the introduction of Fire blight is counter productive to these aims. We see the introduction of New Zealand apples and the imminent entry of Fire blight into Australia if this occurs as undermining our ability to be producers of clean, green fresh fruit for sale in the export markets of Europe and around the world.[32]

13.35 Similarly, the Committee received a submission from Forest Orchards, an organic grower in the Adelaide Hills. Forest Orchards argued that the introduction of fire blight would have a devastating impact on its business due to the lack of any biological controls of fire blight.[33]

13.36 The Organic Federation of Australia also raised the possibility in its written submission that in response to the incursion of *Erwinia amylovora*, the Federal Government or state governments would legislate to require the use of antibiotics to control the disease, thereby compromising the position of organic growers.[34]

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30 Submission 5, p 2

31 Evidence, RRAT, 9 March 2001, p 399

32 Submission 16, p 1

33 Submission 32, pp 1-3

34 Submission 5, p 3

Human Health

13.37 During the conduct of the inquiry, various parties raised the possibility that the widespread use of streptomycin would lead to increased human resistance to antibiotics. Streptomycin is part of the aminoglycoside group of antibiotics, which include gentamycin, one of the most important antibiotics used in cases of extreme infection.[35]

13.38 In this regard, the Organic Federation of Australia noted in its written submission that the medical profession is pushing for a reduction in the use of antibiotics, and that animal industries are under pressure to reduce the widespread use of antibiotics in animal feed.[36]

13.39 Similarly, the Mornington Peninsula Fruit Growers' Association advised in its written submission that in the USA last year, 11,000 kg of streptomycin were used to control fire blight, but suggested that this antibiotic has never been examined to determine its effects on the health of the environment.[37]

13.40 In addition, Mr Ranford from the APGASA noted that the Adelaide Hills is a major producer of wine, and is also a major water catchment area for Adelaide. Accordingly, he raised the possibility that health authorities would place a restriction on the use of streptomycin in the area for health reasons.[38]

13.41 The Committee notes however that the level of streptomycin residue on apples from New Zealand would be insignificant.

13.42 In this regard, ANZFA noted in its written submission that the *New Zealand (Maximum Residue Limits for Agricultural Compounds) Mandatory Food Standards 1999* does not include a specific Maximum Residue Limit (MRL) for streptomycin on apples. However, the New Zealand legislation does have a general "default" limit of 0.1ppm, which apples imported into Australia from New Zealand would need to meet.[39] In hearings, Mr Roche from ANZFA suggested that:

> … the fact that New Zealand has not set an MRL for streptomycin would be an indication that it would be unlikely to leave a residue.

13.43 By contrast to the New Zealand legislation, the Australian *Food Standards Code* currently does not include a default limit. However, in hearings, Mr Roche from ANZFA alerted the Committee to the recent findings of the Joint Expert Technical

35 Evidence, RRAT, 9 March 2001, p 409

36 Submission 5, p 3

37 Submission 15, p 2

38 Evidence, RRAT, 15 February 2001, p 217

39 BA, Response to Questions on Notice, 13 February 2001

Advisory Committee on Antibiotic Resistance (JETACAR), established by the Australia New Zealand Food Standards Ministerial Council:

> The Joint Expert Technical Advisory Committee on Antibiotic Residues … whose report came down over 12 months ago now, did not consider streptomycin specifically as being one of the [bacteria] which has created particular problems with antibiotic resistance.[40]

13.44 It is expected that in the foreseeable future, JETACAR will announce further antibiotic maximum residue limits, including possibly for streptomycin.[41]

13.45 In the meantime, the Committee notes that under the Trans-Tasman Mutual Recognition Agreement with New Zealand, food may be imported into Australia from New Zealand without inspection, provided it is not a food risk. Apples are not currently classified as a food risk.[42]

40 Evidence, RRAT, 11 May 2001, p 445

41 Evidence, RRAT, 11 May 2001, p 438

42 BA, Response to Questions on Notice, 13 February 2001