

**Department of Economics and Marketing
Discussion Paper No.44**

**The Search for Rules for Non Tariff
Barriers: Fire Blight of Apples**

*Harvey Smith
Ralph Lattimore*

December 1997

**International Trade Policy Research Centre
Department of Economics and Marketing
PO Box 84
Lincoln University
CANTERBURY**

Telephone No: (64) (3) 325 2811

Fax No: (64) (3) 325 3847

E-mail: lattimor@Lincoln.ac.nz

**ISSN 1173-0854
ISBN 1-877176-21-4**

Paper presented to the International Agricultural Trade Research Consortium (IATRC) Meeting, San Diego, California, December 14-16, 1997.

Harvey Smith, formerly Director, Crop Research Division, DSIR, Lincoln
Ralph Lattimore, Agmardt Professor of International Trade Policy, Lincoln University

Contents

1.	Introduction	1
2.	Fire Blight Transmission	2
3.	Trade in Apples, Australia and New Zealand	3
4.	Economic Importance of Fire Blight	5
5.	Control Measures for Fire Blight	6
6.	New Zealand and Australian Negotiations	6
7.	Risk of Entry on Apples	9
8.	The Japan - US Fire Blight Saga	11
9.	Summary Framework and Conclusions	12
	References	16

1. Introduction

An appropriate objective for trade policy ought to be to maximise imports. Unfortunately, trade policy negotiators get very caught up in the facilitation of this objective by necessarily arguing about access for exports, Krugman (1997). In this context, a very long list of issues have developed over the last 75 years which are being used as barriers to trade. These technical barriers to trade, as Hillman (1991) called them, have become very prominent in recent years in part because processes are now in place to deal with tariffs and quotas and that has exposed a myriad of restrictions below the surface of traditional trade policy.

One of these issues concerns bio-security: our attempts to manage the risks associated with pests and diseases in national and international eco-systems. As in all topical political areas, bio-security is difficult to deal with because a mythology surrounds the issues creating significant divergence between the expectations of the polity and reality. Consider the area of risk perceptions and the use of growth promotant hormones in beef cattle as an example. The World Trade Organisation (WTO) has employed international scientific panels to show that the naturally-based growth promotant hormones are very unlikely to be harmful to humans. The hormones occur naturally and cannot be detected where they are artificially injected into cattle. Furthermore, the hormones are probably being used in the European Union (EU) in any event. Nevertheless, the EU continues to resist the importation of American (US) beef which might contain these substances.

The disease, fire blight has a number of parallels with the growth promotant hormone case. This paper examines the fire blight case with a view to attempting to devise principles that might be used to ensure that foreign suppliers are accorded national treatment in the spirit and letter of international trade law.

A number of frameworks in economics are useful in this context. Resource constraints exist in attempting to manage bio-security and other risks. This is the basis of an economic problem but this framework is also embedded in the philosophy of sustainable systems as well, Godlovich (1997). The risk of malarial infection, foot and mouth disease, cancer, fire blight, etc can be reduced but there are important tradeoffs involved. We cannot reduce a pest or pathogen risk to zero, with finite resources.

Political economy theory is useful positively and normatively to analyse the behaviour of politicians, bureaucrats, lobbyists and scientists as well as the consumer and producer groups involved (Horn, 1995). For example, bureaucrats have an incentive to act conservatively (risk averse) but such responses can add to compliance costs which themselves become technical barriers to trade. Game theory under uncertainty (Gul, 1997) also has a contribution to make as there are elements of the ‘technical barrier to trade’ problem which parallel the cold war disarmament process which Harsanyi originally worked on.

We first tell the fire blight story in this paper and then attempt to draw out approaches that offer some prospect of contributing to the national ‘treatment’ goal. That is, the WTO principle safeguarding the equal treatment of exporters with domestic producers.

2. Fire Blight Transmission

Australia maintains a ban on imports of apples from New Zealand on the grounds that the bacterial disease fire blight might be imported into the country. Japan maintained a ban against United States and New Zealand apple exports till 1993 on the same grounds. In both cases there have been extensive bilateral negotiations. These negotiations and the scientific evidence upon which they are based raise important issues for the Sanitary and Phyto-Sanitary (SPS) and Technical Barriers to Trade (TBT) Agreements under the World Trade Organisation (WTO).

Fire blight is the first recorded bacterial disease of plants. It had been recognised in New York State in 1780 but it was originally thought to be caused by lightning, heat scald, frozen sap, and insects. In 1880 a professor at the University of Illinois proved that the disease was associated with a bacterium (*Erwinia amylovora*). This finding was later confirmed by Professor Erwin F Smith at Cornell University in 1884. However, it was many years before scientists generally accepted that bacteria could cause plant disease.

Fire blight caused losses in apple and pear crops in the Eastern States of US and this resulted in apple and pear growing moving west to the cooler and drier valleys of Washington State and California (van der Zwet and Beer, 1991). Fire blight spread gradually throughout the US

and Canada and eventually arrived in California in the early 1900's. It was first recorded in Japan at about the same time (Beer et al. 1996).

Fire blight arrived in New Zealand in 1919 (Cockayne, 1920), and over a period of ten years it spread throughout the orchard areas of the country. The disease had spread to England by 1957, Egypt by 1964 and mainland Europe (Netherlands) by 1966. In the following 24 years it spread throughout most of Europe and the Middle East (Israel, Turkey, Jordan, and Lebanon) (van der Zwet, 1996). The first record of its presence in Australia was in April 1997 when it was identified by a New Zealand scientist who was visiting the Melbourne Botanical Gardens (Christchurch Press, May 10, 1997). The identity of the disease was confirmed by Australian and German scientists and announced by Dr Bill Roberts of the Australian Quarantine and Inspection Service in June (Christchurch Press, June 16, 1997).

3. Trade in Apples, Australia and New Zealand

Up until 1920 there was free movement in all primary produce including pip fruit and nursery plants between Australia and New Zealand. After 1920 Australia placed a prohibition on the import of nursery trees known to be susceptible to fire blight because of the occurrence of this disease in New Zealand. The eminent New Zealand scientist, Cockayne (1920 and 1921) had stated that fire blight was a serious disease and that it might cause pear growing to be abandoned. It is likely that Australia also decided to place a ban also on the import of pip fruit (apples and pears) from New Zealand because of this statement, even though the most likely method of arrival of fire blight in New Zealand was by the import of apple or pear nursery trees from California (Cockayne 1920, Cunningham, 1925).

New Zealand and Australia both expanded their pip fruit industries in the 1920s as part of the World War I soldier resettlement programme. This programme was targeting the increasing demand for pip fruit in the United Kingdom and Europe. Until the 1970s Australian apple exports dominated this market because they had a much larger orchard area and production. At this time both countries were growing essentially the same apple and pear varieties under the same system of production and marketing and there was little interest in pip fruit trade between the two countries.

In New Zealand however, there had been a large fruit research programme on developing new apple varieties, production systems, and marketing methods. These contributed to greater profitability and resulted in a rapid expansion in apple growing and exports. The New Zealand export apple crop increased from 3.9 m. cartons (18kg) in 1973 to 12.7 m. in 1993. In the same period Australian apple exports declined from 7m. cartons in 1973 to only 1.4 m. in 1993 (Smith, 1997). The main reason for the decline in Australian apple exports was that they continued growing the older less profitable varieties and did not adopt the intensive growing systems and new marketing methods. This inefficiency in production was largely due to their own domestic market being totally protected and a loss of cost competitiveness in Australia due to subsidisation. There has been virtually no imports of apples, or other pip fruit into Australia since 1920.

The differences in policy appear to be having important effects on the relative performance of apple markets in the two countries. This shows up in retail apple prices. In Australia in April 1997 apples sold at retail between \$2.99 and \$3.99 per kg. while in New Zealand the prices were between \$0.59 and \$1.50 per kg for fruit of equal and even better quality. The Australian consumer appears to be paying a high price for having this totally protected market. By contrast, the New Zealand apple market has been open to competition from both North America and Australia for many years.

New Zealand has been trying to gain access to the Australian apple market since 1986. The first application was rejected in 1988. After considerable negotiation and the development of an inspection protocol for fire blight, the revised application was again declined (because of fire blight risk) in November 1990 (AQIS, 1990). The most recent application, based on New Zealand and overseas research, showed that commercial apple fruit were not a fire blight risk. It was submitted in December 1995 and declined again (on fire blight risk grounds) in April 1997 (AQIS, 1997). The recent confirmation of the presence of fire blight in Australia has not yet resulted in any change in Australian policy.

4. Control Measures for Fire Blight

In the first few years after the disease arrived in New Zealand, some small pear orchards were removed because of severe fire blight infection. The disease was thought to be a possible threat to the whole pear industry. However at present, even in pear orchards the disease is of minor importance and only kills trees in young orchards in occasional years if control methods are neglected. In apple orchards even in the warmer North Island the disease is of minor importance and only rarely are control methods (spraying and pruning) used to reduce damage to branches. No loss in fruit production has been recorded, and no infection has been found on mature apple fruit (Hale et al., 1996).

The normal orchard operations of pruning and spraying are usually quite adequate to prevent serious outbreaks of infection in most temperate apple and pear growing districts. Pruning out infected shoots and the application of copper or antibiotic sprays are key measures to reduce orchard infections.

Spray applications have to be very carefully timed in relation to the weather conditions before and during flowering to be successful and of economic value. However, in cooler apple growing areas such as New Zealand (even though fire blight is common on ornamentals such as *Cotoneaster*, and *Crataegus* species) there is very little winter carry over infection in orchards and spraying is seldom used because it has not yet been shown to be of any economic value (Gouk *et al.*, 1996). It has also been suggested that one of the main factors causing the lower virulence of fire blight in New Zealand is the high level of competitive saprophytic bacteria on the orchard trees, particularly *Erwinia herbicola* (Thomson and Hale, 1987).

5. Economic Importance of Fire Blight

Fire blight has now spread to over 37 countries throughout the world, from two (US and Japan) at the beginning of the century (van der Zwet, 1996). The only apple exporting regions where it has not yet been recorded are in the Southern Hemisphere: South Africa and South America. The only important apple exporting countries which are still free of fire blight are South Africa and Chile.

The disease has the potential, rarely, to cause considerable damage in warm climates (Smith, T J 1997). The serious outbreak in Southern California in 1901 to 1904 caused 95% of pear trees (150,000 trees) to be killed or removed because of fire blight in the San Joaquin Valley. These orchards were never replanted in pears (Reil et al. 1979). Another serious outbreak occurred on pear trees in Egypt in the 1980s.

In the USA in recent years there have been attempts to estimate the losses from fire blight but this has proved to be difficult to do accurately. The incidence of severe infection is very sporadic and severe infection may occur only in occasional years when weather conditions are very favourable. The average annual losses in the USA during the 1950s was estimated at about \$4 m. (Zwet and Beer, 1991). This loss represented around 8 percent of the value of the crop¹. In a 1976 survey, California reported a loss of \$4.7 m. mainly in pears. In 1991 a severe outbreak in Michigan resulted in estimated losses of \$3.8 m. dollars. In the drier, cooler Washington State, fire blight can be serious but only in occasional years in a low percentage of orchards (Smith T J, 1996). The orchards in Washington State are very efficiently managed and have produced very high quality apples for export to many countries throughout the world.

In the United Kingdom where fire blight has been present for over 40 years, and in Europe where many countries have been infected for over 20 years, there have been no reports of serious losses in commercial apple crops. The only reports of fire blight losses have been in occasional years in some late flowering varieties of apples and pears grown specially for cider and perry production (Gwynne, 1984).

6. New Zealand and Australian Negotiations

Australia and New Zealand are both signatories to the WTO (GATT) agreements in world trade. They have both taken a very active role in the negotiations on the formulation of policy, standards, rules and regulations in sanitary and phytosanitary (SPS) and technical barriers to trade (TBT) agreements. They are also both deeply involved in the international plant

¹ Based upon USDA data, Agnes Perez, pers comm.

protection convention (IPPC) and its regional organisations which endeavour to set standards for trade and the movement of plant material to prevent the spread of pests and diseases of plants.

The escalation and proliferation of regulating and rule making organisations and committees has led to confusion, and the lack of progress in negotiating conflicts raises the question as to whether the costs of these negotiations result in a far greater cost to the consumer than the actual losses which would occur with the unrestricted movement of plant pests and diseases.

The cost benefit analyses that have been prepared in the past (AQIS, 1990 p.19. AQIS, 1997 p.4) appear to have grossly over estimated the potential losses from the incursion of fire blight into Australia. The various estimates made in Australia have suggested that annual losses would range between \$125 m. and \$165 m. per annum; for the Goulburn Valley \$77 m. per annum, and for Queensland \$20.9 m. per annum. This assumes that all areas would be infected simultaneously. This is an unrealistic assumption and leads to very high estimates for a country where the total value of the apple and pear crop in 1994-5 was \$346 m, suggesting that the losses would be about 30% of the total crop. This estimate may be compared with 8 percent losses in the US during the 1950's. In Europe and in the UK there have not been any serious economic losses recorded in commercial apple and pear orchards.

The Australian loss estimates apparently ignore the commonly observed fact in all other countries that fire blight is a very sporadic disease (only severe in occasional years) highly dependent on carry-over canker infections and weather conditions. The cost-benefit analyses of the Australian Government also appear to overlook the degree to which good orchard management reduces the risk of outbreaks, for example pruning is able to reduce the carry-over infection and losses in the orchard.

In addition to exaggerating the potential yield loss, the analyses also ignore the fact that even the best quarantine procedures only succeed in buying time and do not prevent the eventual entry of new pests and diseases. The real risk that a disease will eventually occur in a country with susceptible host plants appears to be 100%. This is particularly true for bacterial diseases which are invisible and extremely difficult to detect. The incursions of plant pest and diseases into Australia has occurred at a constant rate over the past 25 years in spite of the complex quarantine service (Nairn et al. 1996). The inevitability of the arrival of serious plant pests and

diseases even to remote countries like Australia and New Zealand was pointed out by a previous director of plant pathology in New Zealand (Cunningham, 1925). He showed that in the 1870s, peach trees in New Zealand were widespread throughout the whole country having been introduced as seeds in the early 1800s by missionaries. These trees were free from all of the diseases present overseas. However, with the advent of steam ships, live trees were introduced along with their accompanying diseases and pests. As a result practically all of the fruit tree diseases present in Europe and North America were present in New Zealand by 1925.

In spite of extensive quarantine services in both countries since the 1940s, there has been a constant flow of new pests and diseases into both Australia and New Zealand. For both countries it is now highly likely that the costs of plant quarantine and the extra costs to the consumers from trade restrictions are many times greater than the potential losses from the arrival of new plant pests and diseases.

Another risk management technique is the use of plant breeding. Existing research programmes in plant breeding, plant introduction, and plant protection could readily control the relatively minor increase in pest and disease incursion if plant quarantine ceases. Observations on past incursions show that only a small proportion of introduced species cause serious crop losses in New Zealand and Australia.

There are a number of examples in New Zealand of introduced pests and pathogens which were originally considered to be very serious but which in reality turned out to be of minor importance. Examples include potato cyst nematode, yellow rust of cereals, aphids on lucerne, peas and cereals, oriental peach moth and apple leaf curly midge. The New Zealand Government took extreme measures in the case of potato cyst nematode. Regulations were put in place prohibiting the planting of crops on infected land, on the movement of farm machinery and infected areas were gazetted making land sales much more difficult. Suddenly these restrictions were all removed. The breeding and release of new resistant potato cultivars has alone been adequate to eliminate crop losses from the pest. The whole saga of potato cyst nematode in New Zealand (and also in Australia) demonstrates the tendency for scientists and Government officials to exaggerate the potential losses from newly recognised or introduced pests and diseases by acting in a risk averse fashion.

The basic features of quarantine policy in Australia are outlined in the publication “Australian Quarantine” (Nairn *et al.* 1996). One main conclusion in the Executive Summary is “the fundamental importance to the community of maintaining Australia’s unique natural environment”. The review also stated that the quarantine programme was essential to achieve this objective. Given the constant rate of incursions² (particularly high in the plant sector), and the huge environmental changes occurring through developments in primary, secondary and tertiary industries in Australia it is difficult to see how quarantine can possibly have a significant impact on the “unique natural environment”.

With the \$50n-60 million annual cost of the Australian Quarantine Programme and the additional costs of participating in the international regulatory organisations it is surprising that an independent cost benefit analysis has not been made of quarantine in Australia and New Zealand. Both countries were trying to develop a ‘clean green’ image to stimulate export markets and are trying to preserve the concept that they are still free from major pests and diseases, a situation that did apply in the 1800s, but certainly does not apply in 1997.

There may be a significant need for quarantine in the human and animal health sectors but with the plant sector over 90% of the world’s serious pests and diseases are already in New Zealand and Australia and any that are not will certainly arrive within the next 10 to 50 years. In the plant industry, quarantine has been used as a ‘de facto’ trade barrier to protect local markets. This has been justified in the past by using exaggerated risk assessments, but the real losses have been the greater costs to the community in high prices for locally grown products. Australia has had a long history of quarantine trade barriers against New Zealand horticultural produce, e.g. potatoes, tomatoes, cut flowers, and pip fruit. New Zealand has recently negotiated a protocol to allow trade in Australian vegetables and New Zealand consumers have benefited greatly from lower food prices.

² The total number of incursions of plant pathogens in Australia in the 25 year period, 1971 to 1995 was 562 with approximately 110 in each of the five year periods (Nairn *et al.*, 1996, page 227).

7. Risk of Entry on Apples

New Zealand's first application for access into Australia was made in November 1986 (AQIS, 1990). The Australian Quarantine Service (AQIS) requested the Bureau of Rural Resources (BRR) to examine this application, and their report appears as attachment No.4 in the AQIS report "Assessment of New Zealand Proposal to Export Apples to Australia (AQIS, 1990). The BRR study was conducted over a period of two years with both Australian and New Zealand scientists. The conclusion of the BRR risk assessment was that "the risk of introduction of fire blight into Australia by the importation of mature, apparently healthy apples from New Zealand under the proposed protocol is of a low order" (AQIS, 1990 p.15). The conclusion that mature apples are not a risk for the introduction of fire blight has been confirmed in the USA (van der Zwet, et al. 1990 and Roberts et al. 1993 and 1996).

Recent opinions of the world's leading scientists on fire blight research have confirmed that there is no evidence that fire blight on mature apple fruit has been responsible for the spread of this disease. Dr van der Zwet of the US Department of Agriculture in West Virginia stated that "with proper precautions *Erwinia amylovora* (the fire blight bacteria) cannot be spread on apple fruit (van der Zwet, 1997). Dr T J Smith of the Department of Tree Fruit Production, Washington State University, Wenatchee, USA stated that "there has been no confirmed case of the spread of this disease (fire blight) by means of commercially packed fruit. The far more likely way the disease spreads is by way of propagative material (Smith T J, 1997). Even the scientist studying fire blight at the Plant Research Institute, Burnley, Victoria, Australia stated "the proposed importation of apple fruit from countries having fire blight may only be minimal, but the risk of fire blight coming into Australia was increasing because of the increasing volume of propagating material imported (Wimalajeewa et al. 1990).

In spite of the extremely low risk of fire blight being introduced on mature apples the Australian Inspection Service rejected the New Zealand application in 1990 (AQIS 1990) and again after a second application in December 1995, it was rejected in April 1997 (AQIS 1997).

The draft risk analysis which was the basis for the 1997 application concluded:

1. that the New Zealand research was not based on conditions comparable to export apples.

2. that fire blight would be a devastating disease in Australia.
3. there were significant areas of uncertainty about certain steps in the possible pathway of disease establishment.
4. that apples from New Zealand could carry fire blight bacteria.
5. that the New Zealand claim that apples cannot act as a vector is unproven.
6. that the New Zealand proposal does not provide an equivalent degree of quarantine risk mitigation as required by Australia for other high risk products.

Again in relation to New Zealand applications for access to Australia an international fire blight scientist at Washington State University stated “The Australians are great at calculating odds and carrying out statistical what-ifs’, as are the Japanese. We are tired of all this. If agriculture had any influence in the USA, we’d lower the trade sanction boom, but we don’t. If it wasn’t fire blight it would be something else” (Smith T J, 1997). An eminent fire blight scientist at Cornell University Plant Pathology Department commented “There is no question that the spread and preference of fire blight has caused all sorts of problems and intrigue, particularly lately in the Far East and Down Under” (Beer, 1997).

The draft risk analysis of 1997 (AQIS, 1997) was seriously flawed in its study of pathways for fire blight in not giving adequate recognition to the relatively high risk of illegal entry of propagative plant material, or passengers carrying bacterial infection on horticultural equipment or clothing. Bacteria are invisible and cannot be detected by normal quarantine methods. The rate of increase of international air passengers into Australia is 10% per annum and the present number is about 7 m. per annum (Nairn et al., 1996). Surveys of the airport passengers in 1995 in Australia have shown that of the 85% who use the green channel (no plant material to declare) 35% have items of quarantine significance. It is obvious that this pathway must be a high risk compared to the possibility of fire blight entry on apple fruit.

Although Australian Quarantine (Nairn et al., 1996) claims to **not** have a ‘no risk’ policy in relation to plant quarantine; the absence of any progress in negotiating the access of apples from New Zealand over the past ten years clearly negates this claim.

8. The Japan - US Fire Blight Saga

A very similar situation to that between Australia and New Zealand, developed over the past ten years between Japan and the US, in relation to apple exports. In spite of fire blight disease having been recorded on Hokkaido in Japan in the 1900s and again in the 1970s and the identity of the causal bacteria being confirmed by studies in the US (Beer et al. 1996), the Japanese Government has claimed that the disease in Japan on pear trees is different and has been eradicated. Japan still maintains that it has a fire blight free status (in spite of overwhelming scientific evidence) and maintains a “de facto” trade barrier against the importation of apples from countries with fire blight.

The US started negotiations for apple entry into Japan in 1974. In the US, scientific evidence showed that mature apples from Washington State do not carry fire blight bacteria (van der Zwet *et al.* 1990). The Japanese did not allow access of US apples from Washington until 1993 when the US Trade Representative (Mickey Kantor) threatened general trade sanctions. This is a very heavy policy instrument and one that is not available to small and medium sized countries. The Japanese then offered the compromise of allowing access provided the US followed a strict protocol of paying the costs of Japanese inspection of orchards and import access for only two older apple varieties. Apple trade started in 1994 but the compliance costs of the restrictions and inspection requirements are so high that the trade in imported fruit from the US has been virtually destroyed.

In the course of the negotiations for trade access, there were many cases where the Japanese officials would not cooperate with US requests for information on the outbreak of fire blight disease on pear trees in Hokkaido. A detailed discussion on the Japan- US apple trade dispute has been published in the Los Angeles Times newspaper (Helm and Eisenstodt. 1996). The article states that the evidence presented “shows how politics can pollute science when research becomes the handmaiden of national and industry interests”. In addition to not cooperating with US requests for information the Japanese Government pressured government scientists working on fire blight to change their research reports and to cease working on the disease. So much pressure was put on one Japanese scientist at the Hokkaido Central Experimental Station that he committed suicide (Helm and Eisenstodt. 1996).

9. Summary Framework and Conclusions

An appropriate framework for fire blight disease risk management needs to recognise that international transmission can occur using a number of vectors including accidental introduction by tourists, cargo or returning residents. There are severe limits on the measures that can be taken to reduce risks from these vectors as some effective measures might involve major tradeoffs for the tourist industry, for example. If trade restrictions are put in place which lower pathogen entry risk beyond that from other vectors, they ought to be regarded as a barrier to trade.

Normal export quality control processes ensure that mature apples from New Zealand have a very low probability of transmitting fire blight. Accordingly, trade in apples ought not be restricted whatever else is done to inspect other vectors like tourists.

Nations have a responsibility to pursue the spirit of the national treatment rule. Trade barriers ought not be permitted if there is a probability that the pest is already in the country. This implies that countries have a monitoring responsibility in conjunction with the creation of an import regulation. Australia now knows that it has fire blight and that properly treated NZ apples are very unlikely to make the problem worse. Australia also knows that New Zealand knows (and other trading partners know). This environment creates an unreal environment which can potentially taint future negotiations, especially in CER which is an extremely intimate free trade agreement³.

There is an interesting question regarding risk aversion that needs to be considered here. The basic question is whether national treatment implies that equal risks ought to be accepted from domestic and international services. Quarantine is but one of a number of possible control mechanisms. It is not necessarily the most effective nor the least cost approach even in cases where the pest is probably not present in the country - especially where a pathogen is likely to arrive in the near future in any event. Dr Tim Smith the Washington State University Extension Scientist has developed a simple, minimal intervention, fire blight control system for Washington State apple orchardists. It has minimal environmental effect and gives effective control of fire blight disease. Investment in this type of research will give far greater economic

³ Requiring high levels of goodwill to maintain anti-dumping prohibitions, the control of industry subsidies, mutual recognition agreement, the joint food facility and compatible competition policies, for example.

benefits than endless research on ‘risk assessments’ and negotiation rules which are often overtaken by the spread of the feared pathogen (e.g. Australia and fire blight) or by the realisation that the disease is already in the country (e.g. Japan and fire blight).

All countries should re-examine their quarantine and science research priorities and seriously consider the value of reducing expenditure on trade access negotiations and on quarantine, which often attempt to ‘close the door after the pest has already entered’. A far better strategy may be to increase expenditure on plant breeding and plant protection research in anticipation of the inevitable arrival of the pest or disease. The international cooperative plant breeding programmes such as CYMMIT have enabled countries throughout the world to breed new food crops resistant to plant pests and pathogens before they have arrived in the country. This programme has had major success in maintaining world food supplies in cereals. Other programmes in the private sector are equally successful for other crops.

Embedded in issues of this type are a series of complex institutional and human incentive systems. Bureaucrats administering public policy have little incentive to take risks because they are not rewarded for such actions but may be penalised in the event of adverse outcomes. The greatest risks bureaucratic face are from domestic producers and other citizens who will be affected by imports of the product and/or a pest, rather than from foreign exporters. Domestic producers and bio-security lobbyists understand this asymmetry (vulnerability) and accordingly have an incentive to try to show that any damage that occurs has resulted from a bureaucratic decision because it raises the risk level of an already risk averse group.

Scientists have a strong incentive to promote the need for further research. This tendency must be constrained particularly where policy decisions are related to scientific outcomes. There is always a need for further research because we can never know all there is to know on a topic. Accordingly, it only makes sense to delay a policy decision on the grounds of requiring further research if the current pathogen risk (correctly calculated) is actually above an appropriate threshold. This raises the question of the credibility of science. One US scientist has stated “We will never be able to convince, by scientific tests, people who are protecting their home producers through non-tariff barriers (Smith T J, 1997). On any issue like fire blight there is an infinite number of scientific points that can be raised to support a government conclusion of ‘not proven’.

The fire blight and growth promotant hormone cases both appear to involve a political standoff, in spite of the scientific evidence. They are high profile cases in Australia and the EU respectively. Research has a role to play here in educating the general public on the reality of ecological dynamics with human intervention including the important elements of multiple vectors and the tradeoffs that inevitably have to be made. Research on pathogen and pest incidence may assist in this process. It is important that the general public understand the limitations of science as well as the possibilities. It will be difficult for the polity to accept a policy which involves no new risk unless they understand that to be the case. At present, the polity tends to believe that the arrival of any pest or pathogen raises the bio-security risk level and that is often not the case at all.

The complexity of these scientific and risk issues makes these situations very difficult for bureaucrats to deal with administratively - whether the administrators are associated with national governments or international organisations like the IPPC. The easy way out for negotiators is to appear to liberalise trade by tying shipments to a new regulatory environment with high compliance costs. This is a form of political or bureaucratic failure. Mutual recognition and related types of agreements are a way forward in this area but only if such agreements are broad enough to encompass wide areas of current and likely future concern. Otherwise, new agreements have to be devised for each new issue.

References

- AQIS (1990) Assessment of New Zealand Proposal to Export Apples to Australia. An AQIS position paper Dept P.I.E., Canberra, Nov.19.
- AQIS (1997) New Zealand Request for the Access of Apples into Australia. Draft pest risk analysis, April.
- Beer, S V; Kim, J; Gustafson, H L; Zumoff C H ;Molol, T; Bogdanove, A G; Laby, R J; Tanii, A; Tamura, O and Aldwinckle, H S (1996) Characterisation of bacteria that cause “bacterial shoot blight of pear” in Japan. *Acta Hortic* 411:79-181.
- Beer, S V (1997)Dept of Plant Pathology, Cornell University, NY, USA, pers.comm.
- Berrie, A M and Billing, E (1996) Hawthorns as a source of fire blight inoculum in English pear and apple orchards. *Acta. Hortic.* 411:.
- Christchurch Press (1997a) Fire blight find amazes scientist. May 10.
- Christchurch Press (1997b) Tests confirm fire blight in Australian plants. June 16.
- Cockayne, A H (1920) Fire blight; a serious disease of fruit trees. *NZ Journal of Agriculture*, 20:156-157.
- Cockayne, A H (1921) Fire blight and its control. *NZ Journal of Agriculture*, 23:39-.
- Cunningham G H (1925) Fungous diseases of fruit trees. *NZ Fruitgrowers' Federation*.
- Elliot, R (1996) Rules based global trading - the role of science in making access agreements work for New Zealand. *Min. Res. Sci. Technical Report No.55*.
- Godlovich, Stan (1997), “Things Change: Holding Course in the Flux”, Discussion Paper 33, Department of Economics and Marketing, Lincoln University, Canterbury, New Zealand.
- Gouk, S C; Boyd, J R and Hutchings, S O (1996)Applications of the Maryblyt computer model for identifying infection risk for fire blight of apple. *Proceedings 49th NZ Plant Protection Conference* : 96-100.
- Gul, Faruk (1997), “A Nobel Prize for Game Theorists: The Contributions of Harsanyi, Nash and Selten”. *J. Econ. Perspectives* 11 (3), pp. 159-174.
- Gwynne, D C (1984) Fire blight in perry pears and cider apples in the south west of England. *Acta Hortic.* 151:41-47.
- Hale, C N; Taylor, R K and Clark, R G (1996) Ecology and epidemiology of fire blight in New Zealand. *Acta Hortic.* 411:79-85.
- Helm, L and Eisenstodt, G (1996) Caught in the cross fire of pacific apple war. *Los Angles Times* 22 July. Home edition Part A, page 1.

- Hillman, Jimmye (1991). *Technical Barriers to Trade*. Boulder, Colorado: Westview Press.
- Horn, Murray (1995). *The Political Economy of Public Administration*. New York: Cambridge University Press.
- Nairn, M E; Allen, P G; Inglis, A R and Tanner, C (1996) Australian quarantine a shared responsibility. Department of Primary Industries and Industry, Canberra.
- Reil, W O; Moller, W J and Thomson, S V. An historical analysis of fire blight epidemics in the Central Valley of California. *Plant Disease Reporter* 634:545-549.
- Smith, Lindsay (1997) Producer Boards. Christchurch Press 25 August.
- Smith, T J (1996) A risk assessment model for fire blight of apple and pear. *Acta Hortic.* 411:97-104.
- Smith, T J (1997) Tree Fruit Production, Washington State University. Pers. Comm.
- Thomson, S V and Hale, C N (1987) A comparison of fire blight incidence and environment between New Zealand and Western United States. *Acta Hortic.* 217:93-98.
- van der Zwet, T; Thomson, S V, Covey, R P and Bonn, W G (1990) Population of *Erwinia amylovora* on internal apple fruit tissues. *Plant Disease* 74:711-716.
- van der Zwet, T and Beer, S V (1991) Fire blight. Its nature, prevention and control. USDA Information Bulletin No.631, 83pp.
- van der Zwet, T (1996) Present world wide distribution of fire blight. *Acta Hortic.* 411:7-8.
- van der Zwet, T (1997) US Department Agriculture, Agricultural Research Service, Appalachian Fruit Research Station, West Virginia, USA. Pers. comm.
- Wimalajeewa, D L S and Atley, K (1990) The potential vulnerability to fire blight of pear and apple crops in the Goulburn Valley, Victoria, Australia. *Acta Hortic.* 273:67-72.