5. Integrated fruit production – quality apples for discerning consumers

The New Zealand apple industry is small by international standards and is driven by exports, not domestic sales. New Zealand's apple growers produce just 1% (approx. 500,000 tonnes) of the global crop but account for 5% of the apples that enter international trade. The industry has a strong export philosophy because over 50% of the national crop is exported, to the Northern Hemisphere markets. New Zealand is unique in having built its apple industry on an export base.

During the last decade large supermarket customers have begun to reflect the concerns of the consumers who seek 'safe' and 'environmentally grown' fruit, that is fruit grown in a recognised, integrated fruit production (IFP) system. These market signals prompted New Zealand orchardists to implement approved production systems that can be audited and which complement the market differentiation already established through growing new apple varieties with excellent eating qualities.

- During the 1970s and 1980s science recognised the need to find ways of reducing the use of agrichemicals within apple orchards. Much of the underpinning science studies that provided the basis for the subsequent development of robust orchard management technologies were completed during this period.
- Anticipating the demands of their customers, the apple industry decided to implement an integrated fruit production (IFP) programme in 1995 as a step toward ensuring the continued entry of New Zealand apples onto the global market. The programme was led by ENZAFRUIT as the exporter with active participation from science, producers, technologists and consumers. Some of the technology evolved during the programme.
- The uptake of the IFP programme was rapid. It was introduced in 1995 and by 2000 almost 100% of the export crop was produced using IFP technology. There has been a marked reduction in the use of organophosphates on apple orchards and in the number of fungicide sprays applied during the mid to late summer period.

The failure of New Zealand apple producers to adopt the integrated fruit production system would have placed their products at risk in the global market. Equally, the absence of a carefully managed implementation programme would have risked uncontrolled outbreaks of pests and diseases during the implementation stages of this programme.

Following deregulation of the apple industry in 2001, New Zealand Pipfruit Ltd has taken responsibility for the IFP programme. The industry continues to support the sharing of data (spray diaries, monitoring records and packhouse fruit quality) for the purpose of IFP development and market access.

The underlying philosophy of controlling pests and diseases through other means than the extensive use of agrichemicals was initially focused on apples. The approach has been picked up by scientists working with other crops such as kiwifruit, grapes, potatoes, lettuce, squash, asparagus, avocados, and summerfruit.

The commercial significance of the IFP system lies with the ability to audit the production technologies and use the information to provide a measure of confidence to the customers and biosecurity agencies of the importing country. Producers acknowledge the reduction in health risks to their families and workers. Science and will continue to be needed as the programme evolves and future food safety and sustainability issues are addressed.

The genuine working partnership between science and industry was an essential element of the implementation programme and led to strong industry ownership of the outcomes. A key outcome has been a paradigm shift away from the use of 'hard' agrichemicals towards an holistic and informed approach to pest and disease control within the pipfruit industry.

1. Background:

Pheromone trap used for mating disruption of male moths – pests within apple orchards.

New Zealand has few serious pests of apples, with leafrollers, codling moth and scale insects the key pests requiring control. Mealybugs, woolly apple aphid, apple leaf curling midge, and European red mite are occasional pests. The main diseases are apple black spot, powdery mildew, crown and collar rots, and fire blight.

Development of the integrated fruit production (IFP) programme for apples commenced in 1995 with the establishment of a national IFP-Pipfruit Committee. Its principles were based on European International Organisation for Biological Control (IOBC guidelines and IFP was defined as: "*The economic production of market quality fruit, giving priority to sustainable methods that maintain consumer confidence and are the safest possible to the environment and human health".* The programme was based on continuous improvement and was developed through a structured decision-making process. ENZAFRUIT provided leadership of a committee that represented technical experts, growers, consultants, consumers, the environment, and the agrichemical industry.

New Zealand IFP guidelines for apples were developed by 15 technical sub-committees covering site selection, rootstocks, varieties, soils and nutrition, water management, understorey management, tree management, spray application, pests, diseases, orchard environmental quality, industry operations, cleaner production, grower training, and auditing.

The pest management objective was to eliminate organophosphate (OP) insecticide use and through the implementation of selective pest control, to maximise use of biological control. Other than OP insecticide use, many of the practices used by New Zealand apple growers in 1996 already met IFP standards. Agrichemical use in orchards was highly controlled; growers were required to submit Pest Control Record books to ENZAFRUIT or their exporter for auditing. Regular testing also ensured that residues were below the lowest residue tolerance internationally.

To assist IFP implementation, consultants received training in facilitation, and pest and disease management. Growers and consultants were required to attend IFP discussion group meetings and practical training sessions.

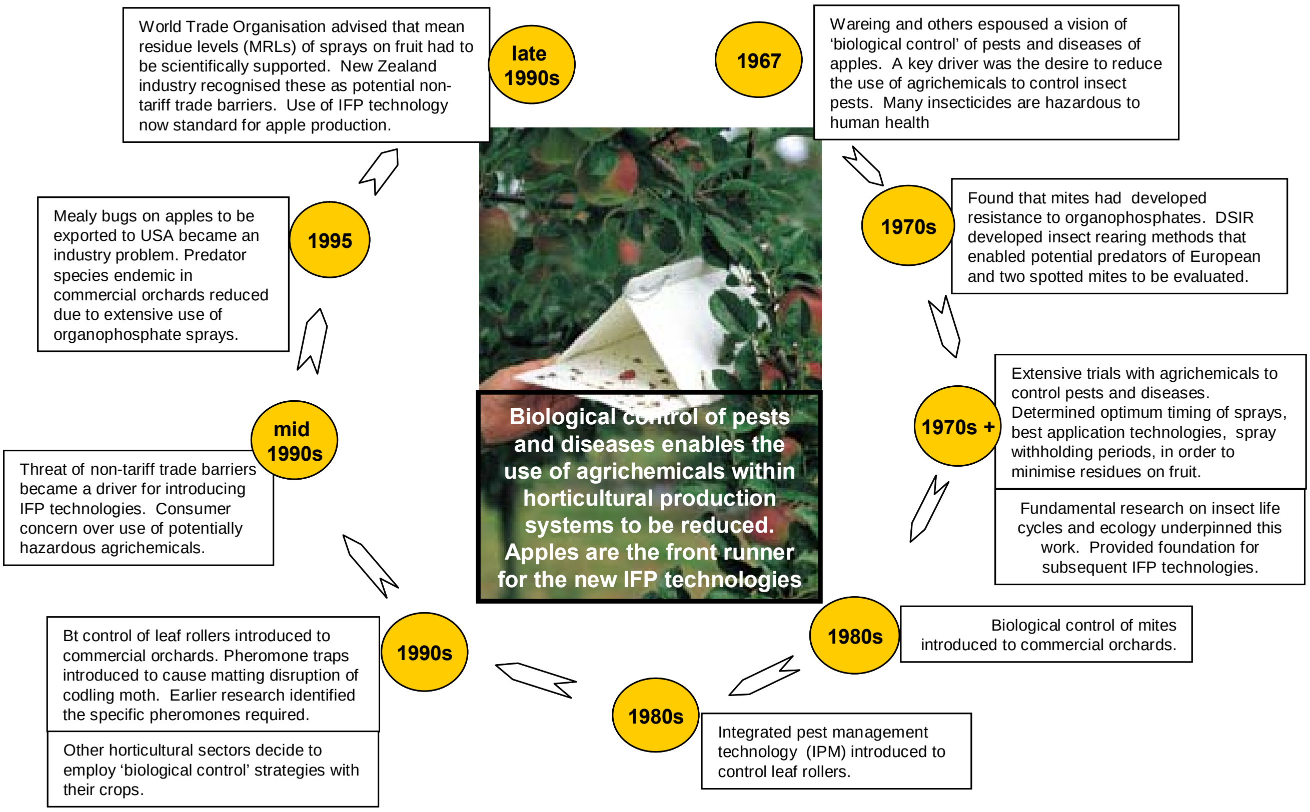
IFP is now the minimum standard for all apples exported from New Zealand. During implementation fruit quality was monitored annually to refine IFP procedures and to help build grower confidence in IFP recommendations. Pest thresholds and pesticide options for IFP in New Zealand were recommended and reviewed each season as new information from research on pest and disease control became available.

Pest and disease management were the focus for review in the early stages of implementation of the programme. Reduced pesticide use presented potential quarantine and market access risks and required parallel development of different leafroller thresholds to meet both customer demands in Europe and USA market access. Postharvest treatments were also developed to reduce phytosanitary risks, including apple washing for occasional passenger pests, and controlled atmosphere storage regimes for some pests.

IFP pest management guidelines are often based on understanding the life cycle of the pest and taking appropriate action. For example the use of pre-bloom spraying of mineral oil to control scale insects or the application of insecticides at petal fall to control codling moth as well as preharvest to minimise the risk of infestation in harvested fruit. Other guidelines may require growers to monitor the pests and respond with insecticides only when pest thresholds are exceeded. Pest and disease monitoring must be recorded in an IFP Field Monitoring notebook. Applications of agrichemicals must be justified, recorded and cross-referenced in the Pest Control Record book and submitted for auditing.

The science underpinning the horticultural IFP programmes originates primarily from Crop & Food and HortResearch. Landcare's scientists in biosystematics provide support by identifying the pest and diseases. Science research capability is present at most of their regional centres throughout New Zealand. Usually the regional scientists specialise in the primary crops of their region.

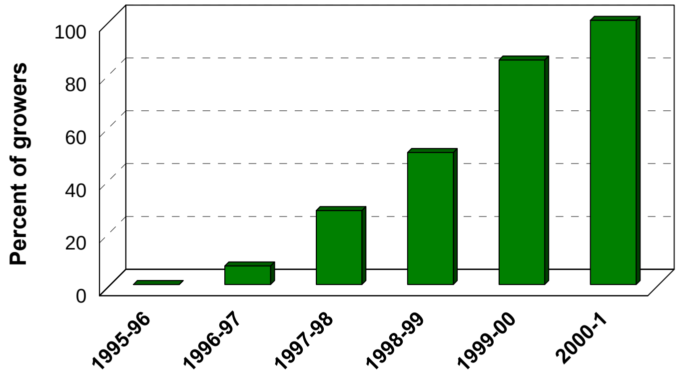
2. Timeline:



3. Science & Innovation Features:

- ***Multidiscipline science.*** The development of IFP programmes required contributions from a range of scientific disciplines, such as entomology, plant pathology, crop physiology, climatology, information technology, molecular biology, plant breeding, environmental physicists and others, working cooperatively with industry leaders and technologists.
- ***Rapid uptake of IFP technology and risk free implementation.*** There were no serious pest or disease management issues during the implementation of the IFP programme throughout the main apple growing regions of New Zealand. All

export apples were produced under IFP technology only 5 years after the programme was introduced.



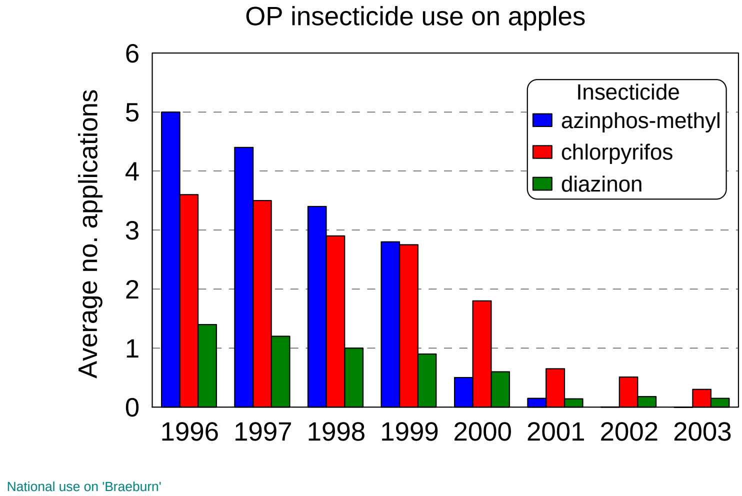
Adoption rate of Integrated Fruit Production technology by New Zealand apple orchardists.

(After Walker 2004)

- ***Independent audits***. To ensure programme integrity IFP auditing is now completed by independent non-government agencies on behalf of exporting companies.
- ***Industry leadership***. The future of IFP pest and disease management was facilitated by the initial leadership that ENZAFRUIT was able to apply to the programme through its export monopoly. However, since then the industry has collectively decided that IFP will be the minimum standard for export production. Leadership of the IFP programme is now with New Zealand Pipfruit Limited, a grower-owned company.
- ***Organic production.*** The greatest challenge that IFP faces in the New Zealand pipfruit industry is the increasing interest in organic production. This interest has increased due to higher financial returns and progress made with some of the significant technological hurdles for pest and disease management and market access requirements. This has been, in no small part, due to the advances made in these areas as a result of the research carried out for the development of the IFP programme.

4. Benefits

Reduced insecticide use. Insecticide use was substantially reduced under IFP recommendations, 50% fewer applications were applied for insect control nationally in 2000 than were applied in 1996. By 2004, OP insecticide use has declined nationally by 95%. The average number of OP applications is now less than one per year. Post-flowering OP insecticide use have been replaced by selective insect growth regulator (IGR) insecticides with a typical use of 2-4 applications per season. Leafroller and codling moth control has been excellent in most orchards. Instances where damage was higher than anticipated were associated with growers not following IFP recommendations eg – use of products below recommended rates, inadequate spray coverage, and improper use or maintenance of pheromone traps. Miticide spray applications have been drastically reduced.



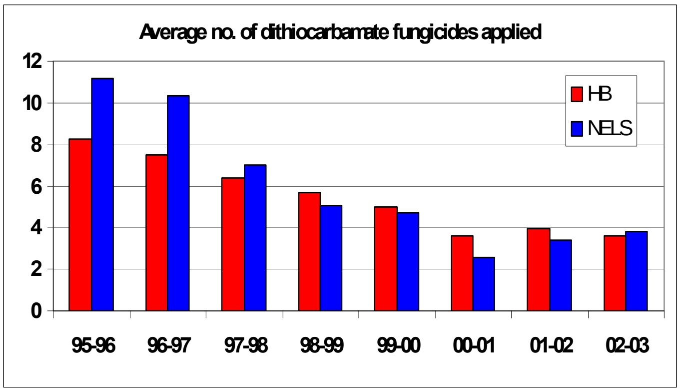
Organophosphate insecticide use on New Zealand apple orchards. (After Walker, 2004

Fruit quality retained. Fruit damage by insects and disease has been monitored using both field and packhouse assessments across many New Zealand orchards using the IFP technology. IFP practices were found to produce fruit of equivalent quality to orchards using conventional calendar-based spray programmes. Insect control improved under IFP pest management because biological control of some pests was able to become better established within the orchards. Annual reviews of pesticide use and IFP programme recommendations led to refinements to pest and disease recommendations. These are now widely accepted by growers. This is an on-going process supported by industry funded research (about $750,000 per year).

Biological control expressed. Initial control difficulties with wooly apple aphid declined on most orchards as parasitoids played a significant role under the selective management programme.

Benefits of less fungicide. Decreased use of dithiocarbamate fungicides resulted in more consistent mite control by predator mites to a level where miticide use has become uncommon.

Average number of fungicide sprays applied on New Zealand apple orchards. (After Walker, 2004)



Apple orchardists have significantly reduced the number of fungicide sprays applied especially during the mid- and late-summer period. This reduction has been assisted by monitoring the black spot infection and predicting the maturation and release of the ascospores. Meteorological data have also been used to aid the prediction of periods of disease risk. 80% of orchards are sited within a 5 km radius of a climatological station.

Mealybug control. The incidence of mealybug in crops at harvest has declined with decreased organophosphate insecticide use. Several general predators now adequately control mealybug populations in IFP orchards.

Apple washing. Apple washing technology was developed primarily for the elimination of mealybug and other pests infesting fruit at harvest. This technology was implemented by many large packhouses and has significantly increased the proportion of blocks passing USDA pre-clearance inspections for quarantine actionable pests. (Reduced failures from about 20% to less than 5%)

IFP management practices. Pest management has had the largest impact on orchard management under IFP.

- Reduced pesticide use has been offset by additional IFP pest monitoring costs, but the new crop protection practices simultaneously addressed important food safety and market access requirements for New Zealand growers.
- Other IFP management practices are now widely adopted – weed and understorey management.
- Use of residual herbicides declined markedly and most orchards now have weed-free strips below 30% of their total ground cover.
- The role of understorey vegetation, grazing, and soil fauna in the degradation of overwintering black spot ascospores is now widely accepted.

Training & orchard monitoring. IFP training programmes have improved grower and industry awareness of both pest and disease management. The shift to pest and disease monitoring, justification of pesticide use, and selective insect control has been achieved through comprehensive training for consultants and growers that was maintained through IFP Discussion Groups.

Worker & family safety. New Zealand pipfruit growers consider that their IFP programme contains desirable elements of worker and environmental safety, with significant potential consumer and marketing benefits for their fruit. Growers consider that the IFP programme provides safety for themselves and their families.

Sharing information. Other benefits include improved access to technical information and access to shared information from experiences of other growers through the discussion groups.

5. Return on R&D investment

The return on investment was not assessed because there is a significant difficulty in obtaining a single causal relationship between the IFP innovation and the sale of apples in the export market. Too many other factors have an impact on the commercial returns for the export apples.

6. Quotes:

"*As the grape and apple programmes now mature, this slightly divergent evolution may prove to be of advantage to both. Some of the data collection and analysis tools that were developed for use in pipfruit are now being applied to the SWNZ programme. Likewise, there is potential to implement the scorecard experience from SWNZ in the pipfruit and other New Zealand fruit industries. It is important to acknowledge that our primary industries do not exist in isolation from each other and that on many sustainability issues (e.g. access to water and ground water pollution) they are inexorably linked."* Manktelow et al. 2002.

The World Apple Report 2004 rates New Zealand and Chile as the world's most competitive apple producing countries.

'ENZA, science providers and pipfruit growers worked very effectively together in introducing Integrated Fruit Production (IFP) to the industry to reduce the use of chemical sprays, and to encourage biologically sustainable means of controlling pests and diseases.' MAF. 2000.

7. Related activities:

Many other horticulture sectors have developed integrated fruit production or similar programmes. These may be regarded as spin-offs of the initial apple integrated pest management (IPM) programme of the 1980s. The underlying science within each horticultural sector was much influenced by the 'biological control' research philosophy developed within DSIR during the 1970s and 1980s.

- The ***Kiwigreen*** programme was introduced to the kiwifruit sector in 1992 and 6 years later the complete export crop was produced using the programme. The programme was developed using the extensive knowledge of the biology of kiwifruit pests and their potential control options that was developed during the 1980s and early 1990s.
- ***Sustainable Wine Growing New Zealand (SWNZ)*** programme provides a "best practice" model of environmental practices for the vineyard and winery. It grew out of the NZ Integrated Winegrape Production programme which started in 1995. Some of the data collection and analysis tools that were developed for use in pipfruit are now being applied to the SWNZ programme. The total insecticide use in the grape industry, while dominated by organophosphates, was only a fraction of that used in apples. It has been greatly reduced under the SWNZ programme. Pest mite problems in grapes are largely managed by the use of sulphur sprays.

- ***Aphid watch*** provides information on aphid flight records, virus forecasts and other aphid information to New Zealand farmers and growers. Aphid suction traps are located in Hawke's Bay, Canterbury and Pukekohe. Information is provided to growers who are using IPM programmes to control pests during the production of potatoes, squash and lettuce.
- ***AspireNZ*** is an interactive decision support system that can help asparagus growers to achieve higher yields and better long-term crop performance by monitoring and managing root carbohydrate content during the crop's annual growth cycle.
- The ***AvoGreen®*** programme has been developed for avocados. The key strategies are to (i) monitor pest levels and refrain from spraying until pest thresholds are reached, and (ii) plan for the integration of both chemical and non-chemical means of control as part of the overall control strategy. The programme requires that agrichemicals be used only when necessary and at rates and frequency detailed in the AIC Avocado Quality Manual. Pests must be monitored and recorded by an accredited operator. Leafrollers, armoured scale insects, greenhouse thrips and six-spotted mites are the primary pests, but several other minor pests have also to be considered. These pests have several natural predators in the orchards.
- The ***SummerGreen*** programme was implemented by Summerfruit New Zealand for fresh market summerfruit (including peaches, nectarines, cherries, and apricots) in 1999. At present > 85% of growers use this integrated approach to production. The programme is one of continuous improvement and continues to identify best management practices for summerfruit production. Summerfruit New Zealand has produced a SummerGreen Manual to guide growers that is refined each year as new technologies are introduced to growing systems relating to agrichemical management practices, food safety, and targeting production to meet market requirements.

8. Information sources:

Information supplied by:

- Dr Jim Walker – HortResearch, Hawke's Bay. Leader, IFP-Pipfruit Programme

Other references:

- *"Integrated pest management in New Zealand horticulture."* 2003. Suckling, D.M., C McKenna, and J T Walker. Chapter 29. CAB International, "Integrated Pest Management in the Global Arena." Ed. K M Maredia, D Dakouo and D Mota-Sanchez.
- *"Technical Developments in Sustainable Winegrowing in New Zealand." 2002.* David Manktelow, Tessa Renton and Sarah Gurnsey. Presentation at the Romeo Bragato conference in Christchurch, 2002.
- Review of the Regulatory Framework for Pipfruit Exporting. MAF Public Discussion Paper No. 23. November 2000
- Integrated Fruit Production In The New Zealand Pipfruit Industry. 2003. Jonathan W. Wiltshire. Report written for the Primary Industry Council/Kellogg Rural Leadership Programme. www.events.lincoln.ac.nz/kelloggs

This case study is one of a 21-part case study series aimed at demonstrating the value of science and innovation in New Zealand's leading edge bio-science industries... and their significance to New Zealand.

Martech Consulting Group is a strategic consultancy based in New Zealand. The growing**futures** case study series was in part based upon Martech's extensive work with sector representative groups, science providers and organisations that interact with science providers to achieve consensus on co-ordinated actions, improve governance, develop sector-based strategies and improve innovation processes.

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