

Operational research contract FMA169

Generic HACCP Models for Food Assurance Programmes



Final Report

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Dated :

December 2001

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1.0 EXECUTIVE SUMMARY

This report describes the process used and the outcomes of the MAF operational research project FMA 169 commissioned by MAF Food Assurance Authority.

The project produced 4 reports :

Reports

Objective 1. International Literature search

Objective 2. Generic HACCP model

Objective 3. Implementation Guide

Final Report

Objectives 1 & 2 have been combined into one document –“ *Generic HACCP Models for Food Assurance*” Objective 1 – Stage 1 & 2 International Literature Search, Objective 2 HACCP Models Report, dated August 2001.

Objective 3 is a separate document Titled “ *Generic HACCP Models for Food Assurance – Implementation Guide*”, dated September 2001.

Report 4 : Final report detailed as follows, December 2001.

Recommendations

That:

- The outcomes from this project are used to underpin the NZ Fresh Produce industry bodies and exporter organisations current operating systems and provide a basis for review;
- The produce industry in New Zealand applies HACCP principles and Good Agricultural Practices (GAP) as appropriate instead of all the HACCP principles, unless enough scientific evidence and food safety objectives for HACCP plans are available;
- Any further work on food safety for the NZ Fresh Produce Industry by MAF Food is undertaken in conjunction with relevant industry members
- MAF Food consult with key industry parties including research bodies, to communicate the project process and outcomes;
- The work undertaken too date is reviewed and updated from time to time.
- MAF Food consult with the industry to initiate a framework for the collation of chemical residue test results.

The first task was a review of the outcomes of a previous project (FMA 101) commissioned by MAF in 1999 which undertook to review, research and design HACCP Models acceptable to the NZ Fresh Produce Industry for the

integrity of plants and plant products exported from New Zealand. The recommendation from this previous project for a separate Code of Practice for HACCP application is no longer considered appropriate because the Fresh Produce Industry has since taken more ownership and responsibility for food safety and produce integrity.

This project identified that it is more appropriate for the produce industry in New Zealand to apply HACCP principles and Good Agricultural Practices (GAP) as appropriate instead of all the HACCP principles, unless enough scientific evidence and food safety objectives for HACCP plans are available. This is in line with current international thinking.

Generic HACCP Models have been developed for a range of fresh produce using information obtained from a literature search in conjunction with analysis of some specific production systems operating in New Zealand.

Potential biological, chemical and physical hazards have been identified, both for generic conventional and organic production systems. Although the literature search was extensive there are still gaps in our knowledge with respect to food safety risks in the produce industry and acceptable limits for hazards.

Information for determination of measurable Food Safety Objectives has been difficult to obtain for biological, chemical and physical hazards. Information on chemical residue monitoring programmes for fresh produce exported from New Zealand is not publicly available.

The information from the literature search was also used to identify the hazards most likely to occur at each step of the process together with an analysis of the conditions leading to their presence in fresh produce in specific production systems.

The significance of the hazards was determined by considering whether or not their elimination or reduction to acceptable levels was necessary for fresh produce safety. Acceptable limits have been described as the HACCP plan's food safety objectives.

Suitable controls for hazards have been identified. The danger of implementing and maintaining impractical unnecessary control measures has been highlighted.

All processes of the growing, harvesting, processing and transporting of fresh produce rely on the good management, use, disinfecting (sanitising) and handling of water. At any time water is in contact with produce there is a potential risk of contaminating the product. Report one suggest water control is addressed using GAP's.

The process concludes with techniques to verify the adequacy of the controls together with supporting documentation.

The information collated through the literature search may become dated over time. Up to date information is important and it may be necessary to

undertake a similar literature search and review of the outcomes from this project to address new scientific data as it becomes available.

2.0 INTERNATIONAL PERSPECTIVE

With the increasing interest globally, of improving the diet and health of consumers, there is increased demand for fresh fruits and vegetables. (O'Brien, 2000).

Meeting this demand has stimulated trade of fresh produce worldwide. This has highlighted the reported incidences of foodborne illnesses related to the consumption of fresh produce.

Worldwide the importance of Good Agricultural Practises (GAP's), Good Handling and Hygiene Practises (GHP's), Good Manufacturing Practises (GMP's) and HACCP programmes have been identified for producers to utilise for the production of safe produce.

Various Governments and industry bodies have developed guidelines outlining GAP's to assist commercial producers to develop appropriate production systems to minimise food safety risks for fresh produce. All the guidelines are similar in their intent to base the systems on prevention rather than elimination of foodborne illnesses. There are reasonable steps that a grower can take to reduce the risk that pathogens will contaminate the food produced on the farm (Cornell University 2000).

The Codex Committee on Food Hygiene (CCFH) have developed the draft Code of Hygienic Practice for Fresh Fruit and Vegetables (Step 8) Oct 2001. This code addresses GAP's and GMP's that will help control microbial, chemical and physical hazards associated with all stages of the production of fresh fruits and vegetables from primary production to packing. It is recognised that the industry is very complex and of necessity the code is flexible and provides a general framework of recommendations for worldwide adoption.

There has been some debate internationally, over the safety (particularly from a microbiological perspective) of organic products. In particular the use of natural fertilisers is seen as a potential source of microbiological contamination that could lead to a serious food borne illness outbreak. However, little scientific information is available to support or refute this concern.

The Literature search identified a number of different initiatives currently operating around the world these are detailed as follows :

2.1 United States of America

The USA have developed a guide to Minimise Microbial Food Safety Hazards for Fresh Fruit & Vegetables which is aimed at developing the most appropriate good agricultural practices (GAP's) and good management practices (GMP's) for each specific operation. Prevention is favoured over reliance on corrective actions (US Dept. of Health and Human Services 1998). The guidelines contain some of the procedures outlined in the Codex Alimentarius Commission - Code of Practice (COP) under CAC/RCP 44-95 (FAO of the UNWHO 1995).

2.2 Ireland

The Food Safety Authority of Ireland (FSAI) launched their country's first Code of Practice for Food Safety in the Fresh Produce Supply Chain on the 6 th September 2001 to assist fresh fruit and vegetable producers, processors and retailers to ensure the highest levels of food safety are followed.

The Code of Practice is the first set of guidelines for Ireland that agree comprehensive standards of food safety practices for the production, management and handling of fruit and vegetables. It is aimed at producers, processors, wholesalers and retailers involved in the provision of horticultural produce to consumers. It will enhance the current high standards being attained by the sector.

The COP contains general hazard control information on water, farmyard manure, hygiene practices, use of pesticides and seed production.

(Dr Patrick Wall, Chief Executive, FSAI)

2.3 Australia

Australia have developed a draft " Guide to the production of safe food in the Australian vegetable industry".

The draft guide specifically addresses microbial contamination. It covers whole fresh vegetables (not fruit) through the production process. It does not cover distribution at retail level or minimally processed vegetables. It details Hazards, Regulatory requirements and industry recommendations. The draft states " HACCP based food safety plans are a new concept for vegetable growers with little information based on sound science. Consequently, standards demanded of growers are sometimes not consistent and may not be appropriate for the horticultural industry " (21/02/2001 draft)

In addition Agriculture, Fisheries and Forestry – Australia (AFFA) have recently produced " Guidelines for On Farm Food Safety for Fresh Produce. (2001) This document has been developed to address the issue stated above of inconsistency in the standards demanded of growers in Australia.

3.0 PROJECT BACKGROUND

Internationally there is a growing interest and concern over the safety (particularly from a microbiological perspective) of edible plant products. This concern, at both the consumer and regulatory level, has been fuelled by some high profile (albeit quite product specific) food borne illness outbreaks, involving a number of deaths, which have been traced back to contamination of edible plants.

While New Zealand's exports of edible plant products are not at imminent threat from this trend, a number of countries (most notable the European Union) have signalled their intent to look at introducing regulatory requirements for the safety and hygiene of imported edible plant products.

The growth of the organic production industry in New Zealand has been phenomenal over recent years. New Zealand is well positioned to be a major supplier of organic products to the international market place. It is vitally important to both the organics industry and the wider horticultural sector, that New Zealand's reputation as a supplier of safe food is not tarnished because of a food safety incident that is linked to either New Zealand's fresh organic or conventional production techniques.

Sanitary certification of plant products exported from New Zealand may also be required at some future time. It is vital that the credibility of MAF's sanitary assurances for all products are protected to ensure on-going and/or improved access to overseas markets.

The establishment and implementation of scientifically valid guidelines for food safety in relation to the production, packing and storage of edible plant products will help ensure New Zealand both maintains its current access to markets and is able to protect its reputation as a supplier of safe food.

A previous MAF Operational Research project, reference FMA 101, was undertaken by MAF Biosecurity Authority in 1998 / 1999 in response to industry feedback that existing quality assurance specifications were causing difficulties. The objective of that project was to review research and design user-friendly HACCP models acceptable to industry for export plant integrity.

Analysis of this report highlighted further research was required in order to:

- Validate scientifically (wherever possible) the potential biological, chemical and physical hazards that have been identified, both for conventional and organic production systems;
- Review the models to ensure consistency with MAF/MOH application of HACCP principles.
- Produce HACCP models that can be incorporated into MAF Standards for plant product assurance programmes as such programmes are developed (i.e. organic official assurance programme, grade official assurance programme, fresh produce food safety official assurance programme).

- Provide sufficient guidance to the different levels of the sector to ensure both effective uptake of and maximum benefits from, the models.

MAF Food Assurance Authority applied for and received approval for funding from the 2000/2001 MAF Policy Operational Research fund for the development of HACCP models for MAF (Plants) certification of exported plant products. AgriQuality New Zealand tendered for the Project and were awarded Operational research contract FMA169 – “*Generic HACCP Models for Food Assurance*”

Research contract FMA169 – “*Generic HACCP Models for Food Assurance*” was based on delivering 3 measurable objectives. These were

Objective 1. International Literature search – Summary Section 5.1

Objective 2. Generic HACCP model - Summary Section 5.2

Objective 3. Implementation Guide – Summary Section 6

Objectives 1 & 2 have been combined into one document – “*Generic HACCP Models for Food Assurance*” Objective 1 – Stage 1 & 2 International Literature Search, Objective 2 HACCP Models Report, dated August 2001.

Objective 3 is a separate document Titled “*Generic HACCP Models for Food Assurance – Implementation Guide*”, dated September 2001.

4.0 DEFINITIONS

WORD(S)	DEFINITION
APPROPRIATE LEVEL OF PROTECTION (ALOP)	Level of protection deemed appropriate by the country establishing a sanitary or phytosanitary measure to protect human, animal or plant life or health within its territory
CONTROL (NOUN)	(In relation to application of HACCP principles) the state wherein correct procedures are being followed and criteria are being met.
CONTROL (VERB)	(In relation to application of HACCP principles) to take all necessary actions to ensure and maintain compliance with criteria established in the HACCP plan
CONTROL MEASURES	(In relation to application of HACCP principles) any action and activity that can be used to prevent or eliminate a food safety hazard or reduce it to an acceptable level.
CORRECTIVE ACTION	(In relation to application of HACCP principles) Any action to be taken when the results of monitoring at the Critical Control Point indicate a loss of control.
CRITICAL CONTROL POINT	(In relation to application of HACCP principles) a step at which control can be applied and is essential to prevent or eliminate a food safety hazard or reduce it to an acceptable level.
CRITICAL LIMIT	(In relation to application of HACCP principles) means a criterion which separates acceptability from unacceptability.
HACCP	(In relation to application of HACCP principles) Hazard Analysis and Critical Control Point. A system which identifies, evaluates and controls hazards which are significant and the measures for their control to ensure the safety of food. It focuses on prevention rather than end-product testing.
HAZARD	(In relation to application of HACCP principles) a biological, chemical, or physical agent in, or condition of, food with the potential to cause an adverse health effect
HAZARD ANALYSIS	(In relation to application of HACCP principles) the process of collecting and evaluating information on hazards and conditions leading to their presence to decide which are significant for food safety and therefore should be addressed in the HACCP plan.
HAZARD IDENTIFICATION	The identification of biological, chemical and physical agents capable of causing adverse health effects and which may be present in a particular food or group of foods
MONITOR	(In relation to application of HACCP principles) the act of conducting a planned sequence of observations or measurements of control parameters to assess whether a critical control point is under control.
RISK	A function of the probability of an adverse health effect and the severity of that effect, consequential to a hazard(s) in food
RISK MANAGEMENT	The process, distinct from risk assessment, of weighing policy alternatives, in consultation with all interested parties, considering risk assessment and other factors relevant to the health protection of consumers and for the promotion of fair trade practices, and, if needed, selecting appropriate prevention and control options
STEP	A point, procedure, operation or stage in the food chain, including raw materials, from primary production to final consumption
VALIDATION	Obtaining evidence that the elements of the HACCP plan are effective

5.0 PROCESS FOR THE DEVELOPMENT OF THE GENERIC HACCP MODEL

A summary of each step in the process is provided in the following sections :

5.1 Literature Search

To meet Objective One of the project an extensive Literature search was undertaken to identify food safety issues, hazards, controls and desired outcomes over the range of crops listed below:

- Root crops - potatoes, carrots, onions,
- Fruit crops - apples, kiwifruit, summerfruit, sub-tropicals,
- Seeds/sprouts,
- Leafy green - lettuce, brassicas,
- Glasshouse - tomatoes, capsicums,
- Berryfruit, and
- Organic crops.

The Report " *Generic HACCP Models for Food Assurance Programmes* " dated August 2001 detailed the findings of the International Literature Search.

The process involved a web search and utilisation of the technical libraries within NZ (including the AgriQuality NZ, Crop & Food, HortResearch and MAF Food) to provide the detail for the comprehensive report.

The Literature Search contained :

Trends in Foodborne illness outbreaks in Fresh Produce.

Foodborne illness outbreaks in Fresh Produce have increased internationally in recent years. A combination of factors may have caused this increase.

The change in dietary habits i.e ready to eat food with no" cook and kill" step.

Better reporting and identification of pathogens

More virulent strains of bacteria

Changing Bacterial behaviour

New pathogens have emerged

All year round supply of produce

New foods now eaten raw

The report was broken into sections to cover Potential Biological Hazards, Potential Chemical Hazards , Heavy Metals and Potential Physical Hazards.

5.1.1 Potential Biological Hazards

After completing the literature search a number of potential biological hazards were found to be associated with fresh produce. These are detailed below :

Viruses

Fresh produce may act as a vehicle for transmission for virus infection, however viruses cannot grow in or on foods.

The specific viruses which have been identified from the Literature search associated with fresh produce were :

- Norwalk Like Viruses
- Hepatitis A
- Rotavirus
- (Other viruses)

Pathogenic Micro organisms

The specific Pathogenic Micro organisms which have been identified from the Literature search associated with fresh produce were :

- E.coli 0157:H7
- Salmonella
- Campylobacter
- Shigella
- Clostridium botulinum
- Clostridium perfringens
- Listeria monocytogenes
- Yersinia enterocolitica

Parasites

All the parasites identified require passage through an animal or human host.

Specific parasites covered were :

- Giardia
- Cyclopora cayetanensis
- Cyclosporidium parvum

5.1.2 Potential Chemical Hazards

The Literature search focussed on 3 areas for potential chemical hazards of fresh produce these were :

Residues in Soil
Residues in Water
Pesticide Residues in Fresh Produce

Specifically DDT , DDE and copper were identified as having some persistence in soils in New Zealand.

There was limited information on residues in water.

It was found that the results from the combined MAF / MOH surveys were in broad agreement with residue monitoring in other countries and confirmed the Department of Healths rankings, which put microbial contamination of food as a potentially more serious health problem than residues.

5.1.3 Heavy Metals

Similarly the Researchers broke this area into the same categories

Heavy metals in Soil
Heavy metals in Water
Heavy metals in Fresh Produce

It was found that the presence of Cadmium in all Phosphatic fertilisers could present the greatest risk. However published data on Cadmium levels in New Zealand is scarce.

A potential cause for concern for heavy metals in water is roof catchment systems rather than atmospheric deposition.

Published data and or reported incidences of heavy metals in Fresh produce was difficult to find.

5.1.4 Potential Physical Hazards

The Literature search highlighted that there is very little reported incidence of physical hazard contamination of Fresh Produce.

Care needs to be taken not to draw a conclusion that physical contamination does not occur – perhaps it is more likely that incidences are not recorded.

In summary the Literature Search highlighted the following :

It has not been possible to identify measurable food safety objectives from the information obtained from the literature search. This highlights the need for further research and / or improved recording systems in food safety issues for fresh produce.

As a result the Food safety objectives used to underpin the HACCP models are described generally as absence for biological and physical hazards. Researchers believe this may not be desirable due to the possible control measures required to achieve absence of some or all of the identified hazards.

In other words there is a danger of implementing and maintaining impractical control measures where they are not necessary.

The food safety objectives for chemical residues should be defined as not exceeding the importing country MRLs. However the researchers note that the information obtained from the literature search which has been used to determine the significance of chemical residues, is based on the New Zealand MRLs. Information on compliance with importing country MRLs is not publicly available.

5.2 HACCP Model development

The information from the Literature Search was analysed and the results were used to develop the generic HACCP model. Continuous consultation with MAF Food staff has been undertaken to ensure the application of HACCP principles was consistent with MAF Food's application of HACCP and followed Codex guidelines on HACCP Application.

In addition, the project outcomes have been developed in consideration of the existing Food Safety and/or related programme's currently operating in the Fresh Produce Industry.

Because this process has been followed, the structure described in the Report, *Generic HACCP Models for Food Assurance Programmes*, provides an internationally credible platform from which to develop or review existing Food Safety Programmes for Fresh Produce. The structure includes:

- An international Literature Search
- Product Descriptions
- Process Flows
- Hazard Identification
- Hazard Analysis and Significance
- Control Measures
- Critical Control Point Determination (CCP)

- Critical Limits
- Monitoring of CCP's
- Corrective Action Taking
- Verification Procedures
- Documentation and record keeping

Because of the lack of information available to determine food safety objectives HACCP application is difficult to achieve in the fresh produce industry. Rather the researchers believe that at this stage it is more appropriate for this industry to apply HACCP principles and good agricultural practices as appropriate instead of all the HACCP principles, unless enough scientific evidence and food safety objectives for HACCP plans are available.

It should be noted that the models produced are generic. Every operation would need to complete a Hazard Analysis to ascertain if their individual / unique operation required further HACCP application.

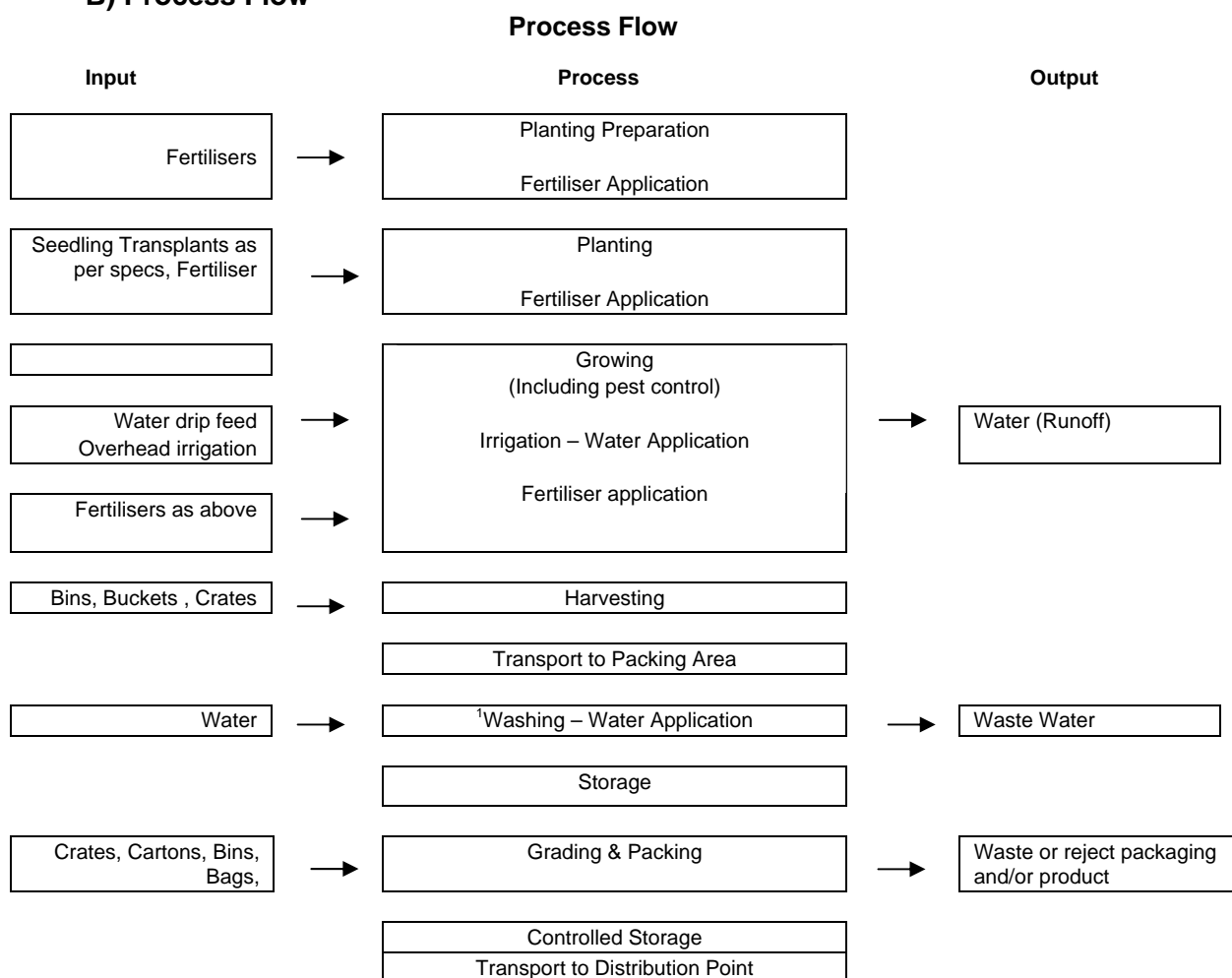
To follow is the recommended HACCP model outline. For a more detailed example please refer to Objective 3 Report, Appendix 1 - September 2001 which is available from MAF Policy.

HACCP Model Outline - Leafy Greens

A) Product Description

Description:	
Relevant safety information:	
Packaging:	
Durability & storage conditions:	
Method of distribution:	
Expected uses:	
Vulnerable groups of population:	
Potential for abuse:	

B) Process Flow



C) Hazard Identification, Analysis and Significance

Process Step	Hazard Source	Hazard
1 – Planting Preparation		
2 – Planting		
3 – Growing	e.g Fertiliser Application	Norwalk-like Viruses, Hepatitis A, E. coli O157:H7, Salmonella, Campylobacter Shigella, Listeria, Clostridium
	E.g. Water	
4 – Harvesting		
5 – Transport		
6 – Washing		
7 – Storage		
8 – Grading/Packing		
9 – Controlled Storage		
10 – Transport		

D) Control Measures

Process Step	Hazard Source	Hazard	Control Measure
1 – Planting Preparation			
2 – Planting			
3 – Growing	e.g. Fertiliser Application	Norwalk-like Viruses Hepatitis A <i>E. coli</i> O157:H7 <i>Salmonella</i> <i>Campylobacter</i> <i>Shigella</i> <i>Listeria</i> <i>Clostridium</i>	Manures, biosolids and other fertilisers are certified or sourced from reputable suppliers. This may include following appropriate composting standards to ensure proper treatment.
	e.g water		Treat water separately for each operation
4 – Harvesting			
5 – Transport			
6 – Washing			
7 – Storage			
8 - Grading/Packing			
9 – Controlled Storage			
10 – Transport			

E) CCP Determination

Process Step	Hazard Source	Q1	Q2	Q3	Q4	CCP Y/N
1 – Planting Preparation	e.g Incorrect Fertiliser Application	Yes	No	No		No
2 – Planting	e.g Contact with ill food-handlers	Yes	No	No		No
	e.g Incorrect Fertiliser Application	Yes	No	No		No
3 – Growing						
4 – Harvesting						
5 – Transport						
6 – Washing						Treat water separately for individual property
7 – Storage						
8 - Grading/Packing						
9 – Controlled Storage						
10 – Transport						

NOTE : Water is to be treated separately for individual properties.

Q1 = do control measures exist for the identified hazard

Q2 = is the step specifically designed to eliminate or reduce a hazard to an acceptable level

Q3 = could contamination occur or increase to unacceptable levels

Q4 = will a subsequent step eliminate or reduce the likely occurrence of the hazard to an acceptable level.

Documented Procedures for CCP's

Controls:	
F)Critical limits (CCP only)	
Parameters being checked	
Target level for each parameter.	
G) Monitoring procedures	
Responsibility for monitoring	
What is going to be done	
Monitoring method, sampling regime etc.	
Monitoring frequency	
How the observations are to be recorded	
H) Corrective action procedures	
Responsibility for taking corrective action	
How is control restored	
How is control and disposition of non-conforming product managed	
Action taken to prevent the problem from happening again	
Escalating response is available if preventative action fails	
How the above actions are to be recorded	

I) Verification Of HACCP Plan

Verification is the application of methods, procedures, tests and other evaluations, in addition to monitoring, to determine compliance with the HACCP plan's food safety objectives and control measures.

For the control measures one of the main methods of verification is through audit and testing. Examples of this are:

Internal

- a. Internal audits by a competent staff member,
- b. Obtaining a Certificate of Analysis (COA) from suppliers of manure, biosolids and other natural fertilisers to demonstrate the absence or control of potential hazards,
- c. Reviewing results of refresher training for food and packaging handlers to determine ongoing awareness and compliance with appropriate safe food procedures,
- d. Testing of produce for biological and chemical hazards,
- e. Visual inspection of produce for physical hazards, and
- f. Visual monitoring of food-handlers practices.

External

- g. Third-party audits of each operation such as those carried out by auditors for industry export programmes,
- h. Third-party audits of product and service suppliers to determine safe practices are being followed, e.g. packaging, equipment, transporters, stores,

J) Documentation and record keeping

For each hazard and CCP, verification activities in addition to the activities described above, should be described as in the following table :

Responsibility for validation / revalidation	
How validation is to be done	
Responsibility for ongoing operator verification	
When is ongoing operator verification to be carried out	
How is ongoing operator verification to be done	
What follow up action is to be taken if non-compliance occurs	
How the above activities are recorded	

6.0 IMPLEMENTATION STRATEGY

The horticultural industry is facing demands from both regulatory and commercial parties for operating systems that ensure “customer” requirements are met. Customer requirements range from regulatory phytosanitary to commercial ethical staff practises, and include assurances of organic production and food safety. Most require the supplier to undertake a Hazard Analysis and identify any Critical Control Points (HACCP) as part of their system development.

The Final Report from Project FMA 101 dated May 2000 *To Review; Research and Design HACCP Models Acceptable to Industry for Export Plant Integrity* recommended the development of a separate Code of Practice. Since this recommendation was made the Fresh Produce Industry has taken more ownership and responsibility in the area of Food Safety (e.g. the New Zealand Fresh Produce Approved Supplier Programme contains considerable guidance information on the production of safe food). Industry members consulted during this project believe a separate Code is not appropriate. Some parties indicated willingness to work closer with MAF Food to ensure a unified approach to any further development of the programmes currently operating in the Fresh Produce Industry.

Objective 3 Report recommends that MAF implement the outcomes of this project using existing links and channels of communication e.g PMAC, MAF Website.

To facilitate the integration of the findings of this project it is critical that a close working relationship is developed with the Industry Federations and associated bodies such as:

- New Zealand Vegetable & Potato Growers Federation (Vegfed)
- Fruitgrowers Federation of New Zealand
- The Plants Market Access Consultative Committee (PMACC)
- Pipfruit Growers New Zealand Inc.
- Horticulture Export Authority (HEA)
- Ministry of Health (MoH)
- Zespri International Ltd.

It is possible that the reports generated from this project could be used to support existing initiatives undertaken by the industry (e.g. the NZ Fresh Produce Approved Supplier Programme (NZFPAS) and various exporter programmes), particularly if it becomes necessary to negotiate food safety border access arrangements for New Zealand Fresh Produce with overseas regulatory authorities. Building on existing industry programmes would avoid a duplication of work in this area in addition to enhancing the uptake of Good Agricultural Practices and HACCP principles.

The produce industry is an international industry and is exposed to the impact of change on a global basis, which has lead to the increased awareness of global initiatives such as The European Union Working Group Good Agricultural Practices (EUREP GAP).

The NZFPAS programme has been developed using HACCP principles and Good Agricultural Practices for the domestic market. The NZFPAS Programme Committee have been working with the NZ Ministry of Health since the development of the programme. A natural progression would be to build on the findings of this project to further develop the programme to meet international requirements (e.g. EUREP GAP). The Researchers believe that any such development to address international requirements would be enhanced by considering the outcomes from this project because of the consistency with Codex and MAF Food's application of HACCP.

Further Research

The Literature Search highlighted a number of areas where further research or more information is required before a hazard can be determined as significant or not. These include:

The presence of *Yersinia enterocolitica* in New Zealand waters,
The level of health risk associated with *Cyclospora cayetanensis*,
The uptake of residues in soil by plants and any conditions leading to the presence of heavy metals,
Information to determine hazard significance for heavy metals in soil such as likely occurrence, evaluation, persistence and conditions leading to the uptake by plants.

Crown Research Institutes (CRI's) could better target their research in this area of microbial, chemical and physical hazards utilising the information generated from this project.

Further information can be obtained in the report Operational Research contract FMA169 – Generic HACCP Models for Food Assurance – Implementation Guide – September 2001.