HACCP as an Innovation Tool: Case Studies in Horticulture

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ABSTRACT

The application of the CODEX Hazard Analysis Critical Control Point (HACCP) methodology has been actively encouraged if not demanded in Australian horticulture to prevent or eliminate the food safety risk in fresh produce or reduce it to an acceptable level. HACCP has had a significant impact in the reduction of foodborne illness relating to the consumption of fresh (and processed) horticultural produce and in the management of farm chemical residues. It has also assisted in the management of physical contamination.

Although HACCP was designed for food safety purposes, there has been strong support in its application to manage produce quality risk resulting in an improvement in the consistency of quality of fresh fruit and vegetables. There is also strong evidence to suggest that the application of the method can lead to increasing awareness of new ways to deal with existing problems and improve or widen the scope of operational processes.

This paper reviews the principles underpinning the HACCP methodology in the light of data collected during an action research project. It then looks at the way three case study organisations have applied the principles as a problem-solving / risk management technique and extended the process to identify potential improvement opportunities and implement solutions that have had substantial benefit for their businesses.

The paper then draws the conclusion that successful implementation of the HACCP method could be a major stimulus for product and process improvement in the horticultural sector.

Keywords: Hazard Analysis Critical Control Point (HACCP), Horticulture, Innovation

1.0 Introduction

Many horticultural enterprises are looking for ways of improving what they do. Although Australian horticulturalists are amongst the most efficient in the world (Day et al., 1997, p. 1.17) they are still searching for productivity and process improvement gains. Anecdotal evidence suggests that more often than not the improvement focus has been towards breeding more productive plant varieties, better soil management, the introduction of sustainable agricultural practices, improved mechanisation and the development and more efficient use of farm chemicals. Much of the improvement gains have been orchestrated by representative industry associations and with the support of research and development institutions.

Although newer 'good farm practices' have been actively encouraged by the supporting organisations, their adoption on-farm has often been slow. There are many reasons for this including the costs associated with implementing the new practices, the changes to daily routine and procedures that must be undertaken and the doubts associated with whether the new practice will really work.

In the last twelve to eighteen months the fresh produce market has been insisting that growers of produce develop, implement and maintain appropriate food safety and quality systems, if they want to secure their place as a supplier (Bryar, 1999, p. 40). A number of quality system/food safety initiatives have evolved. Many growers saw the development and implementation of such programs in their business as an imposition to, or in addition to their daily operations, instead as complimentary to, or supportive of their current management practices. The continual stream of daily work particularly during the harvest period did not promote tactical or strategic thinking or planning. The business focus was on operational tasking. The failure to think beyond the day-to-day activities was often exacerbated by a poor understanding of planning processes and the perceived lack of time available for anything other than the task-at-hand. Responding to customer demands for HACCP became yet another problem to be confronted. The dearth of information on what HACCP was, system requirements, what system was most appropriate and how to implement it encouraged putting the decision aside and the continuance of existing practices.

There is growing evidence to suggest that once horticultural enterprises develop and implement a HACCP-based food safety/quality system, they are encouraged to look deeper into and beyond day-to-day activities, often finding improved ways of working.

2.0 Research Method

The research problem became apparent to the author whilst undertaking an action research consultancy assignment with a group of small to medium sized horticultural enterprises. The growers were somewhat perplexed as to what HACCP-based food safety/quality system they needed to implement to meet the needs of their customers and how to put it into place.

Dick (1992, p. 2) noted that action research is a methodology that has two aims: an action aim (to bring about change in some community or organisation or program); and a research aim (to increase knowledge or understanding on the part of the researcher [or consultant]) or the client organisation or both.

This project clearly aimed to bring about change. Firstly, a change in the way participant organisations undertook their day-to-day operations. Secondly, a change in business focus to that of food safety and the meeting of customer requirements. The research aim was to discover how such businesses went about the process of developing and implementing HACCP.

Although the process of participatory action research can be described as a series of steps, it is generally thought to involve a spiral self-reflective cycles of

> planning a change,
> acting and observing the process and consequences of the change,
> reflecting on these processes and consequences, and then
> replanning,
> acting and observing,
> reflecting, and so on …… (Kemmis & McTaggart, 2000, p. 595).

During the process of discovering the appropriate food safety/quality system and the learning, development and implementation of that system, the above steps were applied in a collaborative process. The data collected was shared and group and personal reflection took place. Interestingly, the group found that the process was not as cut and dried as the model suggested and that the simple steps of our process often overlapped – but that is another story.

It is the intention of this paper to initially review each of the principles in turn in the light of the group experience and then look at case study enterprise innovation. The paper will not review the research project or report in detail in terms of the action research or action learning aspects.

Following the successful development and implementation of the HACCP-based food safety/quality system, three horticultural enterprises reported what they believed were significant changes to their operations. They became case study organisations for the purpose of this research. The paper will then report on how those organisations took the HACCP method one step further using the framework to promote innovative practice.

The persons with the food safety/quality system responsibilities within the case study enterprises were interviewed using a structured process. This data gathering activity was complimented by the open discussion that followed allowing others in the workplace to take part. The focus of this process was to seek both what was common and what was particular about the cases, and then trying to find the link or stimuli, if there was one, which supported innovation. To reduce the likelihood of misinterpretation, feedback was actively encouraged at all times to clarify the accuracy of the data collected.

3.0 The Case Study Enterprises

A description of the three case study organisations follows:

a. A strawberry grower, packer and agent whose market is primarily linked to the retail sector (major supermarket chains) and a substantial wholesale stall at the Melbourne Fresh Market. They are one of the largest businesses of their type in the state of Victoria. They also have over 10 independent growers that sell their produce under the generic company label or through their own labels at the market.

b. A large strawberry and capsicum grower and packer who has supply links with one of the major supermarket chains and the Melbourne Fresh Market. They operate independently and do not use the services of a market agent.

c. A small strawberry grower and packer who acts as a market agent selling their own produce through the Melbourne Fresh Market and through an interstate agent in the Flemington (Sydney) Fresh Market.

The first two case study enterprises were part of a network of grower businesses that were drawn to a Victorian Farmers Federation HACCP information evening. Although more of the group did implement HACCP, these two enterprises expressed interest in sharing their learnings and successes. The third case study organisation implemented HACCP independently and was drawn to the study through their involvement with the Victorian Strawberry Growers Association.

4.0 The HACCP Methodology

The HACCP system, which is science based and systematic, identifies specific hazards and measures for their control to ensure the safety of food. HACCP is a tool to assess hazards and establish control systems that focus on prevention rather than relying mainly on end-product testing.

Any HACCP system is capable of accommodating change including advances in equipment design, operational procedures and developments in practice. Essentially, the HACCP system will facilitate the prevention or elimination of the food safety hazard or their reduction to an acceptable level. The CODEX Alimentarious Commission (1993, p. 2) suggests that the successful application of HACCP requires the full commitment and involvement of management and the workforce. It also requires a multidisciplinary approach; this multi-disciplined approach should include, when appropriate, expertise in agronomy, production, microbiology, public health, food technology etc.

HACCP describes a logical sequence for thinking through a known process, considering where the likely sources of non-conformances could arise and then taking appropriate action in order to prevent these from happening (Adams, 1998, p. 333). With a food safety focus, the non-conformances take the form of microbiological, chemical and physical contamination.

4.1 The Seven Principles of HACCP

The HACCP system consists of the following seven principles:

- Principle 1 - Conduct a hazard analysis (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).

- Principle 2 - Determine the Critical Control Points (CCPs) - 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.
- Principle 3 - Establish Critical Limits (a criterion that separates acceptability from unacceptability).
- Principle 4 - Establish a system to monitor control of the CCP.
- Principle 5 - Establish the corrective action to be taken when monitoring indicates that a particular CCP is not under control.
- Principle 6 - Establish procedures for verification (methods, procedures, tests and other evaluations, to determine compliance) to confirm that the HACCP system is working effectively.
- Principle 7 - Establish documentation concerning all procedures and records appropriate to these principles and their applications.

4.2 HACCP in General

A key element in each principle is common sense coupled with a sound knowledge of the produce, the processes involved and an understanding of the principles and application of the HACCP system. The HACCP system is also dynamic encouraging food producers to look at new and better ways of processing.

The strength or success of the HACCP method depends on its application in enterprises. Generally speaking, horticultural enterprises have had limited exposure to HACCP and it has been the influence of the market, notably the major supermarket chains, that have forced its implementation. Obviously smaller horticultural enterprises will not have the same resources as larger businesses - all too often it is one or two people that manage and work the business on a day-to-day basis, relying on casuals and packers during the harvest period. This fact contributes heavily to potential weaknesses in the application of HACCP in the prevention, elimination or reduction of food safety/quality risk to an acceptable level. However, as it is the owner who has the food safety/quality responsibilities and is the one who is intimately involved with all aspects of the business, they are in a good position to respond to potential problems and to exploit the opportunities for improvement.

Implementing HACCP systems requires both education and training. Daly (1998, p.20) reinforces that education is required to convince horticulturalists of the need for maintaining

systems and understanding customer requirements. Training is required to ensure that people involved in processes understand and can follow procedures on a consistent basis.

5.0 Discussion on the Application of the HACCP Principles and Their Link With Innovation

The seven principles of the CODEX HACCP method are reviewed in turn. Grower data obtained from the action research project, where appropriate, is also explored.

5.1 Principle 1 – Conduct a hazard analysis

The first principle is essentially about the process of collecting and evaluating information on hazards and conditions leading to their presence, deciding which are significant for food safety and therefore should be addressed in the HACCP plan. This principle requires the development of a flowchart that identifies all process steps including inputs, transfers, inspections and delays. The process flow diagram plays an important role in hazard prevention. It details how the produce is produced and indicates all critical steps in the process. It can be used to check that none of the critical steps have been changed or other potentially hazardous steps introduced. For many businesses this is the first total operational review that they have undertaken.

For each step in the process horticulturalists must identify the hazards, assess the significance of the hazards and determine what control measures need to be applied to control the significant hazards. All inputs to a process including raw materials like fertilisers, farm chemicals, water source, packaging materials, equipment, storage conditions, processing methods, produce, premises and people that have a potential to introduce a hazard into the produce need to be considered.

Unfortunately the assessment of the significance of a potential hazard is subjective and relies heavily on the knowledge and experience of the HACCP team – in many cases, the grower themselves. When a hazard has been identified the horticulturalist needs to ask and answer two questions:

- What is the severity of the hazard (the seriousness of the hazard to consumer safety or produce quality)?
- What is the risk of the hazard (the likelihood of the hazard occurring)?

These two questions force the grower to think about what they do, how they do it and what are the potential consequences, particularly if processes are out of control. It is normally this principle that stimulates the new thinking.

This principle has stimulated change in a number of areas including:

- the use of farm chemicals and the impact of withholding periods during harvest (an increased risk of chemical contamination).
- the use of uncomposted manure like chicken droppings in the soil (the risk of microbiological contamination).
- The use of water sources such as streams and dams for irrigation purposes (the risk of microbiological contamination).

Control measures have been developed by growers to prevent, eliminate or reduce the above risks to an acceptable level.

5.2 Principle 2 - Determine Critical Control Points (CCP)

Once the significant hazards and the control measures have been identified for each step in the process, it is necessary to determine whether that step in the process is a critical control point (CCP). A CCP is one where loss of control will result in a hazard to the safety of the consumer or the loss of produce quality. The question is really 'if nothing is done at this step in the process, will the hazard become uncontrollable'? If the answer is yes, one or more control measures need to be applied.

This principle reinforces the need for growers to take and keep control of operational processes. It often shows that current practices are not sound enough and that they need to be modified in some way. Examples from the group include:

- Developing farm chemical spray schedules that take into account projected harvest timings and withholding periods.
- The use of fully composted or heat treated/sterilised manure instead of raw chicken droppings.
- The move from overhead to trickle irrigation to prevent potentially contaminated water coming into direct contact with produce.

5.3 Establish Critical Limits For Each CCP

Critical limits need to be established for each CCP. A critical limit is a 'prescribed tolerance' from which there can be no deviation if the produce is to meet food safety and specified quality criteria. They provide the opportunity to distinguish between acceptability and unacceptability, establishing the difference between safe and unsafe, good quality and poor quality produce. Every control measure must have a critical limit. If the critical limit for a control measure is exceeded a hazard may exist. Hence it is vital that they are validated and that they are easily measurable, and where possible, monitored continuously.

Since the aim of any quality system is amongst other things to detect problems as soon as they occur and certainly before they reach the customer, the critical limits chosen must give rapid results.

Many growers have had difficulties in determining critical limits particularly in the area of microbiological contamination. Generally, they have had to rely on ‘good farm practice’ or established industry norms such as appropriate cool room storage temperatures and strictly following farm chemical label instructions.

5.4 Establish a System to Monitor Control of Each CCP

The HACCP plan will determine what monitoring procedures are necessary to ensure that the process remains in control and that the critical limits are not exceeded. Monitoring is the act of conducting a planned sequence of observations or measurements of control parameters to assess whether a critical control remains under control. Monitoring can also help growers identify problems before they occur and pinpoint the cause of problems.

On many occasions horticulturalists have to monitor their own actions. Unless specific monitoring procedures are put in place requiring checklists or diary entries to be completed, this task is often overlooked resulting in potential food safety breaches that could have been dealt with early. The question ‘If I have completed the action and I know it, why do I have to document it?’ is often asked. The answer falls back to the provision of objective evidence for external audit purposes.

5.5 Establish Corrective Actions

When monitoring indicates that a critical limit has been exceeded, corrective action must take place. The immediate action is comprised of two parts. Firstly, the process needs to be adjusted to regain control. Secondly, the suspect produce should be segregated and dealt with.

Corrective action is focused on:

- Identifying the nonconforming produce to prevent it being inadvertently used.
- Deciding what is to happen to the nonconforming product.
- Adjusting the process to maintain control.
- Recording the corrective action taken.

Corrective actions should be reviewed at least annually looking for trends and the opportunity to implement preventative strategies.

5.6 Establish Verification Procedures

There are three main elements to verification:

- Continuous internal review of the monitoring and corrective action records to ensure that the overall process and each CCP is in control.
- Internal and external auditing to ensure that the principles of HACCP are being followed and that the process and inputs have not changed.
- Internal or external justification or validation that all relevant hazards have been identified, that the analysis of significance is valid and justified, the critical limits are appropriate and the monitoring and corrective action procedures are effective.

Horticultural enterprises often must utilise external sources to verify that they are managing the potential food safety risks. Such testing will normally include chemical residue and microbial load testing of produce, and microbial load testing of the irrigation water source. Regular laboratory testing will verify that their practices are sound. Underpinning this activity are grower ‘good farm practices’ and HACCP support programs such as calibration of measuring equipment, cleaning, pest control, good management practices, traceability and recall, training and approved suppliers that assist to keep the system under control.

5.7 Establish Documentation and Record Keeping

This is often the most difficult step for enterprises. Record keeping must provide (for external audit purposes) objective evidence that:

- Each control measure and monitoring procedure has been correctly applied.
- The critical limits have not been exceeded.
- The monitoring procedures have been followed.
- Verification procedures have been implemented and adhered to.
- Where there has been a deviation, corrective action has been implemented.

For many horticultural enterprises this will mean the development of new documentation and the introduction of a regular schedule of daily and monthly checks as well as internal audits. Existing documentation such as Farm Chemical Spray Diaries, Fertiliser Diaries and Dispatch Records will complement the requirement for record keeping.

It is essential that these businesses record all the information required by legislation, institute a process for effective produce identification and traceability, and put operational procedures in place that will ensure control of their processes.

6.0 The Cases

6.1 Case Study 1

This horticultural enterprise is one of the largest businesses of its type in the industry. It grows and packs substantial quantities of produce and has a network of growers who provide additional produce for sale under a generic label or through the market agency.

During the conduct of the hazard analysis and identification/assessment of potential risks they were able to recognise where the weaknesses in their current system of control were and modified the processes and procedures to deal with the potential risk. When questioned about what prompted them to look beyond their existing system and the HACCP Plan they explained that they wanted to grow their business to substantiate their claim as one of the largest supplier of fresh strawberries. HACCP had given them a degree of confidence that they could expand their operations without increasing the food safety and quality risk.

When deciding to undertake the HACCP process, this organisation made a number of conscious decisions that would facilitate growth without compromising food safety and quality. This involved the building of new packing and storage facilities – the design of the infrastructure and operational process changed a number of times as they became more familiar with the application of the HACCP principles. After the implementation of their HACCP system, they decided to construct a new, purpose built facility at the Melbourne Fresh Market that would enable customers to view their produce in a food safe/quality environment. The organisation's knowledge of HACCP made that task easier.
The enterprise also developed an approved supplier system that would enable their grower network to link with them without increasing the food safety/quality risk. This involved the conduct of an on-site hazard analysis of each of the individual growers businesses and the identification of the potential hazards and the control measures that needed to be put in place to minimise the risk.

6.2 Case Study 2

During the development of the process flowchart and subsequent hazard analysis this organisation saw the considerable quantity of produce (both strawberries and capsicums) that did not meet agreed customer specifications. This produce would normally be dumped or sold cheaply at the front gate. Their HACCP food safety risk assessment indicated that the produce was food safe and suitable for other purposes (they had assumed incorrectly that the produce was not sound). Rather than continue to throw the produce out they searched for another market. In the case of strawberries they found that they could sell them to a producer who would use the produce for jams and sauces. They also found that the producer would accept the produce in a number of forms - fresh with or without the calyx and whole and diced frozen. All forms had to comply with specifications.

The enterprise conducted a further hazard analysis relating to the requirements for processing/part-processing the fruit and determined that it was within their capabilities. They saw that their new idea could be put into practice without too much modification to their existing operations. Suitable equipment was purchased and a processing line developed.

They are still fine-tuning the processing of strawberries. They have tried removing the calyx in the field and in the shed with a simple, farm-made machine. The process worked well in

both locations however there is a higher food safety risk if the capping is conducted in the field. They are currently verifying their system.

The business has also found a customer that requires frozen, diced capsicum. They are able to use capsicums that have blemishes or marks on them that were unsuitable for the fresh market. They are able to cut away the blemishes or marks, dice and sanitise the capsicums prior to freezing.

The business owners believe that if they did not have a practical knowledge of HACCP that they would not identified the opportunity to process produce that was largely unsaleable.

6.3 Case Study 3

The third case study enterprise is small when compared to the previous two. Nonetheless, they sell fresh strawberries in the Melbourne and Sydney markets. The business owner identified that chemical residue on produce was his biggest potential risk. Generally speaking, strawberries require much chemical treatment to manage pests and diseases. Not only is this an expensive exercise, it is also time consuming.

This organisation decided to look for other methods of pest and disease management that would reduce the need to spray thereby reducing the potential food safety risk. They investigated the use of predatory mites to control invertebrate pests and saw promise. They introduced an integrated pest management program whereby they substantially reduced the need for farm chemicals resulting in cost and labour savings.

The business owner suggested that if he did not look into his operations as deeply as HACCP required, he would not have seen the possibilities for change. He also indicated that the process made him question the everyday things that he had been doing for years, often without really knowing why, and that provided the stimuli for new practices. This organisation still uses farm chemicals but it is only part of the total strategy for pest and disease management. They are keeping abreast of new methods and have volunteered to be a part of government trials in pest management.

7.0 Implementing HACCP: The Challenges

There is little doubt that HACCP is the best-developed and most widely accepted system for the management of food safety and quality risk. As straight-forward as it is, enterprises that decide to implement HACCP, face a number of challenges. Von Holy and Marais (1998, p. 29 & 31)) suggest these include:

- The system – whilst it is relatively easy to set up the documentation, implementation and maintenance of the system provide a plethora of potential problems.
- Time, resources and training – it takes time to implement HACCP. During this period an in-depth analysis of all processes and inputs needs to take place and control measures activated. These activities need resources – people, and they need to be trained.
- Senior management commitment – HACCP can only be implemented and maintained if a food safety/quality culture is evident in the business supported by senior management.
- Responsibility: a team effort – everyone in the business has a part to play. Like a chain, a HACCP plan is only as strong as its weakest link.
- Operators drive HACCP – HACCP will only function if it is driven by operators, the person on-the-job doing the job.

The action research group certainly experienced the above. However, once HACCP is bedded into an enterprises operation and becomes a part of the day-to-day practice, it can promote new thinking when operators at all levels start to question what and why they do particular actions.

8.0 Concluding Remarks

Morrison et. al (1998, p. 364) writes that HACCP is a risk-based food safety assurance system that concentrates prevention strategies on known hazards. Proponents of HACCP have argued that the system can focus on the critical stages from producer to consumer in a cost-effective manner. HACCP identifies potential hazards and faulty practices at an early stage rather than reacting to deficiencies in end-product testing.

The case study organisations support this statement however have provided objective evidence that HACCP can also be used to stimulate new practices that can result in productivity gains. HACCP therefore offers a new dimension for those enterprises that do

not want to accept the status quo and are willing to continuously question how and why they operate in the quest for improvement.

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