

# **HAZARD ANALYSIS CRITICAL CONTROL POINTS (HACCP): A TOOL FOR MANAGING FARM CHEMICAL RESIDUES**

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*Abstract:* Strategies to reduce potential food safety risks in fresh fruit and vegetables need to start in the paddock or orchard with the horticulturalist. Although Commonwealth and State food safety legislation is not directed at regulating inside farm gate activities, the market itself is demanding that growers, packers and distributors apply the Hazard Analysis Critical Control Points (HACCP) methodology within their quality management systems to prevent, eliminate or reduce the food safety risk to an acceptable level.

The identified food safety risks in horticulture include chemical (agricultural chemical residues in produce and soil, cleaning agents etc.), physical contamination (sticks, stones, glass, plant matter etc.) and microbiological (bacteria, fungi, viruses and parasites). These three food safety risks have the potential to harm humans.

HACCP has made a significant impact in the reduction of foodborne illness relating to the consumption of fresh (and processed) horticultural produce. It has also led to improvements in the consistency and quality of produce. However there is emerging concern that HACCP, particularly when applied at the grower level, is not truly addressing potential excess chemical residue contamination.

This paper explores the Codex Alimentarius Commission Guidelines for HACCP and its application in the horticultural industry, focusing on small horticultural enterprises (SHE), in ensuring maximum chemical residue limits are not exceeded.

*Key words and phrases:* Quality Systems, Horticulture, Hazard Analysis Critical Control Point (HACCP), Maximum Chemical Residues Limits (MRL), Small Horticultural Enterprises (SHE)

## 1.0 Introduction

The horticulture industry in Australia is valued at \$3.5 billion and in Victoria is worth \$1.3 billion per annum. Horticulture in Victoria supports 8,500 enterprises employing 50,000 people full-time and up to 100,000 during harvest periods (NRE, Farming and Agriculture – Horticulture, 2000). When compared with other primary producers from around the globe, Australian horticulturalists are amongst the most efficient in the world. On average, each farmer produces enough food to feed over 80 people compared to ten people in 1940 (Day et al., 1997, p. 1.17). This increase in productivity is due to many factors including the breeding of 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.

Farm chemicals have become an important part of modern farming techniques. Pesticides are used for agricultural purposes to control unwanted insects, mites, fungi, rodents, weeds, nematodes and other pests and to control diseases in crops. Pesticides have been used in world agriculture for many years and provide higher yields, year-round availability and improved quality, quantity and variety in our food supply. Herbicides are used to control weeds help to reduce plant competition for moisture, light and nutrients. Fungicides prevent or contain outbreaks of fungal diseases that cause injury to plants (Day et.al, 1997, p. 1.17).

Chemical contamination may also take place because of naturally occurring substances or environmental pollutants. Unlike farm chemicals, contaminants are not deliberately added to food or crops (ANZFA, 1998, p. 2). Ingestion of excessive levels of pesticides and contaminants can have detrimental health effects on consumers.

The consumer is starting to question the application of farm chemicals on fresh fruit and vegetables. There is an ever increasing demand for clean, safe food from Australian and overseas customers. This has prompted the adoption of quality assurance schemes by customer focussed individuals and companies involved in food production and distribution. The key question is whether such quality assurance schemes can effectively manage the potential chemical residue problem.

## 2.0 Definitions

The following definitions are offered by Cook (1998) and will assist the reader to understand the nature of the research and the problems associated with it:

**Residue** – a residue is a small amount of an agricultural (farm) chemical that remains in the produce after application to the plant. Residues may also refer to the small amount of heavy metal taken up from the soil by the plant during its growing period.

**Maximum Residue Limit (MRL)** – the MRL is the residue level that is legally allowed in food. It also represents the level of residue that should not be exceeded if good farm practice is followed. The National Registration Authority recommends the MRL for each agricultural chemical in various food types in Australia. The Australian and New Zealand Food Authority (ANZFA) publishes MRLs in Standard A14 of the Australian Food Standards Code.

MRLs are action levels that indicate the need for investigation. They do not necessarily indicate that consumption of food containing residues exceeding MRLs would be dangerous to a person's health.

**Maximum Prescribed Concentrations (MPCs)** – The MPC is the highest concentration of impurity not deliberately added to agricultural produce (mainly heavy metals) which is legally permissible in Australian produce. ANZFA publishes MPCs in Standard A12 of the Australian Food Standards Code.

Where an MPC is not listed for a metal contaminant in a particular food, residue monitoring and consumption data for that food indicates that dietary intake of the metal contaminant does not constitute a health hazard.

**Withholding Period (WHP)** – the WHP is the minimum period of time which must elapse between the last application of the chemical and the harvest of the crop. Together with the correct application practices, the observance of the specified WHP is essential to ensure that unacceptable residues are not present in the produce.

**Violation** – A violation occurs when produce is found to contain residues above the MRL. If there is no MRL listed for an agricultural chemical in a particular line of produce, there must be no detectable residues of that chemical in that food.

**Limit of Detection (LOD)** – the LOD is the minimum concentration of chemical residue that can be confidently detected in a sample by a specific method of analysis.

**Good Farm Practice (GFP)** – GFP is the nationally recommended, authorised or registered pattern of use of agricultural chemicals.

### **3.0 Farm Chemical Use**

Agricultural (farm) chemicals are widely used in Australian horticulture. Public awareness and concern about the environmental and health hazards associated with their use have become significant factors. Public concern has led to stringent regulation of farm chemicals and the types used. Two questions are in the minds of horticulturalists. Should growers use farm chemicals? Are there effective alternative methods for the control of pests and diseases? Although chemical minimisation is being actively encouraged in the industry at large, farm chemicals still have an important part to play in agriculture and horticulture.

#### **3.1 Economic Benefits**

The economic, social and environmental benefits of agricultural chemicals are many. The Food and Agriculture Organisation of the United Nations (FAO) estimates that 20 to 40% of the world's agricultural production is lost annually because of the effects of weeds, insect pests and diseases (Day et. al, 1997, p. 1.17). It is broadly accepted that if all farm chemicals were withdrawn, agricultural production would be likely to fall by around 30%. Farm chemicals directly contribute at least \$3000 million a year to agricultural production in Australia.

The future of Australia's fruit and vegetable industry rests with the assurance that we grow and harvest produce that is natural, food safe and wholesome. Consumers want to be confident that minimal or no chemicals are being used. When chemicals are used, consumers want to be

sure that they have been used responsibly and that Maximum Residue Limits (MRLs) and Maximum Prescribed Concentrations (MPCs) are within acceptable levels.

From the small horticulturalist's perspective, the application of farm chemicals is a serious matter. The process is costly in terms of money, time and labour and can often underpin wider strategies like integrated pest management plans. Few can take the use of agricultural chemicals for granted particularly when they are subject to random customer (market and retailer) audits and government department residue tests. In many cases farm chemicals are used because it is the most appropriate way of dealing with a potential or actual problem - a pest or disease threatening to destroy the crop, or the weather conditions facilitating the development of mildews. Purchase and associated labour costs, the time involved, the wait to see if the application has worked, and the all too often worry that chemical residue limits may be exceeded place undue stress on growers. Their position is further exacerbated when an unregistered chemical, even with an appropriate permit, is applied.

### **3.2 Pesticides For Minor Crops**

Many minor crop growers face the problem that when they want to use pesticides, no chemicals are registered for their line of produce. The problem stems from the fact that due to the small size of the market, minor crops are often not considered when pesticide products are being developed and registered (NRA, 1998, p. 35). Growers have three choices:

- They can decide not to use chemicals to manage potential or actual threats.
- They can apply to the National Registration Authority (NRA) to have the minor use approved.
- They can take the risk and use unapproved sprays.

In many cases horticulturalists are damned if they do, and damned if they don't. Damned that they have to use a chemical to control the problem in the first place. Damned that all too often the chemical used is not registered for use with that particular crop (few registered chemicals are available for many minor crops). Damned if they don't because if ignored, the problem can get out of control and ruin the produce.

## **4.0 Methodology**

The research problem became apparent to the author whilst undertaking an action research project with a group of small horticultural enterprises (SHE) who were active in the strawberry industry. The growers were somewhat perplexed as to which quality system they needed to implement to meet the needs of their customer base and how they were going to manage their food safety and quality process. Possible systems included the Woolworths Vendor Quality Management Standard, SQF 2000<sup>CM</sup> Safe Quality Food Code: 1997, AS/NZS ISO 9002, horticultural industry ISO 9002 variants and the Hazard Analysis Critical Control Points (HACCP) methodology which underpins many food safety based quality systems.

As grower understanding of the principles and application of the HACCP framework increased, they became more aware of the potential weaknesses and pitfalls relating to their new food safety and quality management system. Farm chemical application clearly became a potential food safety risk for their product. The question was asked ‘Can the HACCP method effectively manage this risk?’

The following paper shares information that was forthcoming through a number of focus group discussions with those growers and how they might reduce the potential food safety risk relating to agricultural chemical application.

## **5.0 Some Background to the Problem**

Consumers want clean, high quality, wholesome food and are increasingly concerned about chemical residues in their fresh fruit and vegetables. Growers want to provide both food safe and high quality produce. To do so means effective disease and pest control strategies that often include the use of farm chemicals.

The annual Victorian Produce Monitoring Program (VPMP) and the Australian Market Basket Survey (AMBS) are designed to monitor targeted produce for compliance with national food safety standards with respect to chemical and heavy metal residues (Victorian Produce Monitoring Program, 1998, p. 1).

## 5.1 How Significant is the Chemical Residue Problem?

The AMBS monitors pesticide residues and contaminants in food and estimates the level of dietary exposure in Australia. The survey is conducted every two years. The data provides information for the development of standards in the national Food Standards Code and is also used by the National Registration Authority for Agricultural and Veterinary Chemicals during the clearance and registration process undertaken for pesticides. This survey of table-ready foods is a tool that allows Australia New Zealand Food Authority to highlight potential problems that exist in the Australian food supply and to deal with areas of concern (ANZFA, 1998, p. xi).

The 1996 AMBS (p. xiv) stated:

'results indicate that Australians can be confident that the food they eat is very low in pesticide residues and contaminants'.

This result is also supported by the Victorian Department of Natural Resources and Environment (DNRE) research through the annual VPMP. Results are published in Victorian Produce Monitoring on an annual basis with the more recent (Results of Residue Testing 1997 and Program Summary Report 1987-96) supporting the national study:

'Overall, 1.7% of analysis results were above the relevant maximum residue limits (MRL), while 82.8% of results were below the limit of detection for the analysis method used. The results for pesticide residues display a high level of compliance with good agricultural practices' (Dunn & Roberts, 1998, p. 1).

'A targeted sampling strategy was used, whereby DNRE officers selected chemical and produce combinations specifically chosen to investigate emerging or potential residues. Such a strategy would be expected to produce a higher rate of violations than a random sampling program. Despite this targeted approach, the 1997 program results reveal a very low violation rate, confirming the clean, green image of Victorian agriculture' (Cook, 1998, p. 9).

The VPMP 1998 results (VPMP, 1998, p. 3) again indicated that:

‘Similar to previous surveys, the 1998 results confirm the clean image of Victorian agriculture. There were very few instances of produce exceeding MRLs or maximum prescribed concentrations (MPCs)’.

Although the results were very encouraging, monitoring authorities have openly expressed their concern that a single violation can have a severe impact on the health of consumers and that growers needed to do more to ensure that their farm chemical applications will not exceed stated residue limits.

## **5.2 Residue Testing**

Residue studies are conducted for the proposed method of application on crops. These tests determine how much of the compound or its metabolites remains on or in a crop when the proposed treatment is under good farming practices relating to crop production.

The Acceptable Daily Intake (ADI) for humans is derived from feeding studies carried out on laboratory animals. The no-effect level found in such studies in the most susceptible species of laboratory animals is divided by a safety factor that may vary from 100 to 2000 (Day, Hock & MacAlpine, 1997, p. 1.15). The ADI is the cornerstone of toxicological evaluation. The MRL is the yardstick by which residues in food are measured.

## **5.3 Safety Factors**

There are a number of safety factors built into the ADI and MRL:

- A safety factor of 100 - 2000 is used in deriving the ADI from the no-effect level determined in feeding studies with laboratory studies.
- The MRL is set as low as possible, normally accounting for only a small fraction of the ADI.
- Experience shows that residues exceeding the MRL are rare events.
- There is only a very remote possibility that the ADI would be frequently exceeded.
- There is a loss of residues during preparation and cooking.

- The daily intakes of residues under discussion are only a fraction of the quantities required to produce toxic effects.

Before any farm chemical is registered an MRL must be established.

## **6.0 The Hazard Analysis Critical Control Points (HACCP) System**

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. The successful application of HACCP requires the full commitment and involvement of management and the workforce. It also requires a multidisciplinary approach; this multidisciplinary approach should include, when appropriate, expertise in agronomy, production, microbiology, public health, food technology .....! (Codex Alimentarius Commission, 1993, p. 2).

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.

The application of HACCP principles follows twelve steps:

- Step 1 - Assemble HACCP team.
- Step 2 - Describe product.
- Step 3 - Identify intended use.
- Step 4 - Construct flow diagram.
- Step 5 - On-site confirmation of flow diagram.
- Step 6 - List all potential hazards associated with each step, conduct a hazard analysis, and consider any measures to control identified hazards (Principle 1).
- Step 7 - Determine Critical Control Points (Principle 2).
- Step 8 - Establish Critical Limits for each CCP (Principle 3).
- Step 9 - Establish a Monitoring system for each CCP (Principle 4).
- Step 10 - Establish Corrective Actions (Principle 5).
- Step 11 - Establish Verification Procedures (Principle 6).
- Step 12 - Establish Documentation and Record Keeping (Principle 7).

A key element in each step 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 case study strawberry-growing group had all implemented a HACCP based quality system (SQF 2000<sup>CM</sup> and Woolworths Vendor Quality Management Standard – for the purposes of this study the frameworks, implementation and maintenance requirements are the same).

## **7.0 Discussion on the Application of HACCP Principles and Steps With Regards to Farm Chemical Management**

The strength or success of the HACCP method depends on its application in enterprises.

Generally speaking, SHE 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 SHE will not have the same resources as larger businesses - all too often it is one or two people that manage and work the food business on a day-to-day basis and relying on casuals during the harvest period. This fact contributes heavily to potential weaknesses in the application of HACCP to prevent, eliminate or reduce chemical residue risk to an acceptable level.

The twelve steps of implementation of the CODEX HACCP method are reviewed in turn. Grower comments are also explored.

## **7.1 Assemble HACCP team.**

The HACCP system requires a multidisciplinary approach and team members should have a good knowledge of the produce, processes and the potential hazards. However, in the case of small horticultural enterprises, the HACCP team often consists of one - the grower themselves. During the harvest period casual pickers and harvesters may be employed. Such employees often have limited produce knowledge and low level English language skills. Even if they were willing to proactively participate in the food safety and quality process, their contribution would be limited.

The grower therefore needs to be self reliant and keep abreast of *good farming practices* to minimise risk. Many enlist the support of grower associations (in this case the Victorian Strawberry Growers Association) and industry groups (Agriculture Victoria - Institute of Horticultural Development, National Registration Authority etc.) who can, in most cases, assist them through the maze of potential problems.

At times, even with the assistance of these organisations, the pesticide problem cannot be resolved. How does a strawberry grower deal with the Western Flower Thrip when no suitable chemical is registered for use on strawberries? Off-label use has been suggested but the withholding period (WHP) of one of the suggested chemicals presents a dilemma in itself - pick inside the WHP and risk residues that exceed the MRL or pick outside the WHP and have over-ripe produce. Do not use chemicals and the level of mature produce that meets customer specifications can be substantially reduced.

The biggest potential weakness in the system here is for growers to use non-registered farm chemicals and not record their use and hope that if their produce is tested for residue those particular chemicals will not be tested for. This is a dangerous situation. Dangerous in that there may be residues present which exceed the MRL. Dangerous in that this practice sets a precedent that could become common place with both unregistered and registered chemicals alike. Dangerous that what farm chemical management system is in place will subsequently fail to achieve what was intended – the effective management of farm chemical usage.

## **7.2 Describe Product**

A HACCP Plan should be specific to a line of produce or product group. Product descriptions include:

- Description of the produce and how it is presented.
- Method of preservation (to ensure produce meets shelf life).
- Chemical/physical characteristics.
- Primary packaging (size, grade of material).
- Secondary/shipping packaging.
- Storage conditions (conditions under which produce is held prior to dispatch and held by customer).
- Distribution method (conditions under which produce is to be transported to customer e.g. chilled 1-5 °C).
- Shelf life (minimum time period before produce exhibits noticeable quality changes or microbial levels become unsafe when stored under specified storage conditions).
- Sensitive population (does the produce contain ingredients that may be hazardous to certain members of the community).

Many small horticultural enterprises have to rely on their customers for assistance in describing their produce. In some cases, notably the major supermarket chains, a produce specification will be offered and growers will be required to meet those requirements. Such specifications will include the above information as well as food safety and quality criteria, e.g. chemical residue limits for farm chemicals derived from the Australian Food Standards Code. Specifications will assist growers to determine appropriate timing for harvest (degree of

maturity of produce), the development of a suitable farm chemical spray program (pest and disease management following label instructions and WHP) and delivery schedules.

### **7.3 Construct Flow Diagram**

The flow diagram should provide a picture of the process flow. In the case of many small horticultural enterprises this will often include soil preparation and plant selection through planting, nurturing, harvest, grading, packing and distribution to their customer. The flow diagram should also identify 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. With no one else in the business to assist with this step, small enterprises may often miss potentially hazardous inputs when constructing their flow diagrams. This is due to oversight rather than not having an in depth knowledge of their processes. The next step however is designed to ensure that all inputs are taken into account.

Farm chemical application will occur throughout the process. Although some applications can be scheduled (e.g. weedicide and fungicide prior to bed preparation), others will depend on weather conditions (e.g. powdery mildew) and the arrival of particular pests (e.g. Western Flower Thrip, mites). It is these unscheduled applications that present potential problems for growers. In this case growers need to be aware of the consequences of their actions if they fail to follow farm chemical label instructions and WHP to ensure residue limits are not exceeded.

### **7.4 On-site Confirmation of Flow Diagram**

This step requires enterprises to confirm that the process operation is reflected in the process flow diagram. The accuracy and the completeness of the flow diagram is verified by visually walking-through the entire process. This is somewhat difficult for horticulturalists because the process is cyclic in nature and takes, in the case of strawberry growers, up to twelve months for the full process to be realised. This makes verification somewhat more difficult.

Enterprises need to continually check their operations against the flow diagram throughout the

produce cycle if they are to be sure that they have shown adequate consideration to all inputs. Once the total process flow diagram has been verified it is relatively straightforward to compare actual operations against the planned process.

Many growers have found that it is worthwhile looking at a worst case scenario for unscheduled farm chemical application to determine where the potential pitfalls might lie. Generally they will look at the ramifications of an unscheduled farm chemical application (use of both registered and unregistered chemicals that may be applied in the normal course of operations) and gauge the potential impact on the harvest schedule. If there is a need to delay harvest so as to meet withholding times then that particular chemical application may not be an appropriate strategy to manage the given problem.

## **7.5 List All Potential Hazards Associated With Each Step**

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 and 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.

It is also essential to distinguish between the hazard and the cause of the hazard. Consider the hazard of excess chemical residues on produce. The cause of the hazard is more often than not inappropriate chemical application (not following label instructions or withholding period, poorly maintained spray equipment, inappropriate chemical spraying techniques and ineffective calibration of equipment) rather than spray drift from other properties. Control measures are likely to include farm chemical user training for the operator, calibration and preventive maintenance of spray equipment as well as following label instructions including WHP.

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 this case, 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)?

In normal circumstances, farm chemical usage is seen to be both severe in terms of seriousness to consumer safety and has a high likelihood occurring. A control measure must be put in place to prevent, eliminate or reduce the hazard to an acceptable level. In this case a number of control measures are normally put in place:

- Farm chemical user training for the operative.
- The use of registered chemicals for their intended purpose, following label instructions and withholding periods.
- Preventive maintenance and calibration of spray equipment.
- Good farming practices (common sense and industry best practice).
- Monitoring pest and disease levels in the crop.

The responsibility for controlling agricultural chemical hazards must lie with the grower. Clearly, training in responsible chemical use is important. Often this is the first step in the prevention, elimination or reduction of the of the level of risk to an acceptable level..

## **7.6 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.

Each and every farm chemical application becomes a critical control point for growers.

## 7.7 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. Critical limits must be easily measurable and where possible, monitored continuously. Prescribed MRLs for particular crops are the critical limits for farm chemical application. These however, cannot be measured on-farm and require specific laboratory processes and so become impractical for growers. As a practical substitute, horticulturalists tend to follow chemical label instructions taking note of application and dilution rates as well as WHP. This practice must also be supported by chemical residue testing. Such testing will validate grower actions and clearly demonstrate that they are not compromising the food safety of produce. If chemical residues do exceed MRLs and good farm practices have been followed, growers are encouraged to discuss the problem with the relevant State Agricultural Department who will investigate the situation and propose new practices to further reduce the possibility of future violations. Other critical limits may include:

- Operatives must have completed a Farm Chemical Users course.
- Spray equipment must be in a serviceable condition and regularly calibrated.
- Crops will be monitored for pests and diseases.

The use of non-registered chemicals needs to be addressed. In the ideal world non-registered chemicals would not be used however, because of economic necessity, they are used, and used more widely than generally accepted. Many horticulturalists use non-registered chemicals and take the risk of MRL being caught out. Following label instructions and withholding periods for like produce may not be enough. Any level found above the limit of detection (well below MRLs) constitutes a breach of food safety. Simply applying such chemicals and not recording their use in Farm Chemical Spray Diaries constitutes an additional weakness in the system of controlled chemical use. Growers urgently need an industry best practice that will protect their livelihoods and support their food safety and quality practices.

## **7.8 Establish a Monitoring System For 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. In the case of farm chemical usage, monitoring procedures will need to specify:

- What is to be monitored - farm chemical application.
- When or how often it is to be monitored - monthly.
- How it is to be monitored - visual check of spray diary. (This can be supplemented by random inspection of application techniques, checking prescribed application rates against actual area covered and produce chemical residue testing).
- Where it is to be monitored - chemical shed.
- Whom is to monitor it - Packhouse Manager (it is always better to have someone other than the farm chemical operator check the diary entries however this is not always possible in small horticultural enterprises).

All too often operators in small horticultural enterprises 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.

## **7.9 Establish Corrective Actions**

When monitoring indicates that a critical limit has been exceeded, corrective action must take place and will include:

- The deviation being brought to the attention of the responsible person.
- The produce affected is identified by tagging and segregated if there is the potential for such produce to contaminate other produce.
- The status of the produce is reviewed and a decision made on what is to be done with it - dump, accept on concession or accept as is.
- The deviation, corrective action and disposition of produce should be recorded.

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.

In the case of inappropriate farm chemical usage e.g. harvesting produce inside the WHP or applying the chemical at a rate that exceeds label instructions, the corrective action is straightforward:

- Identifying which produce has been affected by excess chemical or has been harvested inside the WHT.
- Dumping / destroying the product.
- Reviewing the farm chemical spray program and ensuring that when sprays are utilised, the WHT and label instructions have been followed.
- Record the corrective action.

A key question is whether the small horticultural enterprise is in a better position to be able to recognise the potential chemical residue problem and control the process than larger enterprises? There is much to support the argument that if one person is responsible for all tasks, they will have a better understanding of how the process is operating however this needs to be tempered with workload. The majority of small enterprises suggest that they can exercise control over their processes but many agree that there is a potential to make mistakes because of the multiplicity of activities that need to be done.

## **7.10 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.

Small horticultural enterprises must utilise external sources to verify that they are managing the potential chemical residue problem. They need to introduce a regular schedule of produce chemical residue testing to verify that their farm chemical application practices are sound. Underpinning this activity are the good farm chemical application practices (following label instructions, WHP etc.) and good farm practices that keep the system under control.

### **7.11 Establish Documentation and Record Keeping**

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

- Each control measure and monitoring procedure have 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 agri-horticultural enterprises this will mean the maintenance of a Farm Chemical Spray Diary (and in some cases a Fertiliser Diary). Any other documentation, even with good intentions, appears to fall by the wayside. 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.

## **8.0 Working Together To Find a Solution**

Producers and government have and are still working together to develop key standards which involve:

- Legislation to control use of agricultural and veterinary chemicals.

- Levels of training and education needed by those applying farm chemicals.
- Compliance with national food safety standards that set residue limits for certain chemicals in various food groups.
- Simplifying chemical label instructions so that they are more easily understood.
- Mutual recognition of food safety and quality systems in the Australian agrifood industry.

In addition to the above government staff are constantly providing support to agricultural producers and monitoring adherence to these controls. Still, there is an air of discomfort and uncertainty that existing systems and processes do not manage chemical residues effectively.

## **9.0 Responsible Farm Chemical Use**

It would appear that responsible farm chemical use is something more than following farm chemical label instructions including withholding periods. Although this is an integral part of good agricultural (farm) practice and one key to minimising the risk of exceeding the MRL, a better solution takes on a much broader dimension.

Sound risk management must commence with appropriate training in farm chemical application. To this foundation must be added an understanding of how the chemical works and the potential impact that its use will have on the plant itself, the soil, the natural predatory insects (nature's means of combating pests) and the environment in general. Horticulturalists should also question the use of chemicals and be aware of the non-chemical means of dealing with the potential problems. Best practice may lie in the integration of these techniques into their good farm practices. I am not at all suggesting that farm chemicals be put aside altogether. What I am suggesting is that a well thought out and applied integrated pest and disease management plan with supportive observation may provide a better solution in many cases.

When farm chemicals are applied, the spraying equipment used must be well maintained and calibrated so that the intended rates of application can be achieved. Even with the best of intentions and good farm practice problems may still occur. Horticulturalists need to instigate a process of residue testing that is specifically designed to test their produce for chemicals that they have actually applied. Such tests should be undertaken as soon as the withholding period has expired. A result indicating that MRLs have not been exceeded should offer a higher

degree of confidence that growers are achieving what they have set out to do – produce, food safe produce.

## **10.0 Conclusion**

Even with good chemical application practices and good farm practices, horticultural enterprises are faced with the possibility of breaching food safety requirements by exceeding produce chemical residue limits. Complacency by individuals will increase the potential risk as will the use of non registered chemicals. Although the perceived risk is deemed to be low (validated by ongoing testing and monitoring by independent authorities) much needs to be done to ensure that growers keep up-to-date with industry best practice in dealing with pests and diseases. Industry groups and relevant authorities also need to be encouraged to address the minor crops and chemical registration problem.

## **11.0 Future Questions**

This paper has raised and discussed the issue of food safety relating to farm chemical application and the potential residue problem on fresh produce. It was not the intention to address non-chemical means of dealing with horticultural pest and disease problems (as part of an integrated pest management plan) and environmental management (including soil and water) except to suggest that these subjects are worthy of exploration in detail.

## **12.0 References**

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