PLANNING AND CONTROL OF IPM FOR GREENHOUSE TOMATO GROWERS: PROCESSES USED BY EXPERT CONSULTANTS

A thesis presented in partial fulfilment
of the requirements for the degree of
Master of Applied Science
at
Massey University,
Palmerston North,
New Zealand

Shinta Milasari Singgih
March, 1999

ABSTRACT

Given the clean, green image used to promote New Zealand produce, greenhouse tomato growers are under pressure to shift from conventional pest control to more environmentally-friendly methods such as IPM. However, growers often lack the specific knowledge required to tailor IPM strategies to their properties. Greenhouse consultants with expertise in IPM may provide a valuable source of assistance in terms of IPM adoption. However, little is known about how expert greenhouse consultants conduct this task. This study investigated the processes used by expert greenhouse consultants to assist greenhouse tomato growers with the planning and control of IPM strategies.

A multiple case study research method was selected as the most appropriate method for meeting the study objectives. Following the review of the literature, two expert greenhouse consultants were selected, and the data were collected using semi-structured interviews, field observations, and relevant documentation. Qualitative data analysis techniques were used to analyse the data.

The two consultants were found to use similar IPM consultancy processes which, for the purpose of this study, have been separated into the physical activities, and planning and control processes. Both consultants perform similar physical activities (telephone calls and visits) to those used by farm management consultants. However, the two consultants studied distinguish between planning and control purpose telephone calls and visits, which the farm management consultants do not. In addition, both consultants use additional communication tools during the control stage.

Throughout the consultancy processes, rapport is considered important to enable a trusting relationship to be built between the client and the consultant. The study highlights the presence of three phases during the consultancy processes, which were not mentioned in other farm management consultancy literature. The "screening" phase is used to ensure the development of the client's favourable attitudes toward IPM in the planning process. The "provision of information" phase, which occurs throughout the processes, is critical due to the complex nature of IPM. The "validation" phase is used to confirm the existence of the problems in the control process.

During the planning and control processes, the client and the consultant share several roles and responsibilities. As the clients own the problem, they are responsible for making the decisions, implementing the plans, and undertaking monitoring. In order to do this, the clients act as the information providers and receivers for the consultant. The consultant is responsible for understanding the clients' system, providing the information required by the clients and designing the preventative IPM strategies during the planning stage. At this stage, the consultant also provides a monitoring strategy and contingency plans to be used by the clients. During control, the consultant is responsible for validating and diagnosing the existence of the problems, providing information about the causal effect of the problems and designing the curative IPM strategies to solve the problems. During the design phase, the consultant uses decision rules to modify his IPM template, according to the need of each client.

Factors such as type of crop, greenhouse age, crop age, whitefly population levels, the ability to heat, season, stud height, and persistence period are mentally structured to come up with various *Encarsia* introduction rates. In contrast, the IPM manual suggests a single *Encarsia* rate is used for all situations. The *Encarsia* introduction rates comprise the initial and maintenance rates. Case Study One starts with low rates of *Encarsia* for 2-4 weeks, followed by increasing the rates. Case Study Two starts with high rates of *Encarsia* for 6-10 weeks, followed by reducing the rates. Introduction is discontinued

when the sustainable level of whitefly parasitism has been achieved. A more detailed IPM manual which allows for the specific circumstances in greenhouse tomato growers' properties is required to assist growers in the adoption of IPM strategies

Key words: consultancy, planning, control, IPM, greenhouse tomatoes, *Encarsia formosa*, multiple case studies.

ACKNOWLEDGEMENT

All glory and honour to the Lord, my God and my Saviour, who has given me unbelievable strength and joy whilst undertaking my two years' study at Massey. What can I do without You?

I would also like to use this opportunity to express my gratitude to the people who have been a great help throughout my study:

- Ewen Cameron and David Gray: Thank you for not only being my great (and I really mean it!!) supervisors for the past two years, but also for encouraging and challenging my thoughts. My apologies for all the last minute writings I submitted, which might have deprived you of your sleep.
- Keith Fisher and Terry Steward: Thank you for giving all your thoughts, which have contributed to enriching my thesis.
- Bryan Hart from Substratus New Zealand Ltd and Andrew Austin from R. A. J. White Horticultural Consultants. Thank you for being open and helpful throughout the interview and field visit process. Also for providing me with all the information I needed. This study would not have been as it is without your cooperation.
- Ministry of Foreign Affairs and Trade: Thank you for providing me with the NZODA scholarship throughout the period of my study at Massey University.
- Denise: Thank you for transcribing most of my transcripts and finishing each of them within days. Also for all the many little things which you've sorted out for me throughout the years.
- All staffs of Agricultural and Horticultural Systems Management: Thank you for all the support, concern, and attention shown to me during the past two years.
- My fellow postgraduate friends, Amelita Rodriguez and Oni Bibin Bintoro: Thank you for sharing all the laughter and tears with me. I will certainly miss watching movies, eating out, and singing in karaoke with you guys!!
- My family: Thank you for all the support you have given me while I was far from you here. For Papa, thank you for asking me the same old question every week ("Now you can get a fixed answer, I'm finished!"). For Mama, thank you for all your delicious recipes which satisfied my craving for your cooking while you were not here. For Uwie, thank you for keeping me up to date with all the interesting stories which you had.

I love you all,

Palmerston North, 31 March 1999

shinta

3.05 am.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE
INTRODUCTION

1.1 PROBLEM STATEMENT

For the past few years, the New Zealand fresh tomato industry has been flooded with imported field grown tomatoes from Australia. In order to win a larger market share in such a competitive market, domestic greenhouse tomato growers need to show the advantages of their produce against those of their competitors. New Zealand growers have stressed their "clean green" top quality image, promoting New Zealand grown tomatoes as being tastier and containing fewer chemical residues than those of their Australian counterparts (Beck, Martin, Workman, 1992). One means of producing these high quality tomatoes is through the use of Integrated Pest Management (IPM) strategies in the growing process. IPM strategies attempt to integrate various control measures, with emphasis on the use of ecologically-based measures, to maintain pest populations below economic injury levels.

However, since IPM strategies may become complicated for growers, the uptake of IPM strategies by greenhouse tomato growers is related to two major issues. First, growers need to know how to design IPM strategies suitable for their specific circumstances, and second, they need to know how to manage the crop system once IPM is implemented.

The solutions to those two issues may require expert knowledge to combine and integrate various factors such as greenhouse structure, pests, natural enemy biology, life cycles, and cropping system into the grower's circumstances. Consultants have been quoted in the literature (Wearing, 1988; Martin, Workman, Marais, 1996) as being one of the main sources of providing these solutions for growers. These consultants, who have expertise in IPM, may provide assistance to the growers in the planning of IPM strategies to meet their specific circumstances, and in the management of the system once the strategies are up and running.

However, currently, there is a limited number of horticultural consultants with expertise in IPM for greenhouse tomatoes in New Zealand. Moreover, there is also very limited literature available for consultants or growers in the planning of IPM strategies at farm level (Dent, 1995). Most IPM literature focuses only on the principles, approaches, and

implementation of IPM, without considering how to move the ideas into practice in the field (Dent, 1995).

Therefore, it is considered important to investigate how these few expert consultants in New Zealand assist their greenhouse tomato grower clients both in the planning and in the control stages of IPM management. The findings from this study will benefit not only the expert consultants taking part in the study, in terms of evaluating and improving their approaches, but also other horticultural consultants who will gain insights into how the experts have operated. This will aid the development of the fresh tomato industry and IPM in New Zealand in general. Moreover, such findings can be used also as teaching material for horticultural management students.

1.2 OBJECTIVES OF THE STUDY

The overall aim of the study was to investigate the processes which consultants use to assist greenhouse tomato growers in IPM planning and control stages.

Specific objectives of the study were:

- to review the literature on the planning and control, consultancy, and IPM strategies for greenhouse tomatoes;
- to develop an IPM consultancy process model, comprised of the planning and control stages used by the consultants in assisting their greenhouse tomato grower clients;
- to identify factors considered important by consultants when developing IPM strategies for their greenhouse tomato grower clients;
- to compare the IPM strategies designed by the consultants with those published in the IPM manual.

1.3 REVIEW OF IPM DEVELOPMENT IN THE NEW ZEALAND FRESH TOMATO INDUSTRY

Tomatoes are the second most commonly purchased fresh vegetable, after potatoes, in New Zealand (Statistics New Zealand, 1997), and have been in this position for at least three years. In 1996/97, New Zealand households have been estimated to spend $55.5 million on tomatoes.

In New Zealand, tomatoes are grown both as a field crop and under cover in greenhouses. The majority of fresh tomatoes, however, are produced in greenhouses, either glasshouses or plastic greenhouses, which are distributed from Keri-Keri in the North Island, to Timaru in the South Island. However, the majority of greenhouse tomato

growers are located in the Auckland region, as it is close to the major markets and is an area which has high winter light and warm winter temperatures, thus reducing the need for heating. The size of the average tomato greenhouse is 2,000 m^2 (Austin, *pers.comm.*, June 1998). In 1998, the price of tomatoes on the domestic market varied between $3.80 - $4.50/kg in winter and $1.00 - $1.50/kg in summer. Analysis of the profitability of greenhouse tomato production suggested that, at these prices, a 2,000 m^2 was not financially sustainable (Hart, *pers.comm.*, June 1998). The minimum property size which is financially sustainable (will support a family, mortgage, and reinvestment for expansion) is between 3,000 m^2 to 4,000 m^2 (Austin, *pers.comm.*, June 1998; Hart, *pers.comm.*, June 1998).

Currently, the average production of the greenhouse tomato system in New Zealand is 28 kg/m^2. This is almost half the average level of production achieved by Dutch and UK growers (Austin, *pers.comm.*, June 1998). However, some New Zealand growers currently produce over 50 kg tomatoes/m^2, while others struggle to produce above the national average (Hart, *pers.comm.*, June 1998). A high level of production is normally possible in modern greenhouses, which have a high stud height (3 - 4 m) and a good ventilation system. About 40% of greenhouse tomato growers have installed this type of greenhouse in recent years (Hart, *pers.comm.*, June 1998).

Despite the importance of the tomato in New Zealanders' diet, the number of greenhouse tomato growers in New Zealand has declined from about 1,000 in 1987 to 700 growers in 1997 (Gargiulo, 1997). In the early years of the 1980s, these growers were subject to domestic competition only because insignificant quantities of tomatoes were imported. However, the fresh tomato industry changed when, in 1982, the New Zealand Government allowed tomatoes to be imported from Australia, particularly from Queensland, through the Closer Economic Relations Trade Agreement (Gargiulo, 1997). These are cheaper than the New Zealand produced tomatoes because they are produced outdoors in Australia's more tropical regions, and then imported during New Zealand's winter, when New Zealand growers have high heating costs.

In this competitive market, New Zealand growers must demonstrate that their produce is superior to that of their Australian competitors. The main advantage promoted by New Zealand growers is the "clean green" image of New Zealand tomatoes. The "clean green" image of the New Zealand tomato is enhanced by the shift from a pesticide-dependent production system to more environmentally-friendly methods such as IPM. IPM is favoured by New Zealand growers for several reasons. First, the greenhouse industry

suffers from pesticide resistance problems (van Lenteren & Woets, 1988), and therefore an alternative method of controlling pests is urgently needed. In New Zealand greenhouse tomatoes, the most common pests are whitefly and botrytis (Martin, 1990a).

Second, the changing reassessment systems of pesticide legislation in many countries have resulted in the rapid withdrawal of chemicals which have traditionally been used on tomatoes, while at the same time, the registration process of new, less toxic, and narrower spectrum pesticides, which are often compatible with IPM programmes, has been relatively slow (Wearing, 1990; Whalon & Penman, 1991). These factors have limited the number of pesticides available to growers and increased the risk of pest resistance occurring with the remaining pesticides. Non-chemical pest control methods would provide opportunities for growers to deal with these situations.

The third reason for favouring IPM strategies is that there has been increasing consumer concern about pesticide use on food crops, particularly in Europe (East & Holland, 1990; Wearing, 1992; Wells, 1994). Consumer perceptions of food safety are mainly driven by media exposure of dietary hazards, which focus on pesticide residues found in food, and environmental contamination by agricultural chemicals (East & Holland, 1990). Such attitudes have prompted increased pesticide residue monitoring in food supplies, particularly those which are eaten fresh. Minimal pesticide residues are becoming an integral part of food standards demanded by consumers, at no extra cost on their part (Wearing, 1992). Unfortunately, this kind of attitude is not typical of New Zealand consumers, and has therefore not been recognized by the New Zealand tomato packhouses, which pack and market about 20% of greenhouse tomatoes in New Zealand (Austin, *pers.comm.*, June 1998; Hart, *pers.comm.*, June 1998). Currently, there is no premium paid for IPM-grown tomatoes over conventionally grown tomatoes. However, it is acknowledged that growers who are able to produce good quality tomatoes, are usually growers who incorporate IPM strategies into their production systems (Tregidga, *pers.comm.*, May 1998). Hart (*pers.comm.*, June 1998) believes that if there was a premium for IPM produce, growers would be more likely to adopt IPM and invest in new greenhouses to support IPM strategies.

Research on IPM in New Zealand greenhouses was initiated by the DSIR (Department of Scientific & Industrial Research) in 1981 (Beck *et al.*, 1992). The tomato was chosen because it represents such a large proportion of the greenhouse industry in New Zealand. Preliminary key areas for research were identified as (Martin, 1987):

1. control of whitefly prior to release of *Encarsia formosa* (whitefly predator) and the use of selective pesticides harmless to the *Encarsia*;
2. control of fruit and leaf feeding caterpillars;
3. control of tomato stemborer.

The active promotion of IPM programmes for some major greenhouse crops, such as tomatoes, cucumbers, capsicums, and beans, however, had to be delayed until 1991, while waiting for the registration of a selective pesticide, buprofezin, for whitefly control (Martin, 1990a; Beck *et al.*, 1992).

When the research started, it was assumed that the Ministry of Agriculture and Fisheries (MAF), through its horticultural advisory officers, would provide free advisory services (Martin, 1990a) critical to the successful adoption of IPM by growers. However, as a result of Government reforms in 1985, which included the removal of all subsidies in the agricultural sector, growers have had to pay for the advice which they receive (Journeaux & Stephens, 1997). Because greenhouse properties in New Zealand are small and geographically dispersed, consultancy costs are relatively expensive for growers. The cost of IPM advice may be regarded by growers as being not worth the savings obtained from implementing IPM (Martin, 1990a).

According to a pest and disease control survey made of greenhouse tomato growers in New Zealand in 1989, the traditional sources of information (in descending order of importance) for these growers were: other growers, grower journals, overseas trips, and consultants (Martin, 1989). Based on this information, IPM programmes were then further promoted through industry magazines, grower meetings, demonstration plots, and manuals (Beck *et al.*, 1992). Key growers from each greenhouse tomato region were supervised regularly by a full-time advisor appointed to provide free assistance for growers on IPM, and paid by the IPM project funding. Group meetings were held to discuss the programmes in detail, and feedback was obtained from growers to improve the programmes. The key growers were expected to pass on their knowledge to other growers in the area. In the meantime, an IPM manual covering all aspects of pest control for each crop was produced.

From the early stage of IPM promotion and implementation until early December 1992, Crop and Food Research (formerly DSIR Plant Protection) was responsible for the supply of beneficial organisms to growers (Beck *et al.*, 1992). However, the supply of these predators, particularly *E. formosa*, sometimes arrived late, by which time the growers had sprayed their crops. These growers often then decided not to use IPM in the following

season (Austin, *pers.comm.*, June 1998). To minimize this problem, responsibility for supplying the beneficial organisms has been passed over to several commercial companies.

Unfortunately, short-term and uncertain funding, particularly for the provision of free consultancy services for growers, have resulted in the lack of permanence of the IPM project. After the completion of the three-year IPM project, growers had to rely on private consultants or retailers of beneficial organisms for advice on IPM, which was often inadequate. In 1992, funding for a two-year IPM project for greenhouse crops was obtained from three sources: the Technology for Business Growth (TBG) scheme, the Fresh Tomato Sector of the Vegetable and Potato Growers' Federation (VegFed), and Crop and Food Research (Martin *et. al.*, 1996). A specialist IPM advisor was again appointed to assist greenhouse growers. In addition to the approaches for IPM promotion used in the first project, this IPM project provided training for consultants and representatives of beneficial organism retailers (Robertson, 1995). It also undertook the distribution of leaflets on the biology of pests and natural enemies, and the establishment of Hortnet, an internet-based source of information on horticulture (Martin, 1996). At the end of this two-year project, growers were again left without a free advisory service. The provision of information for growers has since become a major issue in IPM. This information is now the competitive edge for private consultants and companies which supply beneficial organisms (Hart, *pers.comm.*, June 1998).

Despite the work of the previous IPM projects, few of New Zealand's horticultural consultants specialising in vegetable crops have developed expertise in IPM. Limited literature is available to guide horticultural consultants in developing expertise in tailoring IPM strategies to meet the specific circumstances of growers. Therefore, investigating how such processes are conducted by expert horticultural consultants will assist the development of IPM in greenhouse tomatoes in New Zealand.

1.4. THESIS STRUCTURE

This thesis reports on the findings of a study of the processes used by expert horticultural consultants to help greenhouse tomato clients in the planning and control of IPM strategies. In Chapter One, the fresh tomato industry in New Zealand is described, along with the development of IPM programmes for greenhouse tomatoes in New Zealand. Chapter Two contains a literature review of IPM, IPM programmes for greenhouse tomatoes, the planning and control process, the farm management consultancy processes, and the role of consultants in IPM crop business is presented. The selection

and description of the research method used in the study is provided in Chapter Three. Chapter Four contains a detailed description of the findings from the case studies. In Chapter Five, the cross-case analysis is discussed. Generalization from the case studies are then compared and contrasted with the literature. Finally, the main findings from the literature and the case studies are reported in Chapter Six, followed by a critical assessment of the method used for the study, and indications as to possible areas for future research on the subject.