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Development of an integrated pest management program in celery

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IPM Technologies Pty Ltd

Project Number: VG99070

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Know-how for Horticulture™

Final Report

DEVELOPMENT OF AN INTEGRATED PEST MANAGEMENT PROGRAMME IN CELERY

Project Number: VG99070

Prepared by: Dr Paul A. Horne
IPM TECHNOLOGIES PTY LTD

Executive Summary

Starting point

Prior to the commencement of this project, there was very little grower awareness of the many different species of pests that could cause damage, and practically no awareness that beneficial insects (predators and parasites of pests) existed within celery crops.

The approach to dealing with pests was regular and often frequent applications of broad-spectrum insecticides. This approach meant that aphid-borne diseases such as celery mosaic virus had became worse over time, as natural enemies of aphids were systematically prevented from living in celery crops but aphids were not all killed. Resistance to insecticides by some pests meant that the standard reliance on insecticides meant that a new approach was required.

Development

This project allowed identification of both major and minor pests of celery. These are listed in this report. Following the identification of these pests, specific control measures were developed. These control measures include identification of biological control agents, cultural (management) techniques, and selective or strategic use of chemicals.

Efficacy trials were suggested for registration of products, and this was carried out in a separate project by Crop Protection Approvals. As a result, celery growers have access to insecticides that are compatible with an IPM approach.

Demonstration

The regular and frequent, direct contact between researchers in this project and growers has allowed a unique development to take place. Celery growers have learned the elements of integrated pest management (IPM) and implemented it immediately. They have been prepared to apply the recommendations of researchers because they were deeply involved in the assessment and decision-making process.

This regular contact between researchers and growers has instilled confidence in applying new processes. From a growers point of view, if the advisor does not believe in their advice, why should the grower? Therefore, in this project, the researcher stood in the farmers paddock each week and gave advice, and then assessed the outcome of that advice the next week.

Field Days were run but the growers using IPM were already aware of everything that the researchers had to say. Some growers did attend, but in the main, chemical resellers were the dominant attendees at these days.

Such a result was not unexpected or undesirable. The information on IPM in celery was extended to a wider audience.

Adoption

Major growers

IPM logo

Participating growers in this project were:

- J. & J.M. Schreurs and Sons (Tom, Theo and Adam Schreurs)
- Peter Schreurs and Sons (Darren Schreurs)
- L. & G. Gazzola and Sons (Paul and Andrew Gazzola)
- Corrigan's Farm (Geoff and Deborah Corrigan)
- Favero Farms (Glen and Silvio Favero)

This is a small number of growers, but these growers produce the vast majority of celery in Australia. Of this group of five farms, the first three are using, or plan to use, an IPM logo on their cartons. This proves the success of the implementation component of this project. Of the remaining two farms, one uses an IPM approach now to all crops they grow, not just celery. The fifth farm has heavily modified their insecticide use as a result of this project, but have not fully adopted IPM.

Guide to IPM in celery

This report contains a guide to the species of most interest in celery and methods to monitor the pests. Identification of these insects is possible using some of the currently available guides to insects in other horticultural and broad-acre crops. If required, this section of the report could be used as a stand-alone document.

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Summary of Activities and Achievements

General

This project aimed to develop an IPM strategy for celery and to demonstrate that IPM strategy to celery growers. Both activities occurred at the same time, as growers actively took part in the decision-making process.

The methodology consisted of staff from IPM Technologies P/L visiting participating grower's farms once per week, assessing the insect situation in terms of pests and beneficial species, and making a decision on any pest management actions required. At least two sites were monitored on each farm, to cover different aged plantings.

This methodology allowed several activities to be performed concurrently:

1. A list of pest species and the damage they caused was compiled
2. Species that were present but that did not cause damage to celery were identified
3. Seasonality of key pests was documented
4. Growers became able to recognise both pest and beneficial species
5. Growers were comfortable with decisions because they could see why they were made
6. Researchers from IPM Technologies were able to extend information and see it adopted during the life of the project, not after the completion of the project.
7. The regular direct contact with growers allowed confidence in IPM to be developed, and so control measures based upon biological agents and management techniques usually replaced reliance on insecticides

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Project Milestones:

Description and Achievement criteria:

- **IPM demonstrated on farm to participants**
- **Demonstrations as scheduled, and field trials commenced**
- **Initial field trials completed**

- **Field Day conducted**
- **Complete field days and demonstrations**
- **Final Report**

Research Provider: **IPM Technologies Pty Ltd**
Principal Investigator: **Dr Paul A. Horne**

Summary of Achievements and Outputs

Demonstration of integrated pest management (IPM) in celery

This project has been very successful in providing celery growers with a demonstration of how IPM can help to control pests. In addition to simply demonstrating what is **possible** using IPM, the project has convinced all the farmers involved in the trial to **implement** IPM in their celery crops, and on other crops that they grow. That is, the demonstration showed farmers how IPM was a better method than conventional spraying for whatever crop is considered.

In the early stages of this project, we identified the major pests of celery. Despite being an apparently simple task, growers could not say what insects were really a problem other than list "aphids and caterpillars" as pests they routinely encountered. This is because their previous management relied on a routine spray programme with broad-spectrum insecticides, and so growers did not need to be too accurate in pest identification.

Entomologists from IPM Technologies P/L visited participating grower farms each week since the commencement of the project. On each visit the degree of risk posed by each species of pest, and the level of control likely to be provided by beneficial species, was assessed and discussed with the grower. The result has been a significant reduction in insecticide use in the crops being monitored.

Monitoring for aphids in particular allowed immediate reductions in pesticide use. Timing of other insecticides for caterpillars allowed further reductions in pesticide applications and also better results with less harmful products. There were large differences in the timing of sprays between different regions where celery is grown.

Identification of the real pests in celery

The very first step in this project was to determine what insects were really of concern in celery in Australia. There were many misconceptions of pests, lack of knowledge that some pests were present, and almost total lack of understanding about the presence and potential of beneficial insects in celery. This project has changed that situation, and now growers and advisors are aware of the species that are of real concern and the role of beneficial insects and mites.

The initial discussions with celery growers at the beginning of this project could only identify "aphids and caterpillars" as major pests. The approach to dealing with these at that time was applying regular and frequent insecticides. The development of an IPM approach obviously depended on being much more specific in terms of what species were of concern.

Helicoverpa (Heliothis) armigera was clearly the most important caterpillar pest during this project. Pheromone trap captures indicated the seasonality and so major risk periods of damage from this pest (figure 1).

A summary of the key pests and beneficials, and how to monitor for them is provided in this report in the form of an IPM Guide.

Identification guides to both the pest and beneficial species occur for other industries, including several horticultural industries. Neither the pests nor the beneficials described here are restricted to celery crops.

The major pests identified in this study are:
Helicoverpa (Heliothis) armigera
Aphids, especially Green Peach Aphid, *Myzus persicae*
Cutworm caterpillars (*Agrotis* species)

Pests found regularly but of less importance include:
Helicoverpa (heliothis) punctigera
Thrips (onion thrips, *Thrips tabaci*)
Vegetable weevil (*Listroderes difficilis*)
Lightbrown apple moth (*Epiphyas postvittana*)
Looper caterpillars (*Chrysodeixis argentifera*)

Minor Pests include:
Slugs (*Deroceras reticulatum* and *Milax gagates)*
European Earwigs (*Forficula auricularia*)
Earthworms (contaminants in produce)

Adoption

There has been an extremely rapid adoption of IPM as a result of this project, and this is clearly due to the farmers being able to see the strategy demonstrated on their own crops, and real decisions being made each week. The success of this project is given by the fact that growers have used the celery model to begin IPM on other crops as well. The rapid adoption of IPM achieved through this project stands in contrast with most reported rates of adoption of IPM in crops throughout the world (Ref: Herbert, D.A. 1995, Integrated pest management systems: back to basics to overcome adoption obstacles. *Journal of Agricultural Entomology* ***12:*** *203-210*).

Regular (weekly) visits by entomologists from IPM Technologies P/L to participating growers' farms each week are the key to the rapid rate of adoption of IPM. On each weekly visit, management options have been discussed with the grower and recommendations regarding the selection and use of insecticides (if necessary), have also been made each week.

There is no doubt that the first-hand contact between IPM specialists and the growers, making site-specific decisions, is an important means of implementing change.

Pesticides within an IPM strategy

We have conducted field and laboratory trials to determine how effective and how selective certain new pesticides are, and how appropriate they are within an IPM programme. Trials with spinosad and GemStar have shown that these products would be far more suitable to control Heliothis (a key pest) than the currently available products. Trials were organised with Crop Protection Approvals to obtain registration of these products, as a result of this project.

Spinosad ("Success") and "GemStar" are far less disruptive to most beneficial organisms, and so to any IPM strategy. GemStar is a virus that is only effective on *Helicoverpa* spp. and so correct identification of other caterpillar pests (eg. cutworm, loopers, lightbrown apple moth) is more important than under a conventional broad-spectrum spray-based control programme.

Field Day

A field day to explain how IPM in celery can be carried out was conducted on the property of J. & J.M. Schreurs and Sons in September 2002. In addition to celery growers, staff from E.E. Muir & sons were present and were very interested in finding out about IPM and the details of how to monitor for beneficial insects.

This project, and IPM in celery in general, have been reported in the newsletter VegeLink, by Patrick Ulloa (Industry Development Oficer), and in the Southern Farmer newspaper (August issue) and Good Fruit and Vegetables magazine.

Change in pesticide use

Confidential grower surveys of previous use of insecticides were made during the project. At certain times of the year (summer) when pests were abundant and damage was occurring, some very heavy pesticide use had occurred. For example, one grower used 2 insecticides at a time over a 12 week period, plus one more when damage still occurred. That is, a total of 25 insecticides in 12 weeks.

The insecticides used prior to this project belonged to the organophosphate, organochlorine, carbamate and synthetic pyrethroid groups. That is, non-selective, broad-spectrum insecticides.

All growers involved in this project decreased insecticide use. The change was significant, not only in the volume of pesticide used but in the type used. Before the project, all growers routinely used insecticides for aphids, and subsequently have used selective aphicides just a few times in a year.

A Guide to IPM in Celery

Introduction

There are hundreds of different insect species that can be found in most vegetable crops. A few are pests, but most are either beneficial (helping to control pests) or benign (neither pest nor beneficial). Monitoring the insects regularly throughout the life of the crop, and even before planting in some cases, allows you to know exactly what types of insects are present and determine the risk of damage. Controlling the pests in a sustainable way is best achieved through an Integrated Pest Management (IPM) approach, which involves using cultural, biological and chemical measures in a compatible way.

The risk of damage will depend on many more factors than just the number of pest insects found during monitoring. Information on the numbers of pest and beneficials found is necessary to allow an accurate assessment of risk to be made. Other factors that influence the likelihood of damage are:

1. The type of beneficial insects present (do they feed on the pest concerned?)
2. The end-use of the crop (local, export)
3. Irrigation (type and timing)
4. Time of year
5. District in which the crop is grown
6. Time of planting (early or late crop)
7. Pesticide use
8. Soil management
9. Variety of celery

10. Harvest date

Integrated Pest Management

Cultural Controls and **Biological Controls** are the main elements of any IPM strategy. Important **cultural controls** that impact on pest management in celery are:

(i) weed management (avoid carryover of pests on alternative hosts)

(ii) variety (some varieties are more susceptible to diseases)

(iii) quality of seedling source

(iv) screening glasshouses to exclude disease vectors

(v) Planting and harvesting cycles (avoid planting next to areas being harvested)

(vi) Break crops

(vii) Awareness of adjacent crops and pests (eg. weevils, thrips, aphids)

Biological control agents may be predators, parasites or pathogens. Insect predators and parasites are extremely common and are largely responsible for "unseen" control. They reach where pesticides cannot, and can achieve high levels of control, but they are highly vulnerable to most insecticides. Additional control is often required and if compatible sprays are used that do not kill these beneficial agents then you will have both sprays and beneficial insects working for you. If pesticides are applied that kill beneficial insects then you only have pesticides on your side. Regular monitoring is the only way to know the current situation regarding numbers and control given by biological control agents.

In an IPM strategy, **chemical control** is used to back up cultural and biological controls and should not be seen as the primary control method. When necessary, chemicals that assist biological control should be used rather than those that destroy

biological control. For example, border sprays can be a useful support strategy in an IPM programme.

Recommendations

There are two pests of celery for which control could be significantly improved with some more research and development.

1. A pheromone lure for the species of cutworm (*Agrotis spp.*) would give early warning and information on flight of these moths. I recommend that research funds be directed to developing such lures.
2. It is likely that species of *Epiphyas* closely related to *E. postvittana* (lightbrown apple moth) are pests of celery. I recommend that a small project be funded to identify the species involved and potentially, a pheromone to monitor that species.

Acknowledgements

I would like to thank all of the celery farmers who took part in this project, but especially Mr Tom Schreurs who initiated the project and Mr Theo Schreurs who was the first to try many of the novel approaches to pest management that we suggested. I would also like to thank Mr Patrick Ulloa for his support for this project, and all members of IPM Technologies P/L who took part in different aspects of the project.