

VG034

**Implementation of an Integrated Pest
Management pilot program for the fruit
and vegetable industries in the Bundaberg
district**

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Crop Tech Pty Limited



Know-how for Horticulture™

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PROJECT REPORT: PROJECT V/0034/R1

PROJECT TITLE - IMPLEMENTATION OF INTEGRATED PEST MANAGEMENT
PILOT PROGRAMME FOR THE FRUIT AND VEGETABLE INDUSTRY - BUNDABERG
AND DISTRICT.

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SUMMARY:

Grower awareness of the philosophy of Integrated Pest Management principles has improved in response to a planned extension programme. As part of the programme two IPM videos have been produced and distributed to growers. Pest and disease activity on a wide range of crops with advice on their management have been the topic of daily radio and newspaper reports.

An extensive grid system of 160 pheromone traps has been used to monitor the distribution and population dynamics of potato moth (*Phthorimaea operculella*), the major pest of tomatoes in the region. Weekly data are used to plot areas of heavy infestation on GIS software and the resultant maps published weekly. The source of these infestations are identified and offending growers are counselled on crop hygiene. If producers fail to comply with the advice offered, the IPM coordinator has the power under the Plant Protection Act to order the destruction of the crop. As a result of the IPM program the average time taken for the removal of crop residues has dramatically decreased. This is reflected by a significant reduction in population levels and subsequent damage.

The expected continued decline in pest populations will enable the program to address the use and encouragement of beneficial insects that have been suppressed by heavy chemical use. The next stage of the program will see the establishment of a comprehensive monitoring system for tree crops.

BRIEF SYNOPSIS OF THE PROJECT

The objective of the project was to introduce and develop an Integrated Pest Management pilot programme in Bundaberg for the Queensland fruit and vegetable industry. The programme is aimed at reducing insect and disease pressure, and reliance on chemical controls, by improving cultural practices, strategic chemical usage and encouraging biological control, where possible.

At the commencement of the project, growers were facing rapidly escalating pest populations, that had been exacerbated by poor crop hygiene and continuous cropping through the year. This had led to a reliance on chemical controls in many crops. Chemical costs in the Bundaberg region alone were estimated at \$5.3m/year.

This project has had a high emphasis on training growers in correct management practices. The approach has been to control pests and diseases in a manner which emphasises minimising crop losses by all means at the grower's disposal - the use of resistant and tolerant varieties, appropriate cultural methods, crop sanitation, biological control and a review of spraying strategies to minimise the application of chemicals.

The major crop in the Bundaberg region is fresh market tomatoes which makes up approximately 60% of the gross income for horticultural produce. Capsicums and egg fruit contribute a further 8%, and cucurbits 16.5% of gross values. Tree crops account for 5.6% and other vegetables about 4%. The total value of horticultural crops in the 1990 calendar year was \$127.4 million.

Solanaceous crops constitute the major portion of production and have the highest use of agricultural chemicals, most of which is aimed at Potato Tuber Moth control. Consequently this area has been the focus of the major thrust of the IPM efforts. The high chemical use poses the greatest threat of developing resistance in other pests, which are common to many other crops in the area. Therefore it was imperative to the whole industry that this situation be addressed as a priority.

PROGRESS REPORT:

EDUCATION:

While Integrated Pest Management (IPM) is widely known in the citrus and other tree crop industries, in other areas, very little was known by local growers of the principles that could apply to vegetables and trees in this region.

Many growers mistakenly thought that IPM meant biological control, or organic gardening, and were apprehensive. The perceived benefits were, however, much more attractive than the alarming situation they faced, and the programme received very good support when it was proposed.

Education, therefore, was the first step towards creating an awareness of the basics of IPM. Two seminars were run, a manual was produced, outlining the principles of IPM in our situation. Two videos were produced dealing with cultural control, and the benefits of monitoring crops to spray only when necessary, instead of on a rigid programme. Copies are enclosed.

Over 300 daily radio reports on both the ABC and Commercial radio have been used to pass on information on the activity of pests and diseases to help growers with monitoring operations and warn of potential problems. (Examples are attached). These reports are also printed daily in the local paper. A weekly summary of pest pressures and advice on various matters is also printed in a feature in the growers' section of the local paper.

A comprehensive display with colour posters and other educational material depicting the features and benefits of IPM has been assembled to convey the message to growers. This display has been used at a number of field days and grower meetings in Bundaberg, Gatton, Bowen, Nambour and Rockhampton. Grower groups from Northern N.S.W., Southern N.S.W., Stanthorpe, Sunshine Coast, Redland Bay and Gatton have visited Crop Tech and had talks on the IPM Programme and viewed the displays.

MONITORING:

To closely monitor the population dynamics of Potato Moth (*Phthorimaea operculella*), 160 pheromone traps were set up covering the major growing areas in a 2 km grid. Weekly counts are made at each site and these figures are used to plot the overall population for each area. (See Fig 1). The data are also entered into MapInfo, a GIS Programme which sorts the site counts and plots them on a map, to illustrate areas of high or low population. By identifying the "hot spots" in the district, efforts can be focused on finding the source of the infestation. (Fig 2). These maps are published to alert the growers in affected areas to the increasing population and advice is given to help them avoid potential infestation.

ENFORCING HYGIENE:

In the first two months of the programme (Nov & Dec 1989) the identification of areas of heavy infestation and the location of the source of this insect pressure, in each case, reinforced the concept that poor crop hygiene was a major cause of high pest populations.

Recommendations were forwarded to QDPI in December 1989 requesting a plough out order be served on a particular grower who was clearly in breach of the Plant Protection Act and was not willing to comply with the advice of the IPM Coordinator. Despite a second recommendation some weeks later the QDPI could not enact the order because there was a lack of procedural guidelines.

Although there was a change in attitude and practices of a significant number of growers, the heavily infested crops that remained in the ground into February from the previous spring crops caused a major epidemic. This resulted in some complete crop losses in January and February with losses of 25 - 50 % in some crops as late as March.

During the winter, levels of Potato Tuber Moth declined significantly even though a few growers were still not removing crop residues within a reasonable time.

Some used the excuse that they had used insecticides such as Chlorpyrifos to reduce insect numbers in crop residues while others argued that desiccation of the crops was sufficient to control the emergence of moths. The residues of some of these winter crops lead to a sharp rise in spring.

A trial was subsequently conducted to establish recommendations for the management required to minimize moth emergence from crop residues. (See attached trial results.)

ELLIOTT HEADS, CLAYTON CALAVOS AREAS

□
WEEKLY CATCHES

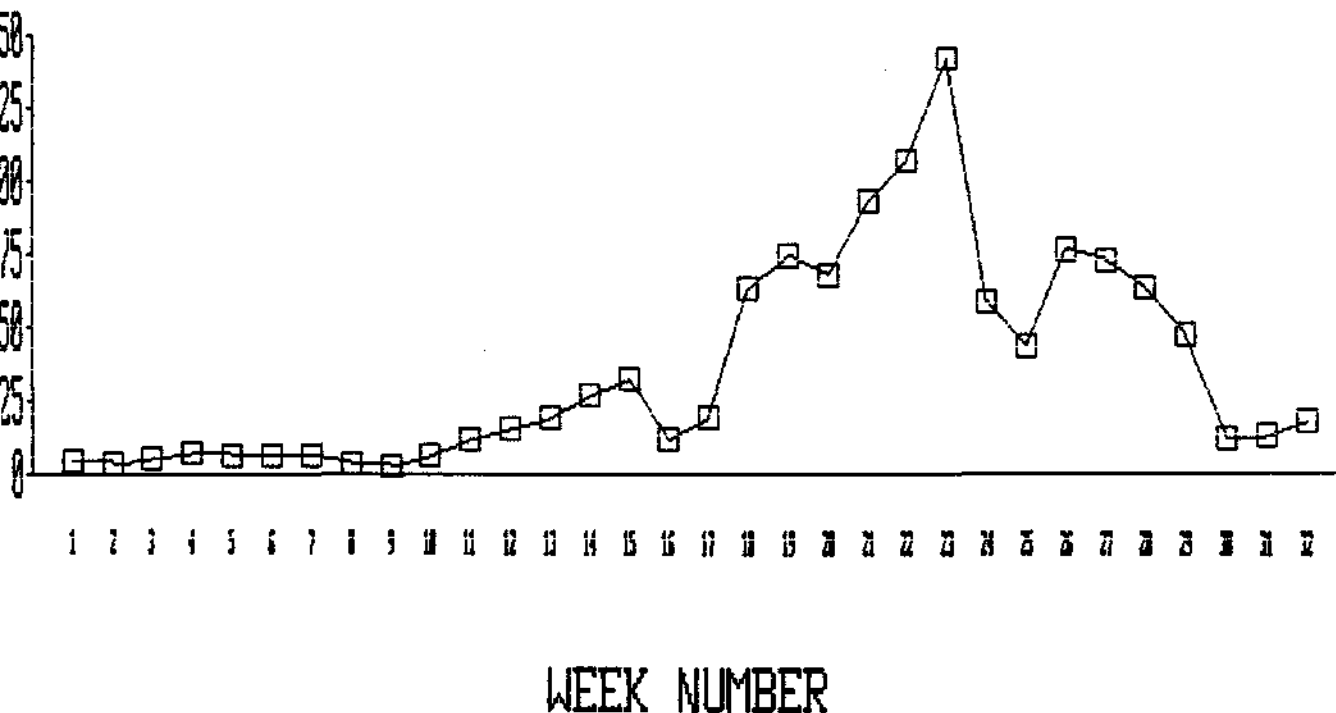
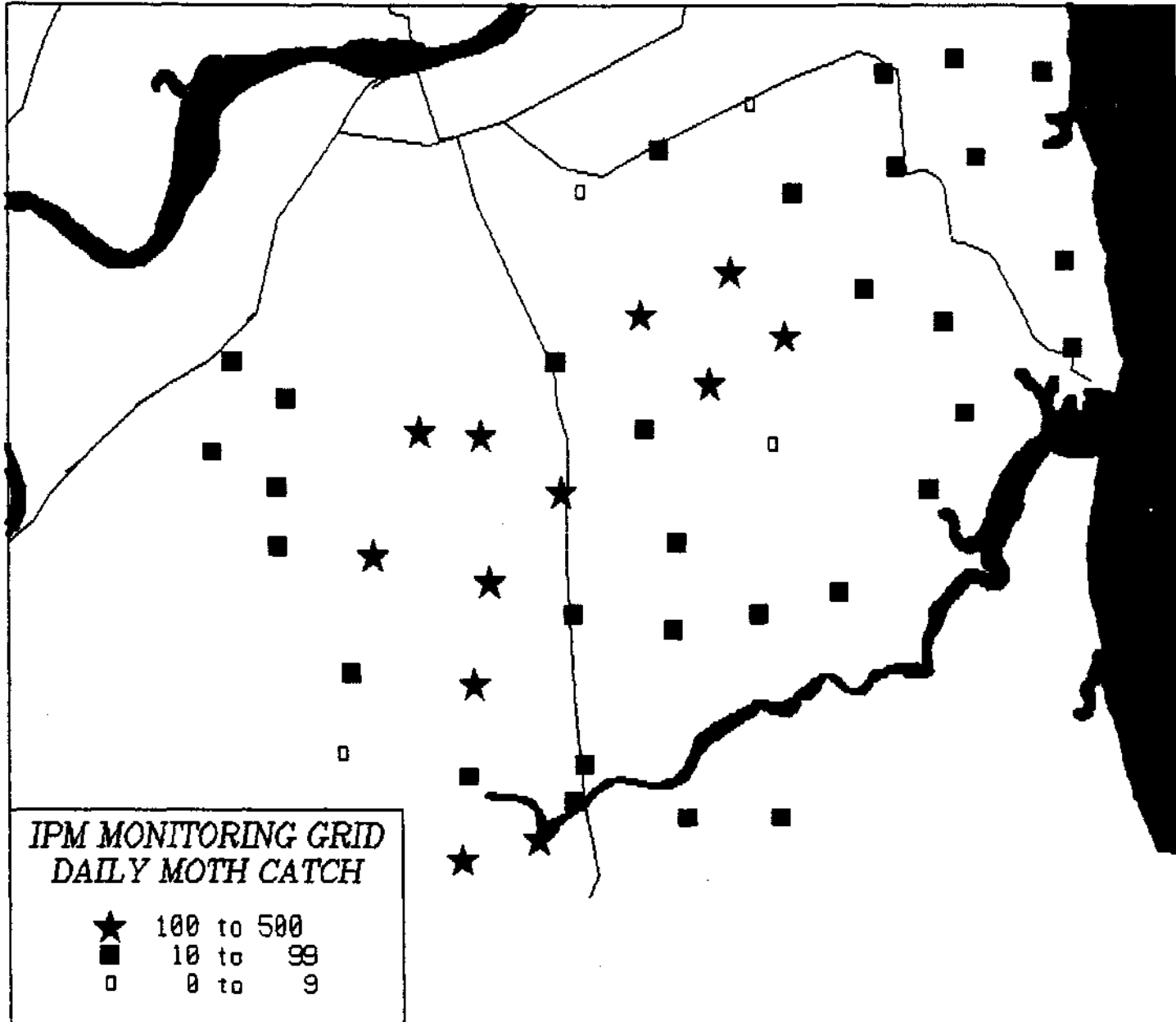


FIG. 2

Weekly moth counts from the grid of pheromone traps are averaged and plotted as daily catches. (week 1 corresponds to the week ending 10/7/1990)

FIG. 2.

Weekly moth counts from the grid of pheromone traps are averaged and mapped using GIS software. Average daily counts of Potato Moth are sorted and symbols used to denote group values. Clusters of stars indicate an area of heavy infestation or "hot spots".



QDPI suggested that the IPM Coordinator be granted the powers of Plant Inspector under the Plant Protection Act. This was formalised and gazetted on 13th October 1990, and the details of specific insect numbers and procedures were finalized on November 20. After the first ploughout order was issued on 21st November, and a number of strong warnings issued, growers from all over the region phoned in information on growers who they believed were in breach of the Act. Reports covered tomatoes, cucumbers, zucchinis, pumpkins, capsicums, sweet potatoes, avocados, and volunteer crops of tomatoes and cucurbits.

The IPM Management Committee grower delegates passed on some strong criticism from their associations on the lack of hygiene enforcement during the period prior to the first plough out order being issued, and this committee passed to the IPM team a very clear message that the growers wanted the main emphasis of the programme to be on improving the crop hygiene in the area.

Since November a massive improvement in the crop hygiene practices has taken place.

The measure of leaf miner numbers shown from the monitoring grid compared to data from previous years shows the same spring increase, but with the peak occurring in December, followed by a major drop in numbers in January and February. (FIS 3.)

This can be attributed to the spring crops of 1990 being pulled out early, compared to 88 and 89 crops being left until February in many cases. Rain during January may also have helped to reduce moth numbers.

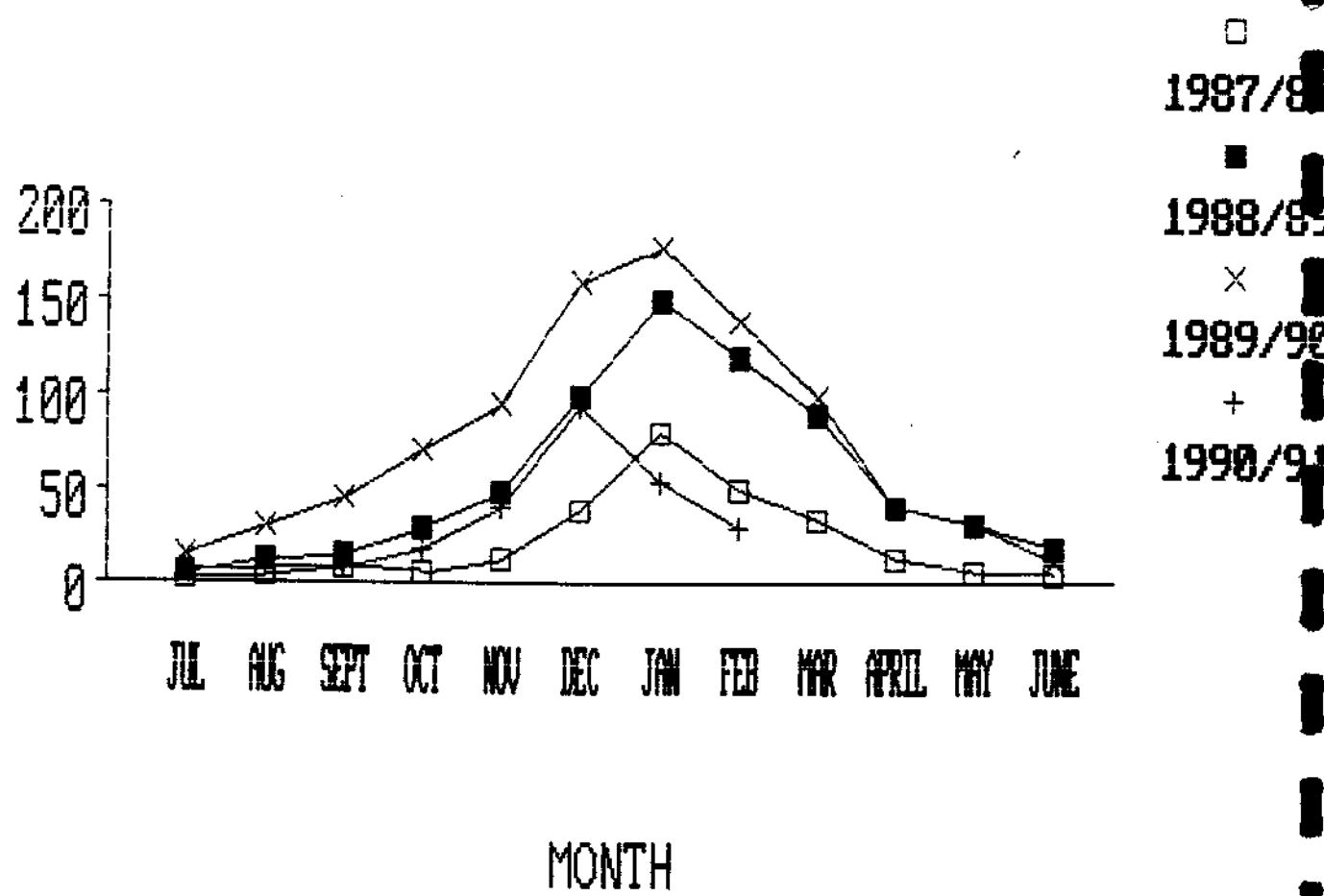
This drop in trapped moths is reflected in the lower damage figures in the field.

From 30 growers and 5 consultants interviewed, all confirmed that their tomato crops during January and February had suffered significantly less damage from potato moth and that they attributed the major decrease in moth pressure to better hygiene practices and the use of other cultural controls, as a direct response to the IPM programme.

Monitoring of cucurbit crops for Watermelon Mosaic Virus, Powdery Mildew, Aphids and Two spotted Mites has been conducted throughout last year. Growers have responded well by improving crop hygiene, which has helped in reducing Watermelon Mosaic and Powdery Mildew. A number of growers successfully controlled Two Spotted Mites for the first time, by adopting an integrated approach involving strategic spraying, better cultural practices, and the release of predator mites, as advised by the IPM Programme.

AVERAGE DAILY CATCH

LEAFMINER NUMBERS



Monthly averages of daily catches of Potato Moth plotted over the past 4 years indicate the levels of infestation in the district.

Although data from previous years have been collected from smaller numbers of traps and can not be compared directly to recent data, evidence from growers and consultants on field infestation levels, points to a good correlation.

FIG. 3

RESEARCH:

Small research projects within the IPM programme are being carried out by Crop Tech staff. These include the development of non-toxic fruit fly monitoring traps, and the further development of pheromone monitoring traps.

A Potato Tuber Moth Emergence trial, referred to earlier, was conducted to establish recommendations for the management required to minimize moth emergence from crop residues. A detailed report follows. Information gained from this project has been disseminated to growers.

FUTURE DIRECTION:

- Continue monitoring Potato Tuber Moth in all areas.
- Continue programme of enforcement of hygiene in tomatoes, capsicum and cucurbit crops. There will also be a continuing programme of extension and education of growers in the use of cultural controls, and the enforcement power will be available as a last resort.
- Maintain general monitoring and radio information.
- Monitor levels of beneficial insects in tree crops as well as fruit and vegetables.
- Communicate with interested parties in other districts, and supervise the setting up of programmes, if requested.
- Conduct Field Days on strategic spraying, and other facets of Integrated Pest Management

APPENDIX. 1

Over 300 daily radio reports have been on both ABC and commercial stations giving advise on pest and disease activity and outlining management practices that would lessen potential risks.

The following are examples of some of those reports.

CROP TECH RESEARCH IPM PROGRAMME

PEST AND DISEASE REPORT BUNDABERG AND REGION

REPORT FOR: 2/5/90

INSECTS:

Heliothis and leafminer are still present in moderate numbers in most areas, but their development is slower. If the pressure in individual crops is low, a six day spray schedule can be adopted.

Aphids are breeding up rapidly, and moderate flights are being detected in the Childers and Bundaberg areas. In some locations the predators are also building up in numbers, and if growers can confirm that the predators are present, then a strategy should be adopted to preserve and encourage them. That is, seek advice on products that are selective on the aphids and other pests, but not dangerous to the predators.

Mites are still active, but pose less of a threat because of the cooler conditions. If growers are considering using predatory mites, they should do so soon, as the predator will also develop more slowly in the cooler conditions.

Some fruit spotting bugs are being caught in the traps around Childers and Gin Gin, and growers should keep a watch on them.

DISEASES:

Target spot, Bacterial spot and Botrytis pose a threat in tomatoes and capsicums with the damp foggy mornings, and a strategy of protectants should be maintained.

Anthracnose in avocados is causing some fruit losses, and it is very important to maintain protectants while fruit is still on the tree. Fallen fruit should be removed from the field, as this provides a source of infection.

REPORT FOR: 10/10/90

Warm and humid conditions with some morning fogs will see moderate disease activity and an increase in the development rate of insects.

INSECTS:

Leafminer moth catches have increased sharply in the Clayton area, while Elliott Heads and Calavos have increased to a much lesser extent. Growers in the Clayton area with old crops that have not been ploughed out, but are finished harvesting, are asked to remove them immediately.

While moth numbers have not approached last year's levels, poor crop hygiene in the warmer conditions could see rapid increases in the population.

DISEASES:

Botrytis infection has increased with the showery conditions and could remain active for some time yet.

Powdery mildew is very active in most areas.

Watermelon mosaic virus remains a serious threat to cucurbit crops in many areas in the district. It is essential that all old crops with any infection be ploughed out immediately after harvest, if this disease is to be controlled.

Other steps that growers can take to reduce the effects of the virus include:

1. Rogue out the diseased plants as soon as they show symptoms.
2. Use an approved oil with the insecticide in the early stage to reduce virus transmission.
3. Maintain good aphid control from emergence until plough-out.
4. Infection rates can be reduced in zucchinis by using highly reflective plastic mulch.
5. Don't plant young blocks next to old crops that have mosaic infection.

CROP TECH RESEARCH IPM PROGRAMME

PEST AND DISEASE REPORT BUNDABERG AND REGION

REPORT FOR: 12/10/90

Drier North Westerlies have increased water use of crops, but also reduced some of the disease pressure.

INSECTS:

Leafminer are still potentially the number one risk for tomatoes and eggfruit this summer, and good crop hygiene must be maintained to avoid epidemics similar to last year.

The moth trapping grid has indicated very strongly that the population is building up in the three locations of Clayton, Farnsfield and Gooburrum. Growers in these areas should do everything possible to reduce the breeding of the pest and to avoid infestation in young plantings.

All tomato crops in those locations are under threat of heavy infestation. Spray schedules should be reduced to 4 day intervals when leafminer monitoring traps show levels of 10 moths per night or above. It is essential to have total coverage of the lower section of the bush, particularly the lower stem, as the most vulnerable stage of the life cycle is the first stage of the larvae. Good chemical coverage of the stems will help kill this stage as they move up the bush after hatching.

DISEASES:

Powdery Mildew has become established in a large number of cucurbit crops in the district at present. Some blocks are showing heavy infection but most would be regarded as moderate.

The potential for the spread of powdery mildew remains high even under these drier conditions because of this widespread source of infection.

The disease only requires a small amount of moisture to germinate, infect the leaf tissue and produce more spores.

Good crop hygiene is therefore an essential part of district wide control of powdery mildew. By ploughing out old infected blocks quickly and reducing the source of spores, control of the disease in the later part of the season will be much easier.

CROP TECH RESEARCH IPM PROGRAMME

PEST AND DISEASE REPORT BUNDABERG AND REGION

REPORT FOR: 16/10/90

Warm nights over the weekend have led to faster development of insects.

INSECTS:

Heliothis moth catches in the light traps over the past 2 days shows a significant population is present in the area. Egglays are expected to remain moderate - heavy for some time.

Fruit fly numbers are fairly stable in the Bundaberg area, but areas of Gin Gin continue to have higher catches. This is mostly due to the proximity to scrub where alternative hosts are very common.

Leafminer moths continued to emerge at a significantly high numbers over the weekend, and the warmer conditions will only worsen the situation.

Rutherglen bugs have been reported causing considerable damage in watermelons, rockmelons, tomatoes and capsicums. Reinfestation can occur very soon after spraying and subsequently daily monitoring should be carried out while the insects are swarming.

Monolepta beetles are being caught in light traps and it is possible that swarms will increase again over the next couple of weeks.

DISEASES:

Bacterial spot and target spot will be active if the forecasts of showers later today are accurate. Plants damaged by the wind on Friday should be protected in case of rain.

CROP TECH RESEARCH IPM PROGRAMME

PEST AND DISEASE REPORT BUNDABERG AND REGION

REPORT FOR: 17/10/90

Some showers and storms are predicted.

INSECTS:

Leafminer moth emergence is increasing in some areas with ideal conditions for the insects development.

Mites are being reported in most areas, with increased activity in the warmer conditions.

Rutherglen bugs have been causing considerable damage in cucurbits, tomatoes and capsicums in the district.

Reinfestation can occur very soon after spraying and subsequently daily monitoring should be carried out while the bugs are swarming.

DISEASES:

Botrytis is showing some activity and may flare up if showery conditions are experienced.

Sclerotium rolpii has shown some activity over the past couple of weeks. If rain or storms are received followed by hot weather, this disease will be very serious. Blocks where heavy sugar cane or sorghum stubble is present will be the most susceptible, and should be treated as soon as the first dead plants are found.

Bacterial Wilt is also active and thrives in hot moist conditions. This disease is very serious in the area and all precautions should be made to avoid spreading the infection to clean areas.

CROP TECH RESEARCH IPM PROGRAMME

PEST AND DISEASE REPORT BUNDABERG AND REGION

REPORT FOR : 7/12/90

Hot and humid conditions have led to rapid insect development.

INSECTS:

Leafminer numbers have increased significantly in Hinkler and Bundaberg but have remained stable in Gin Gin and Childers this week.

High leafminer numbers are directly associated with old tomato blocks in the area.

The IPM Co-ordinator has been requested by all grower organisations in the district to seek out these old blocks and have them destroyed.

If leaf miner are present in an old block, the grower will be given three days to plough it in. If this is not done to the satisfaction of the co-ordinator, a plough out order is issued, giving the grower 7 days to complete the job.

If this is not achieved, a contractor is called in to remove the crop residues and plough in the crop.

The bill for this operation is charged to the grower and if not recovered quickly, is charged against the deed of the land and becomes the land owners debt.

THE EFFECT OF TOMATO CROP RESIDUE TREATMENT
ON EMERGENCE OF POTATO MOTH *Phthorimaea* spp.

Summary

Cultural methods can effect the emergence of Potato Tuber Moth *Phthorimaea operculella* from tomato crop residues dramatically. Abandoned residues provide fertile breeding grounds for the pest. The untreated control in this experiment produced a significantly higher emergence figure than all other treatments. Desiccation as soon as picking is completed is the most efficient way of lowering moth emergence to acceptable levels.

Introduction

The evolution of Potato Tuber Moth (PTM) as the major insect pest of tomatoes in the Bundaberg region has occurred rapidly. Poor field hygiene particularly post harvest has played a significant part in this population explosion. In majority of cases in-crop control of PTM is adequate but the treatment of crop residues and the consequent effect on PTM levels, varies widely and has often been the topic of subjective debate.

As part of the Integrated Pest Management program a trial was initiated to quantify the effects of various post harvest crop residue treatments on emergence of Potato Tuber Moth adults.

Materials and Methods

A block of tomatoes, variety Hayslip was grown on a grey forest sand at Crop Tech Research Farm, Bundaberg. The crop was grown using normal insect control measures with the last application of insecticide taking place on 21st November 1990. The final harvest was completed on 26th November. An assessment carried out prior to the implementation of treatments on twenty randomly selected plants indicated the presence of 18.3 larvae and 1.3 pupae of PTM per plant.

The design of the experiment was a randomised complete block with seven treatments and three replications. Plot size for the implementation of treatments was two rows nine metres long.

The application of the desiccant Tryquat as per treatments 5 (Table 1) took place on 30th November before the removal of stakes and wires. The desiccant was applied at 4 l/ha in 1000 l/ha of water. A similar desiccant and water application rate was used for treatment 3 with the addition of Lorsban at 2 l/ha on the same date.

Following the removal of stakes and wires from all plots on 3rd December the crop remnants were slashed in treatment 2 and plants severed at ground level and removed from the trial area (treatment 4). The plastic in treatments 6 and 7 was removed and rotary hoed to a depth of 125 mm (treatment 6) and ploughed to 300 mm (treatment 7).

Sub plots 3 metres long and 1 metre wide, containing six plants or the equivalent area, were covered with Agronet, a synthetic closely woven material impervious to the adult moth. Each enclosure was supported with three wire hoops ensuring the top of the netting was approximately 500 mm above ground level. The sides of the netting were buried in the ground to a depth of 100 mm. Pheromone traps were placed in each enclosure on 7th December and the first assessment of moth catches took place the following day. During the first week of the experiment assessments were done daily and after that every second day until the completion of the experiment on 31st December 1990.

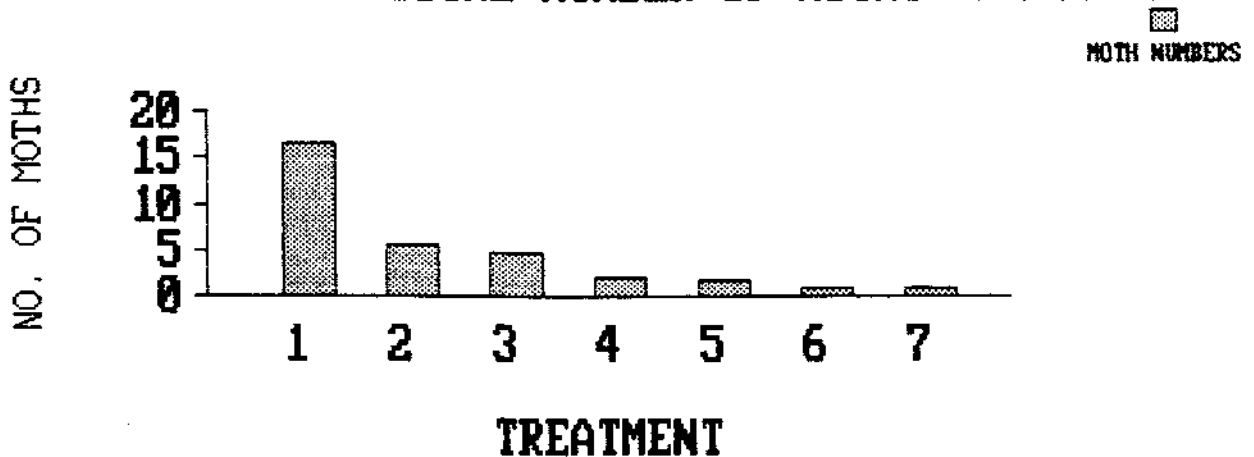
TABLE 1. :- Treatments

Treatment Number	Treatment
1.	Untreated Control
2.	Remove stakes and wires - slash
3.	Remove stakes and wires - Tryquat & Lorsban
4.	Remove stakes, wires and plants
5.	Remove stakes and wires - Tryquat
6.	Remove stakes, wires and plastic - rotary
7.	Remove stakes, wires and plastic - plough

Results

The untreated control with a mean catch of 16.53 adults per a plant was the worst treatment, (Figure 1) the result being highly significant ($P > 0.001$). No significant differences were recorded in the group of treatments which included desiccation, slashing, desiccation combined with insecticide and removing plants, however slashing and desiccating with the addition of insecticide had significantly higher catches than rotarying and ploughing. ($P > 0.05$) There were no significant differences between removing plants, desiccating, rotary hoeing and ploughing.

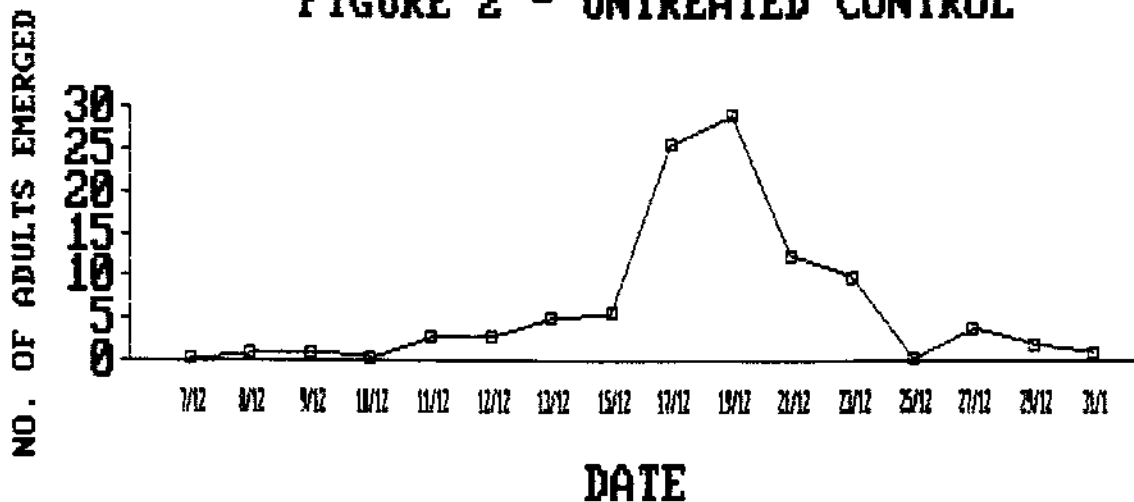
FIGURE 1 - TOTAL NUMBER OF MOTHS PER PLANT



Analysis of data from the first six days indicated a highly significant increase in moth catches from the treatment which included Lorsban. The most likely explanation being the removal of predators by the Lorsban which act on the pupae. The early increase in this treatment has effected the final figures obtained.

The period between the application of the last insecticide spray and the destruction of residues is critical. The adult emergence in the untreated control peaked 26 days after the last insecticide application. (Figure 2) Considering the PTM life cycle takes 19 to 23 days under the conditions that prevailed during the trial period, a life cycle was completed after the final insecticide application and the completion of the trial.

FIGURE 2 - UNTREATED CONTROL



Discussion

Destruction of the larval stage appears to be the main mechanism of reducing the numbers of adults moths emerging. The methods employed to achieve this aim in the experiment worked with varying degrees of success. Use of a desiccant as soon as the last harvest is completed followed by rotary hoeing or ploughing as soon as practicable would be the ideal. It is also interesting to compare the removal of plants and the desiccation treatment. A similar number of adults emerged in both treatments indicating that desiccation is very effective in controlling larvae numbers.

The trial has highlighted the necessity of timely residue destruction if leaf miner numbers are to be kept under control. The preferred method of post harvest management would be, desiccation as soon as picking has finished followed by incorporation of plant material as soon as possible.