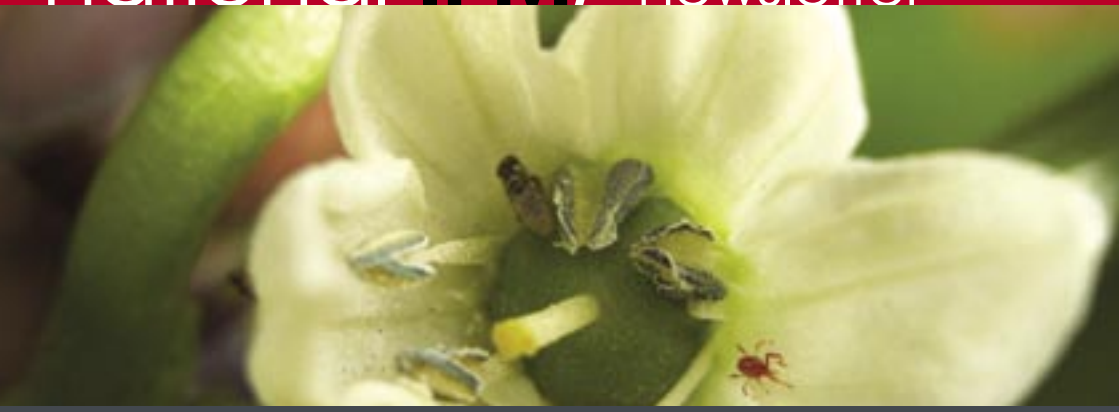
national IPM newsletter



issue 01

in this issue

Four case histories are presented illustrating how successful pest control using Integrated Pest Management in commercial greenhouse farms was achieved including:

- Farm technology and pest issues involved
- Control strategies used – chemical and biological
- Use of crop scouting to make decisions
- Challenges encountered along the way
- Growers views about the results

next edition:

Further case histories will be published in the next edition covering other crops, including field grown capsicums and lettuces.

Vegetable R&D
Your national vegetable levy at work

Acknowledgements

"This project was facilitated by Horticulture Australia Limited (HAL) in partnership with AUSVEG and was funded by the National Vegetable Levy. The Australian Government provides matched funding for all HAL's R&D activities."

Three of these case histories come out of an IPM extension program at Virginia. The Western Australian report comes from a trial conducted through a commercial arrangement between the grower, his consultant and the supplier of beneficial organisms (Biological Services). A local commercial consultant was also involved in Virginia farm trials.

Cucumeris predatory mites for Western Flower Thrips control were supplied on a commercial basis by Biological Services who also provided vital technical support on a range of IPM issues.

The growers involved remain anonymous, but are gratefully acknowledged for their willingness and commitment for IPM trials to be conducted in their commercial crops. They know who they are!

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contents

IPM CASE HISTORIES

The term Integrated Pest (and disease) Management, or IPM, has been around for a long time. But what does it actually mean ? Pest control practices in the vegetable industry have been based largely on the routine use of broad-spectrum insecticides to control pests. There is a high risk of insecticide failure in this approach to pest control, usually due to insecticide resistance, or possibly other errors in spray application techniques, e.g. calibration, timing, spray coverage or tank mixing problems.

Basically IPM refers to pest management programs that reduce the use of broad-spectrum insecticides by skilfully maximising the use of non-chemical pest control strategies to keep pests at acceptable levels. In this article the term 'IPM Adoption' means a gradual program of change away from insecticide reliance. This process begins with steps to improve existing insecticide practices by introducing crop scouting and improving spray coverage and other spray technology factors and paying close attention to timely, thorough crop hygiene. There are usually significant benefits from these changes making it possible to implement further non-chemical strategies. In some farming systems it then becomes possible to switch to using beneficial insects as a major element of the pest control program.

This newsletter will present a series of recent case histories from Australian vegetable farms that illustrate how important elements of IPM practice have worked for commercial growers who have given it a serious try-out. The pest management strategies used in these farm histories include:

- Good farm hygiene
- Greenhouse design features to exclude pests
- Regular pest monitoring as the key to pest treatment decisions and analysis of results
- Well managed spray programs including use of 'softer' chemicals
- The use of biological control options as appropriate.
- Regional strategies to reduce pest threats

As you will see IPM techniques have proved to be very effective at improving management of Western Flower Thrips and other key pests.

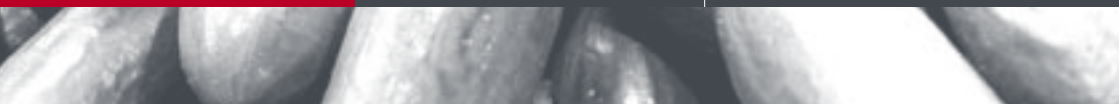
Each case history begins with a farm outline and summary of the pest problems, key IPM changes made and what outcomes were achieved.

case 1

Greenhouse cucumber grower
Success using beneficial insects in a modern hydro greenhouse (2005)

Farm Summary

FARM DESCRIPTION	PESTS AND DISEASES	ECONOMIC SIGNIFICANCE
Location: Western Australia. Very clean and sandy with no external broadleaf weeds and only a few small weed seedlings in the nursery Farm technology: Modern house 5000m^2, gas heating, plastic sides with roof venting, no thrip screens over vents and other openings. Cucumbers are grown in Sawdust bags. Crops: Continental cucumbers	Western Flower Thrips - continually present in high numbers, in spite of regular spraying, (onion and western flower thrips), but extreme pressure during spring. Winds from the east main cause of large influx. Thrips often inflicting severe damage. Newly transplanted seedlings are infested within a day or two. The grower compensates for crop losses by allowing more flower sets and removing the damaged buds, but this is very labour intensive.	Very high
	Two-spotted mite - all year main problems middle of summer; Vertimec not working	High
	Fungus gnats - all year, especially autumn	Moderate
	Aphids - not very often	Very low
	Loopers - mainly summer	Low
	Whitefly - low during winter	Low
	Powdery mildew - all year.	Very high
	Root diseases – high	Very high



IPM practices addressed and outcomes achieved

Stage 1

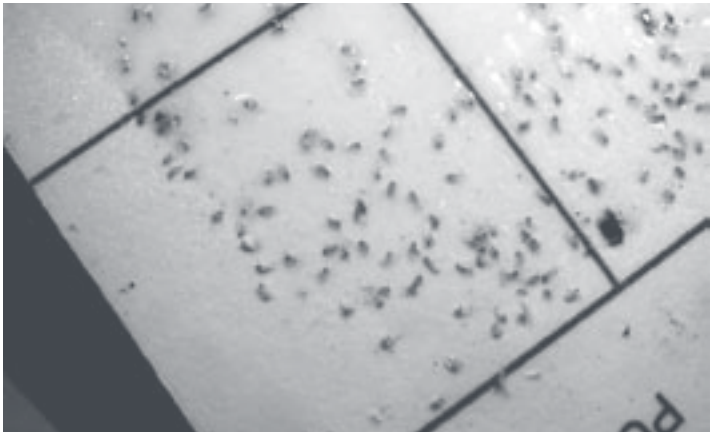
Changes in technology and practices (2003-04)

1. Gathered information about thrips activity and species:

Crop monitoring was increased by using sticky traps and sending them off for species identification. Mostly Western Flower Thrips were found inside the greenhouse and some Onion thrips. There were very few Western Flower Thrips outside of the structure, but plague thrips were living in native vegetation and lilly-pilly trees.

2. Assessing efficacy of various products:

Crop monitoring data showed that no registered chemicals were effective in reducing Western Flower Thrips numbers to acceptable levels. Trials were conducted with two new chemicals, both of which worked, but they did not have a permit for continued use. A botanical oil was tried with limited success. The pH of their powdery mildew treatments were tested and found to be 9, which is undesirably high for good chemical stability in the tank or on leaves.



Stage 2

Introducing biological controls (2005) –
grower assisted by a commercial consultant

BENEFICIAL INSECT STRATEGY	RESULTS AND COMMENTS
Western Flower Thrips – new predatory mite (Neoseiulus cucumeris), released from January to July. Three releases per crop, first release when plants are 3 weeks old, second at 5 weeks and third when they are 7 weeks old. Better to release earlier.	Very effective in Jan-July trial. Will increase numbers. released in spring but doesn't think they will be able to stop spring influx of thrips without thrips screening.
Two Spotted Mites - Persimilis when plants 5 weeks old. Must determine the exact time needed to release, you can't release too early or too late, has to be exact.	Very effective, only requires 1 release, and no spraying after that is required.
Fungus gnats - releasing aquatic nematodes and hypoaspis predaroty mites in the growing medium just after planting out,	Very effective
Aphids - Pirimor	Satisfactory
Loopers – Bt	Satisfactory
Powdery mildew - spraying every 1-2 weeks, number of fungicdes	Control moderate
Root rot - drenching fungicides	Control moderate

Benefits of IPM practices according to the grower;

"Thrips control was not possible previously using insecticides as there are not many effective sprays. Cucumeris gains control without needing to spray.

Vertimec was not working on our Two Spotted Mite problem either. By using persimilis predatory mites we extended our picking by 1-2 weeks with no withholding periods, and the persimilis gain much better control than spraying. We don't miss the spraying!

Using bio-controls is probably more expensive, but the results have been much greater, so by spending more we more than made up for the expense in improved yields.

We are now waiting for the Australasian Biological Control association annual meeting in July to see what new bio-controls are out there!

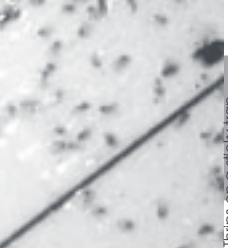
case 2

Greenhouse cucumber grower
Establishing an effective pest control program from scratch (2003-4)

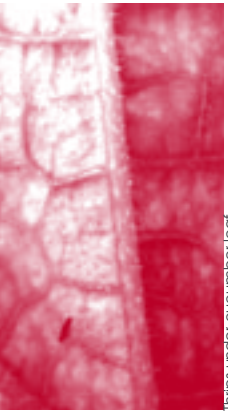
This more detailed report covers the successful implementation of a 'Monitored Spray Program' that was set up in a hydroponic cucumber and tomato farm in South Australia. This story first appeared in a series of IPM Nursery Papers sponsored by the Nursery and Garden Industry Association and Horticulture Australia in 2004.

Farm Summary

FARM DESCRIPTION	PESTS AND DISEASES	ECONOMIC SIGNIFICANCE
Location: Virginia South Australia Farm technology: Modern house 5000m^2, gas heating, plastic sides with roof venting, no thrips screens over vents and other openings. Crops: Lebanese cucumbers and cherry tomatoes are grown in sawdust bags.	Western Flower Thrips – a major problem requiring frequent spraying throughout much of the warm growing season	Medium – due to Virus in tomatoes and feeding damage to cucumbers
	Whitefly – can be high in summer and hard to control with chemicals	Medium due to sooty mould in both crops
	Two-spotted mite – normally well controlled with Avermectin	Low
	Aphids - not very often due to effective chemical control, but have the potential to be a major pest if not controlled	Low
	Powdery mildew and botrytis – low in summer	Low - Moderate

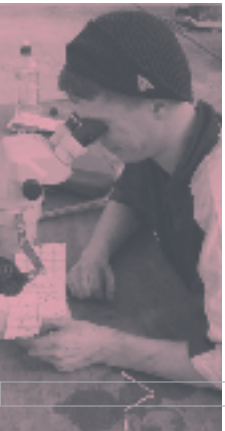


Thrips on a sticky trap



Thrips under cucumber leaf

Thrips in a cucumber flower



IPM practices addressed and outcomes achieved

From beginning to end, regular and systematic monitoring of pest levels and 'hands on' staff training was used to assess and improve every aspect of the pest control program. The steps in implementing this program are outlined below.

1) The production manager invited an IPM advisor to set up a clear and simple pest control program for his staff.

2) The production manager and IPM advisor organised a meeting with staff to discuss existing pest issues and review current management strategies, and design an improved pest management program with staff involvement.

3) Pest problems and activity patterns in the greenhouse were reviewed. Monitoring tactics were explained and discussed, and a monitoring program developed using sticky traps and plant checks to keep on top of changes in pest activity and identify hot spots.

4) The insecticide strategy was reviewed and spray management resources provided including:

- A routine management cycle to follow for crop hygiene, monitoring, spray use and checking of spray results
- A list of approved chemicals for key pests
- A spray rotation planner to reduce the risk of insecticide resistance
- A review of product labels and spray application principles to ensure optimum results and avoid problems due to incorrect use
- A whiteboard and record sheet to connect chemical use with monitoring results.

5) The IPM advisor worked with staff to develop their skills for recording and interpreting monitoring information by:

- Demonstrating use of a hand lens to count thrips and whitefly on traps and leaves
- Introducing staff to using a microscope to identify different thrips species
- Setting up a graph of pest results inside the greenhouse to refer to
- Discussing how to interpret monitoring results from plants and traps and review long term records to better understand pest behaviour and manage chemical use more effectively

Benefits from setting up a monitored spray program

Regular monitoring enabled the manager and his staff to identify pest and disease problems earlier and with more confidence. They were then able to either treat or remove affected plants.

As a result of the monitored spray program:

- Thrips were easily kept at low levels. When numbers abruptly increased, a sample was sent to check for Western Flower Thrips (WFT) to see if spraying was required. Since there was only a very small number of WFT, spray applications were not increased and thrips numbers soon dropped again. The increase was mostly made up of plague thrips, probably flying in through the roof vents. They were easy to control without a heavy spray program.

- A whitefly explosion was stopped by a spray program that removed all stages of the lifecycle over a period of two weeks. Treatments were selected (Applaud and botanical oils) and application rates and volumes were discussed to get the best possible result. The undersides of plant leaves at various growth stages were checked with the help of a hand lens after each spray to assess what was happening to the numbers of adults, pupae and eggs. This resulted in three spray applications, the last being a botanical oil, and the clean up was very effective.

- A highly effective biological control option was introduced for fungus gnats. Fungus gnats began to increase in late September and an aquatic nematode preparation was added to the hydroponic medium. Within a week the numbers of fungus gnats plummeted and never became a problem again in that crop.

- Old plants untreated in a house is not a cost saving. New crops often developed pest problems more rapidly and severely in houses where old plants were also kept.

- Better control with fewer spray applications and more reliance on softer, less toxic chemicals. Insecticide control results improved considerably due to measuring spray effectiveness, avoiding unnecessary chemical use, selecting chemicals more strategically, and considering a wider range of technical points in spray application.

- Greater understanding of pest management, cause and effect. A range of questions were raised by using the monitoring results. Some were answered while others are part of an ongoing learning partnership between the manager, his staff and relevant experts interested in improving IPM practices. A key area to note is the difficulty in interpreting spray label rates and suitability of chemicals approved for low and high volume applicators when being used in other application technologies like foggers.

The greenhouse manager was pleased with the results, especially from including his staff in training on scouting, interpreting and graphing pest counts and understanding the rationale for spray decisions. "It takes some of the load off my back and means that more of us can keep an eye on things to stop them getting out of hand and becoming a big problem".

case 3

Greenhouse capsicum grower
Soil grown capsicums in summer in:

- Conventional greenhouse (improved spray program; 2001-4)
- Improved greenhouses (beneficial insects) (2005)

Farm Summary

FARM DESCRIPTION	PESTS AND DISEASES	ECONOMIC SIGNIFICANCE
Location: Virginia South Australia Farm technology: Structure as for Case 1. Two houses 3,500m2 based on Israeli 'Azrom' design with fine 'anti-Virus' mesh, 2.8m to the gutter + 1.5m to the peak. No heating. May be converted to hydroponics later Crops: Soil grown capsicums	Western Flower Thrips – a major problem requiring frequent spraying throughout much of the warm growing season	Very high
	Whitefly – can be high in summer and hard to control with chemicals	Low-Medium
	Two-spotted mite – normally well controlled with Avermectin	Low- Moderate
	Aphids - not very often due to effective chemical control, but have the potential to be a major pest if not controlled	Low - Moderate
	Loopers - mainly summer	Low
	Powdery mildew and botrytis – low in summer	Low

IPM practices addressed and outcomes achieved.

Stage 1- Initial changes in technology and practices (2002-04)

After a Western Flower Thrips workshop, including a spray coverage test, the grower made major changes to his spray program, reducing chemical use by over 50%, and implemented chemical rotation and crop scouting practices. These changes brought Western Flower Thrips numbers and Tomato Spotted Wilt Virus damage down to acceptable levels. He was not content with this, wanting to do away with chemical use in favour of biological control. To make this more achievable he built two improved 'sawtooth' greenhouses with fine 'anti-thrips' mesh for summer growing of capsicums. This mesh reduces, but does not prevent thrips entry.

Stage 2 - Introducing biological controls (2005)

The grower invited us to implement a summer program of biological control in his new greenhouses. Based on the success of the new cucumeris mites in controlling WFT in cucumbers in WA we decided to proceed. Pest threats considered were Western Flower Thrips, greenhouse whitefly, Two Spotted Mites and aphids.

Two capsicum crops were planted on September 21st and October 5th with about 5,500 plants in each house. Cucumeris predatory mites were released to control Western Flower Thrips and these have successfully prevented thrips from breeding in the crop. The mites established after two releases two weeks apart, and have been very effective with almost no thrips larvae detected in the crops. Unfortunately adult thrips still make it through the fine mesh in low but significant numbers on warm windy days, bringing in Tomato Spotted Wilt Virus. Success (spinosad) has been used occasionally when more than about 10 adults are detected in a sample of 150 plants. By early December 2005 total losses due to Virus were about 105 plants so far (80 in one house and 25 in the other) – mostly in susceptible varieties.

Ladybird larvae and aphid parasitising wasps were also introduced into the crop to control green peach aphid. Ladybirds and wasps multiplied rapidly and reduced the aphid population to acceptable levels. Whitefly have not become a problem as yet, but encarsia parasitic wasps have been introduced as a control measure. They are not as hard to control in capsicum as in cucumbers and tomatoes. Persimilis predatory mites have been introduced in response to early signs of Two Spotted Mites.

Neighbours weeds a challenge, plenty of thrips.

As this trial is just commencing the jury is still out on the final result, but progress is positive in several respects:

- The grower is very enthusiastic and is scouting the crop regularly and closely, observing changes and discussing options before making his decisions
- The grower is paying for the beneficial insects (except the ones he has caught and put in the crop himself !) because he considers the trial to be a worthwhile investment in sustainable pest management
- The supplier of beneficial insects (Biological Services – Loxton) is providing close technical back-up
- Volunteer predatory mites of another species appeared at the 2-3 week stage (due to the absence of broad spectrum insecticides) and have proven as effective as cucumeris in controlling thrips and are possibly keeping aphids and whitefly down as well

SARDI are providing technical support in the form of weekly visits and back-up for technical issues, but leaving the bulk of the job to the grower who recently remarked "Give nature a chance and look what happens !!". An interesting comment, especially from someone who found himself trapped in his greenhouse with two brown snakes recently !!

This trial indicates a real future for biological control in greenhouses, even in regions with high pest pressure, if a way can be found to control humidity adequately. There is still real concern that powdery mildew will become a problem as the crop matures, even in summer, with airflow being restricted by the fine mesh on the sides and roof.

case 4

Greenhouse cucumber and tomato grower
Success using beneficial insects in a modern hydro greenhouse structure (2001-4)

Farm Summary

FARM DESCRIPTION	PESTS AND DISEASES	SIGNIFICANCE
Location: Virginia SA. Farm technology: Stage 1: Improved greenhouse (2,300m2) based on Israeli 'Azrom' design, 2.8m to the gutter + 1.5m to the peak. Stage 2: Addition of fine anti-virus meshing and hydroponic plastic bag system in 25% of the house. No heating. Crops: Tomatoes and cucumbers.	Western Flower Thrips	Medium to severe on occasions in both crops
	Greenhouse whitefly	Medium to severe in late summer and autumn in both crops
	Two Spotted Mites in cucumbers (spider mites)	Rarely a problem until spray levels reduced (op's and sp's) then medium to severe threat in cucumbers – chemical control without Vertimec not satisfactory
	Powdery mildew	A significant but manageable problem in both crops until fine mesh was fitted restricting ventilation, then severe in winter
	Botritis	

IPM practices addressed and outcomes achieved

Stage 1 - In response to participation in Western Flower Thrips industry workshops in 2001-02 the grower made the following changes:

1. Improved his greenhouse structure by increasing height and adding roof ventilation
2. Improved farm hygiene program by clearing weeds early and removing Tomato Spotted Wilt Virus infected plants from the crop. Kept his plants generally healthy
3. Began using yellow sticky traps before planting, and routine crop scouting as a basis to spray decisions.

Results

From the beginning there were very few thrips on the sticky traps, although outdoor numbers of Western Flower Thrips were very high in some areas. The grower decided he could withhold pesticides until early December when white fly became a problem. This meant that he was able to withhold all pesticide applications for 5 months during spring and summer. Only 2 or 3 subsequent applications of Lannate were needed over the life of the crop for whitefly control. This is a major achievement at Virginia ! Even 1-2 months of pesticide reduction is a major step forward in an area where most growers spray regularly, even weekly. Only four plants were infected with Virus and the grower saved a lot of time and money by not using insecticides for so long.

Stage 2 - Further changes in technology and practices were initiated by the grower in 2003-04 and assisted by SARDI staff and a horticultural consultant.

1. Shade-cloth was replaced with 'anti-Virus' mesh
2. Pest control trials using beneficial insects were conducted in a tomato crop

Fine 'anti-Virus' mesh was fitted to the sides and roof vents (as with the Azrom demonstration greenhouse) to restrict entry of flying insects.

A tomato crop planted at the end of January was monitored using 6 yellow sticky traps at the four corners of the crop and two in the middle. These were changed weekly and checked for thrips by SARDI entomologists. The grower conducted his own routine checks in his crop for whitefly levels and Virus infected plants.

A range of beneficial insects were used:

- *Encarsia formosa* for whitefly control released weekly at 1/m^2 from week 3
- *Typhlodromips montdorensis* mites for Western Flower Thrips in three doses of 10/m^2 from week 3 at two week intervals
- Hypoaspis (soil) mites to help with control of thrips pupae and fungus gnats were released in three doses over 3 weeks

Tomato leaves were inspected several times after week 6 to look for predatory mites without success. Lower tomato leaves were inspected regularly for whitefly pupae and evidence of parasitism by encarsia. No additional pest control was found to be needed for mites (TSM), aphids etc.

Week 1 (January)		Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9
Average Thrips per trap	7	2	1.3	1.5	1.5	1.5	2	n/a	0.6

Results

At planting there was an average of 7 thrips per trap and very low level of whitefly. The grower used one application of Success in the first week to reduce thrips numbers. Since that time there have only been 1 or 2 thrips per week for 9 weeks. Almost all thrips present were Western Flower Thrips.

Weekly Total Thrips count on sticky traps:

Only six plants were lost to Virus, all at different locations and removed promptly from the crop in secure plastic bags. Whitefly numbers did increase gradually and control by Encarsia failed, probably because the dose rate used was about half of what is required. Since planting there was a persistent hot spot of whitefly near the entry door which, if treated with spot spraying, may have prevented spread of whitefly through the crop.

The crop remained healthy, with minimal thrips numbers and plant disease issues until mid June when problems with botrytis and powdery mildew became a major concern. With the fine mesh on the roof vents and no heating it has been difficult to adequately reduce humidity in the cooler weather. Other pests did not establish in this crop, but could still become an issue in future crops due to lowered pesticide use, especially tomato russet mite (bronze mite), chewing grubs and aphids. Because this was a new greenhouse these pest risks have been lower.

Green house design, crop scouting and hygiene were probably the main contributors to keeping pest and Virus levels low in this trial. The beneficial insects used for thrips and white-fly in this crop were not a clear contributor to success on this occasion. The introduced predatory mites were not found on tomato leaves in the crop, but may be present in low numbers given the long term suppression of the thrips population and our inexperienced sampling techniques. The soil dwelling hypoaspis mites may have contributed to thrips control, but are difficult to monitor.

A repeat trial in a cucumber crop with the same beneficial insects the following summer found that Western Flower Thrips were much harder to control in this crop. Western Flower Thrips generally breed more vigorously in cucumbers and capsicums than tomatoes. Two Spotted Mites also became a problem. Predatory mites (persimilis) were introduced far too late to have any chance of controlling TSM.

Overall the grower was very happy with the results of changes to his greenhouse design and crop scouting for summer control of thrips, TSWV and whitefly in tomatoes, but not in cucumbers. He wants to continue with IPM in these crops by working out how to overcome ventilation problems when using fine mesh, and would be willing to try beneficial insects again.

More detailed information on IPM case histories and the resources used to implement these practices will be released on a new Vegetable IPM web site by early 2006:
www.vegetableipm.com.au

This web site will have information to assist growers and consultants who want to manage crop pests more cost-effectively and would like to reduce their chemical use and costs if possible. It will provide information and management tools for key pests of levied vegetable crops and information from a range of Australian IPM projects. These project are funded through Horticulture Australia and AUSVEG.

AUSTRALIAN VEGETABLE IPM WEB PAGE

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