



Know-how for Horticulture™

**Western flower thrips
management strategy
- Information delivery
pilot project**

Greg Baker
SA Research &
Development Institute

Project Number: VG00085

VG00085

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WESTERN FLOWER THRIPS MANAGEMENT STRATEGY

Information Delivery Pilot Project



HAL Final Report VG 00085

Tony Burfield, Dennis Hopkins

South Australian Research and Development Institute

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1. SUMMARIES

1.1 Media Summary

Western Flower Thrips Management Technology Transfer Pilot

Western Flower Thrips (WFT) is a major pest in vegetable crops nationwide, causing annual crop losses worth millions of dollars. WFT spreads Tomato Spotted Wilt Virus (TSWV) to many crops including capsicum, tomato, lettuce and potato and also causes feeding damage to other vegetables like cucumbers if left unchecked. WFT has been very difficult to control with traditional pesticide strategies. In spite of the availability of published Integrated pest management strategies (IPM) for WFT there has been little apparent adoption by affected growers. Growers have been reluctant to implement IPM strategies without additional support.

For this reason the WFT Technology Transfer project was commissioned in 2000 for vegetable growers on the Northern Adelaide Plains 2000 to June 2002, where there has been severe crop damage from WFT and TSWV in previous years. The projects main aim was to develop and test methods for promoting adoption of recommended WFT management technology to vegetable growers.

This project developed a range of technical and extension partnerships at the industry, regional and national level to support adoption of IPM technologies. Project strategies focused on raising grower's confidence in IPM by demonstrating its relevance for local cropping practices. The project recruited over 50 greenhouse capsicum, cucumber and field lettuce growers into the pilot workshops and demonstrations. Adoption by these growers, of most aspects of recommended WFT management, has been very high

The project has also generated a wide range of 'flow-on' benefits including:

- ◆ most growers choosing to move on to multiple pest planning, and develop their total crop management expertise,
- ◆ leading greenhouse growers preparing to host biological pest control trials in their crops,
- ◆ a self-help IPM and farm improvement group established by twenty greenhouse growers, and
- ◆ formation of a regional working group, involving, local and state government, to manage host weeds

Given the success of this program it is recommended that similar programs are implemented in other horticultural regions including an IPM dedicated extension worker, a collaborative Action Learning strategy and relevant resources from this pilot.

1.2 Technical Summary

Western Flower Thrips (WFT) is a major pest in vegetable crops nationwide, spreading Tomato Spotted Wilt Virus (TSWV) to many crops and causing feeding damage to other vegetables (and fruits) if left unchecked. The difficulty in controlling WFT with traditional pesticide strategies has resulted in greatly increased levels of pesticide application. Resistance by the pest has become a major problem, a serious concern given the very limited range of safe effective chemicals to rotate in a management plan. Harvest with-holding periods are very difficult to maintain with frequent spraying.

More sustainable Integrated Pest Management (IPM) strategies have been available to the industry for several years with little apparent adoption by affected growers. Due to its inability to successfully control this pest the industry is experiencing continuing significant crop losses and rapid movement of this pest into new crops and growing regions.

A WFT Technology Transfer project was commissioned in 2000 for vegetable growers on the Northern Adelaide Plains 2000 to June 2002, where there has been especially severe crop damage from WFT and TSWV in previous years. The projects main aim was to develop and test methods for promoting adoption of recommended WFT management technology.

The extension strategy was based on these key ingredients:

- ◆ access to technical expertise on thrips from SARDI, especially the Entomology Unit
- ◆ a pre-published training package from Horticulture Australia
- ◆ translation of the training package into Vietnamese
- ◆ technical information from a national network of WFT researchers
- ◆ information gathering and output about local pest levels and management issues to promote the programs relevance
- ◆ a local extension team to support the delivery of technical material, Vietnamese translation and liaison and program planning and review
- ◆ a series of pilot training programs for industry sub-groups
- ◆ non-classroom extension activities to complement formal training
- ◆ a wide range of partnerships with industry and regional stakeholders
- ◆ a flexible, grower-centred 'Action Learning' approach

The project aimed at building grower confidence in the new IPM technology, and in their ability to implement it. The relevance and effectiveness of recommended practices was promoted using hands-on experience and local examples. Individual growers who participated in the training program received further assistance during follow-up visits to their farms. This had a major impact on ongoing grower confidence and participation and has generated an ongoing commitment by growers and key partners towards achieving further advancement in IPM skills and adoption. For example, Vietnamese growers responded by forming an IPM learning group that meets regularly.

Farm surveys have identified a very high level of adoption of recommended pest management strategies amongst participating conventional shadehouse and greenhouse vegetable growers. Improved knowledge about the role of thrips in causing crop damage and seasonal cycles of pest activity in weeds and crops has lead to:

- thorough and timely clearance of farm weeds, old crops and TSWV infected plants,
- minimising human transfer of thrips and virus from affected crop sites, and
- improved pest exclusion through improved greenhouse and shadehouse screening, ventilation and entry practices

Pest control and resistance management practices have been improved greatly through:

- implementation of basic pest and virus monitoring practices through crop inspections before and after spraying
- improved spray coverage (equipment and application methods)
- better differentiation of chemical groups as a basis for improved selection and rotation of pesticides

Pest and damage levels have been very low for two seasons on all farms involved in this program. It is doubtful however that the basic improvements achieved in pest monitoring will be adequate to cope with seasons of severe WFT pressure. Both pesticide based control programs and those relying on beneficial insects will require development and adoption of more rigorous and efficient monitoring programs by growers/consultants.

Given the success of this program it is recommended that:

- demand from other horticultural regions under threat from WFT is addressed through transfer of this technology using similar extension strategies,
- IPM development and extension work continues to further improve strategies for multiple pest management, especially WFT, including the use of beneficial insects,
- there is further development/testing of chemical control options and other non-chemical pest control strategies compatible with the commercial use of beneficial insects to control pests in vegetable crops,
- priority is given to developing effective and commercially sustainable crop monitoring strategies, especially for Western Flower Thrips,
- trialing and demonstration of these technologies on commercial farms is undertaken to design grower friendly extension strategies and resources and provide information to assist the fine tuning of research efforts,
- advanced IPM training and mentoring support is made available for crop consultants, and
- consideration is given to developing communication strategies amongst IDO's, consultants, researchers and extension workers that would improve regional IPM adoption initiatives.

2. INTRODUCTION

Western flower thrips (WFT), *Frankliniella occidentalis* was first recorded in Australia in Western Australia in 1993 and was subsequently reported from Queensland (1994), New South Wales (1994), South Australia (1995), Tasmania (1995) and Victoria (1996). Within each state it has continued to spread and cause significant damage in a range of greenhouse and broad-acre vegetables. It can cause direct feeding damage to a broad range of crop plants and is also an efficient vector of tomato spotted wilt virus (TSWV). WFT also has the capacity to develop resistance to insecticides and consequently spray regimes need to be carefully planned to minimise the onset of major insecticidal control failures.

In South Australia, one group of growers (vegetable growers on the Northern Adelaide Plains (NAP)) suffered severe losses (estimated to be as high as \$80M) to potatoes, lettuce, capsicums, greenhouse cucumbers and strawberries in the 1999/2000 season. Research projects on WFT management have been funded by HRDC in WA and NSW from the mid 1990's but the information produced in these projects was not being transferred effectively to many growers in SA. Consequently, this project was established to develop and test pilot extension strategies to assist levied vegetable growers in SA with their management of Western Flower Thrips (WFT). Integrated Pest Management (IPM) principles were to be central to these strategies which may be applicable to other production areas in the country.

The NAP was chosen as the study area as it incorporates all of the typical industry challenges of an intensive cropping region that has mixed greenhouse and field vegetable production intermingled with extensive areas of broadleaf weeds which can host thrips and serve as a reservoir for TSWV. This area also has a range of growers with different ethnic backgrounds which may not be best served by "traditional" extension strategies used in other agricultural industries. The largest ethnic sub-group is the Vietnamese greenhouse growers.

The aims of the project were to:

- develop and test methods of transferring information on IPM of WFT and TSWV to vegetable producers in SA using information developed by interstate research programs. (HRDC funded project HG 97007)
- formulate a cohesive and commercially oriented network of WFT researchers and extension staff for the dissemination of timely, grower friendly and commercially relevant management strategies
- run a technology transfer program aimed at equipping individual growers with the information they need to manage WFT & TSWV
- integrate with concurrent HAL WFT projects on insecticide resistance management and virus transmission
- introduce IPM techniques and concepts to the grower base.

This project was initially designed to run over a 12 month period to cover one "WFT season" but was extended by 9 months to allow the inclusion of a second "WFT season".

It was understood at the commencement of the project that adoption of IPM practices would, in itself, be a significant modernisation challenge for the industry's traditional pest management practices. This challenge required the development of communication activities that could engage and transform the knowledge, relationships and practices of all relevant stakeholders. Methods were required that could facilitate industry change by doing the following things:

- Assessing the industry context for its technology needs and characteristics influencing the extension strategy
- Building collaborative networks with growers and industry, non-industry regional stakeholders and relevant resource providers at the state and national level.

- Developing and delivering locally appropriate and effective extension activities
- Encouraging participation by establishing the value of new pest management technology and project activities in the eyes of industry members and other key stakeholders
- Maintaining an ongoing review and measurement of project performance and outcomes
- Stimulating enduring changes in the industry's uptake of IPM technology and related services

3. ***METHODS***

3.1 **Project Team**

At the beginning of the project a planning and consultative team was established comprised of the three key people involved in facilitating the project proposal and the project appointee. These persons were:

- Dr Peter Bailey, SARDI Entomologist
- Mr Tony Burfield, SARDI IPM Extension co-ordinator for the project
- Mr Robert Kennedy, Virginia Horticulture Centre
- Mr Craig Feutrill, Vegetable Industry Development Officer – South Australia

This team worked to clarify technical and industry issues influencing project development and to establish new working relationships to support the project. This process was assisted by input from the Western Flower Thrips National Strategy, particularly through the National Communications Team at Knoxfield (Alison Medhurst and Bernadette Swanson).

During the course of the project, additional members were recruited to the project team and their details and roles played are presented in the *Appendix 1*.

3.2 **Program Strategy**

Beginning with input from the initial project team there were four main phases in the program strategy; the project development phase, the promotional phase, the workshop phase and the consolidation of IPM initiatives phase. All four phases overlapped and evolved continuously in response to the findings of the project during the life of this 21 month study.

Evaluation and review was ongoing throughout each phase, but is presented here as a fifth area of activity.

3.2.1 **Phase 1: Project development**

A series of meetings and direct contact visits were held with all levels of the vegetable industry on the NAP to define the relevant industry stakeholders and identify the regional characteristics of the Virginia area that might influence and have implications for the extension methodology used in the project. The information from these meetings was used to gain background information on:

- characteristics of the local industry
- areas of the industry that were most affected by WFT
- regional stakeholders of relevance to the program
- current pest management practices and their deficiencies
- IPM adoption issues facing the industry
- previous support made available for growers to assist them with WFT management
- how open the growers might be to learning and change
- how growers could be contacted, informed and recruited into extension activities
- how the needs of non-English speaking growers differed from English speaking growers

This strategy amounted to an informal extension activity to introduce industry stakeholders to the program and prepare the ground for advertising and delivering the workshops.

3.2.2 Phase 2: Project promotion

The broad intention was to impact and involve as many of the industry stakeholders as possible, but reaching growers was seen to be the acid test. The outcomes from this phase were aimed at building industry awareness and involvement in the program and to assist with grower recruitment into training and technology adoption.

A range of promotional activities were designed and delivered to reach the full range of potential stakeholders and keep them informed about the program as follows:

Low to moderate input information and promotional activities included:

- Press and radio releases to report on the project's progress
- Newsletters, local and National to report to a more specific industry audience
- Direct mail-outs to growers providing information about key issues, activities and outcomes
- Promotion of various WFT information and program activities through local businesses

High input project profile boosting activities included:

- A regional monitoring grid and weekly report to collect and provide public information about seasonal thrips activity
- A monitoring clinic in a local chemical reseller to expose growers to sticky trap monitoring
- A formal launch of the 'Bug Er Off' project

Various other invited presentations to interested audiences

3.2.3 Phase 3: Workshops and seminars

Five WFT Management workshops were offered to industry composed of 5-6 evening sessions. These sessions focused on the main technical themes of the WFT Management training manual as follows:

- Relating key pest/host/crop biology and interactions to crop damage and protection
- Introduction to pest monitoring and WFT identification
- Farm and crop hygiene (physical and cultural control)
- Principles of resistance management (chemical control)
- Introduction to relevant biological control options

Spray management training, including spray coverage theory and an 'On Farm' demonstration, were added to the program to emphasise this aspect of effective pest control.

The key resource for these activities were:

- WFT Management training manual, fact sheets and technical newsletters developed by the WFT National communications team
- A Vietnamese translation of the manual
- A Vietnamese interpreter and liaison worker
- A supplementary range of session resources developed in South Australia by the project
- Technical facilitation from a local horticultural consultant

Additional resources to support spray coverage training , were:

- A qualified technical facilitator and volunteer demonstration crop site
- Fluorescent dye and water mixture
- Portable air pressure generator
- Different spray jets (size and age), spray fittings, pressure settings and hand motions
- UV lighting to highlight fluorescent dye results
- Debrief and discussion session on coverage results from a qualified spray technology trainer

3.2.4 Phase 4: Consolidation of IPM initiatives

In the latter stages of the project, as workshops were drawing to a close, attention was paid to extending and establishing relationships and activities that would continue to support IPM adoption.

These all related to interest and expertise in changing farm and regional practices to deal with pest management from an integrated perspective and included the use of beneficial insects, grower self-help groups and regional pest-host vegetation management.

3.3 Evaluation and review

The evaluation process relied on ongoing communication and review with a broad network of industry representatives and technical experts. This created a 2-way cycle of input and review that maintained and supported program directions and priorities. This was done by building on the communication lines established at each phase through consultation, training and follow-up contact.

This information exchange was developed to suit the nature of the target audience(s), which often meant that it was verbal and informal.

Information gathering was also used as an opportunity to maintain communication with industry and identify and support opportunities to extend industry changes that improved adoption of Integrated Pest Management in the longer term.

We looked at the outcomes with growers in terms of establishing initial contact, maintaining ongoing involvement, facilitating changes and obtaining improved results in pest management implementation, and expressed or apparent changes in attitudes and perceptions of IPM.

We looked at outcomes with non-growers in terms of establishing ongoing relationships that assisted with project planning and review, information output and grower recruitment and delivery of extension and resource requirements. We also looked for development of shared strategic IPM awareness and activity.

Evidence for IPM adoption was sought through:

- verbal feedback from contacts in local support networks
- written and verbal feedback from growers during and after training, on farms and at meetings
- visual inspection of local farm weed clearance
- collection of informal case histories from representative groups

The suitability, quality and effectiveness of program design and delivery was evaluated using:

- recruitment and attendance records and discussion at workshops, meetings and seminars
- verbal and written feedback from growers during and after training and at meetings
- verbal review (1:1 and meetings)
- Occasional review from other technical experts in pest management and extension/adult education

4. RESULTS AND DISCUSSION

4.1 Development of an Action Learning Approach

The project developed and achieved its goals through co-operative action and shared learning involving facilitators, technical experts and other industry stakeholders. In this way the extension team was learning with the industry, rather than from outside of it, how to match new pest management technology with the existing farming context. We have concluded that our adopted approach strongly reflects what is called “Action Learning”.

Action Learning, (or Participatory Action Learning), is a way to bring a range of stakeholders together on a shared problem or vision. Change is facilitated through an ongoing collaboration in planning, trialing, reviewing and modifying the program strategy. It can emerge as a natural response to shared problem solving issues, but it usually requires facilitation to develop and maintain itself effectively.

This was not a deliberate choice of methodology at first, but developed out of project experiences as the best way to proceed. This approach was used to build strong and widespread participation and ownership of learning that is critical to the adoption and maintenance of major changes in knowledge and behaviour. This development suggests strongly that action learning can be a very appropriate model for extension programs that are working to achieve significant changes in farm technology adoption.

This dynamic approach to program design also affects the evaluation process used. It needs to capture what is taking place in the ongoing communication activity rather than taking snapshots using a lot of formal quantitative data. Evaluation is based on attracting initial involvement, quality of participation once involvement is established and continuing effects/outcomes of the involvement.

See appendix 2 for further comments on Action Learning and Evaluation with references.

A summary of data gathering tools along with copies of the key ones are provided in Appendix 3.

The remaining results are presented and discussed within the four project phases and their associated extension activities.

Project activity is also summarised as a sequence of events in *Appendix 4*.

4.2 Project Team and related partnerships

The initial project team expanded to include two other key persons for local technical and extension support:

- Domenic Cavallaro: a private horticultural consultant providing technical services to the industry and horticultural training through the Virginia Horticulture Centre
- Nhieu Nguyen: a Vietnamese person with industry experience (sales), translation and interpretation skills and a degree in Agriculture

Mr. Cavallaro provided extensive support with technical content, industry liaison and planning and review aspects of the program. The recruitment of Mr. Nguyen in June 2001 had a dramatic impact on Vietnamese involvement and overall project achievements.

Project related partnerships expanded considerably over time in response to initial consultations and efforts to obtain additional technical and extension support.

These partnerships have provided vital and consistent support through program review, information output, technical support and development of regional IPM strategies.

We encountered no real difficulty in identifying and attracting this additional involvement which indicates the broad recognition and acceptance that IPM initiatives are able to secure at this time.

A summary of the expanded team and partnership network can be found in *Appendix 1*.

4.3 Phase 1: Project Development

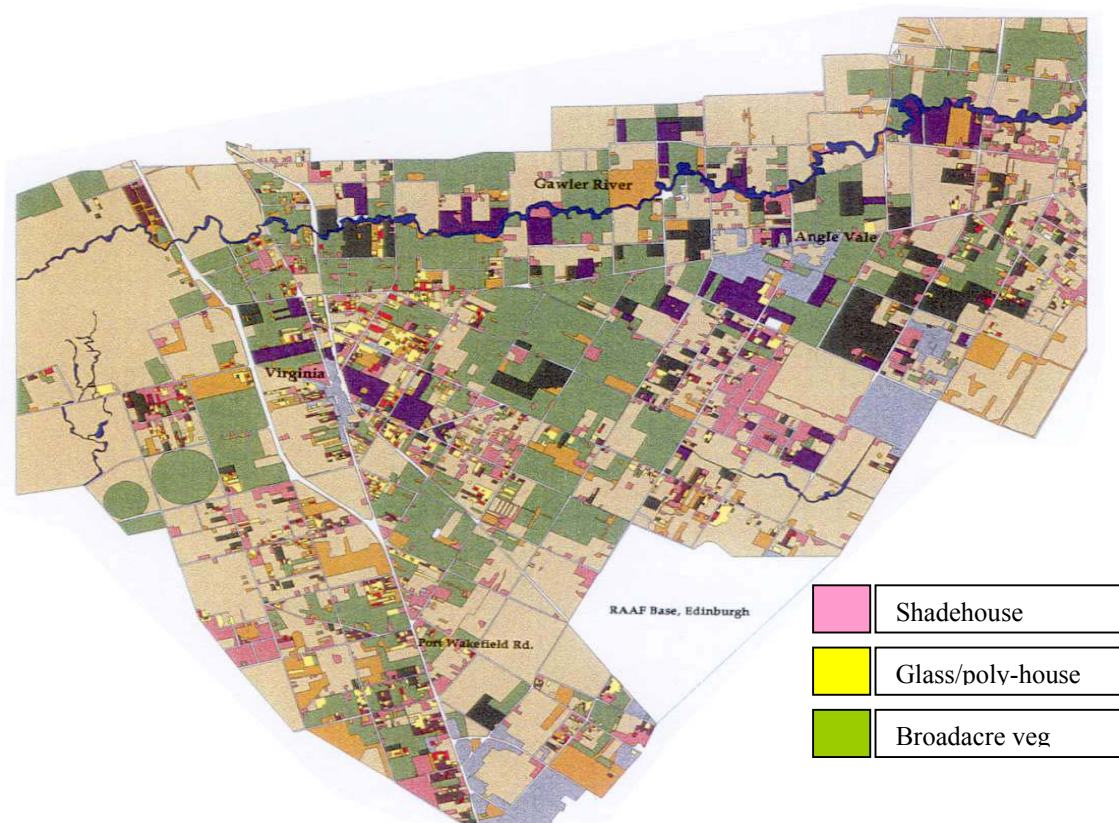
Background on the industry was developed and maintained through regular consultations with the expanded project team and partnerships.

The following information summarises the industry structure and regional characteristics of the NAP and lists some key issues with respect to management of WFT that emerged from information received at two initial meetings with industry representatives and numerous 1:1 contacts made during the early phase of the project.

4.3.1 Characteristics of the local industry

The geographic focus for the project was the Northern Adelaide Plains.

Scale: 0 1km 2km 3km



The region's industry is an intensive mix of greenhouse, shadehouse and field crops with the heaviest concentration around Virginia. The greenhouses occur in groups, thinning out over a 5km radius from the town centre while field and orchard crops are more prevalent towards these margins. There are many areas of overlap between these different farming systems.

Vegetable growers most affected by WFT damage were greenhouse growers of capsicum, cucumber and tomato, hydroponic lettuce growers and field growers of lettuce and potatoes. There was also a significant level of concern from bunch line growers due to thrips damage lowering the economic value of crops. Other crops like almonds experienced a significant level of damage also.

There are approximately 1200 farms in the area that are estimated to be divided up as follows:

- 600 farming businesses registered to Vietnamese growers - almost all being 'low-tech' greenhouse/shadehouse farms and a similar, but much smaller, group of Cambodian growers
- 400 greenhouse/shadehouse/nursery businesses run by English speaking growers, including some more capital intensive hydroponic crops
- 200 English speaking field growers (mostly brassicas, carrots and potatoes with some lettuce and bunch line).

The majority of English speaking and Vietnamese growers alike were operating conventional greenhouse/shadehouse farming, relying exclusively on pesticide to control pests. A couple of larger hydroponic farms were independently developing biological control programs.

Field growing is almost entirely restricted to English speaking growers from a mix of cultural backgrounds. These growers generally have a more developed pest control strategy that includes optimal planting times, weed management and a clear awareness of boundary threats.

The Vietnamese community has generally been difficult and costly to engage in training due to translation/interpretation needs. A significant feature of the community is a 'political' division into two main competing camps.

4.3.2 Identified regional stakeholders

- Growers of WFT affected crops
- Virginia Horticulture Centre representing the industry on issues and facilitating modernisation of industry practices
- Two local horticultural consultants servicing the industry
- Concerned retailers servicing the industry:
 - Two major chemical resellers serving the English speaking and Vietnamese communities*
 - Several seed companies*
 - Irrigation suppliers*
 - Packing sheds.*
- Three local councils (Playford Council subsidises some of the Virginia Horticulture Centre overheads.)
- FarmBis as a source of training subsidies

4.3.3 Summary of current pest issues and practices

No growers in the local area were identified as experienced practitioners of IPM, but there was a small group of leading growers with a good understanding of the main deficits in current practices.

Industry representatives (grower steering committee, main street industry retailers and local horticultural consultants) emphasised the widespread failure of all of the basic recommended management practices for WFT:

- Weed clearance was a very uncommon practice, which was a big concern for those growers who were vigilant about this threat. Many greenhouse growers also tended to leave old crops standing, creating sources of TSWV infected thrips that would migrate from the dying plants.
- There was poor implementation of resistance management strategies and growers were experiencing great difficulty in controlling WFT with the available pesticides.
- Monitoring with sticky traps was almost unknown except by a few growers who engaged a commercial consultant to provide a scouting service.

WFT has been a major problem in vegetable crops on the Northern Adelaide Plains for several years since the initial outbreak in 1995 and peaked with the 1999/2000 season crisis.

Biological control (*Phytoseiulus persimilis*) of two spotted mite in cucumber was used by a few growers in the years prior to WFT arriving. The drastic increase in pesticide use to control WFT ended this alternative to pesticides.

4.3.4 IPM extension and adoption issues facing the project

Delivering IPM extension

The local industry had identified their lack of technical support to manage this problem as a critical need. There was not an ongoing IPM extension strategy in place that could address this need.

There was no established history on the NAP of continuous improvement through learning/extension about integrated farming practices, thus grower participation in continuous improvement strategies has been extremely low. This has begun to change over the past 2 years due to efforts by the Virginia Horticulture Centre to generate a learning and continuous improvement program for the industry. The Centre is also sponsoring a Greenhouse Modernisation demonstration project, just commencing, to trial/demonstrate Best Practice for greenhouse growing.

These programs however were not equipped to address IPM technology so the Virginia Horticulture Centre has been assisting industry through a WFT grower steering group and IDO'S Rob Kennedy and Craig Feutrill.

Several key extension issues were identified:

- Most growers were beginning from a very low base in their pest management technology
- Most growers had apparently not responded to previous advice at meetings and in leaflets on managing WFT (weed clearance, spray rotation and monitoring)
- Direct access to individual growers was limited - in the year 2000 there was no updated grower database to work from
- Vietnamese growers were not regularly accessing technical and training services, probably due to language and cultural barriers

Three major extension opportunities were identified:

- There was considerable local support from the Virginia Horticulture Centre, leading growers, reselling businesses and industry consultants to assist the project with information output to growers
- Businesses servicing an intensive local farming industry were concentrated along a single main street making them ideal information outlets to growers (many other growing regions are much more dispersed)
- FarmBis funding could be used to maintain subsidised training opportunities

Developing Technical support

SARDI entomology has been involved in field monitoring studies of WFT on the NAP since 1997 and several staff were up to speed on the issue and were expert in the identification of WFT. They supported the industry funding proposal and employed the extension facilitator.

Two local consultants are active amongst the crops of concern, but uptake of fee paying technical services is very low. This is reflected in the poor pest management practices and almost total absence of crop monitoring in greenhouses.

The following sources of technical support were identified:

- SARDI: Dr. Peter Bailey, Greg Baker and Gabriella Caon and Anne Frodsham, Nursery Industry IDO
- Domenic Cavallaro, commercial horticultural consultant
- Paul James, PIRSA, previously involved in WFT support to the Northern Adelaide Plains industry
- Alison Medhurst, National WFT communications team, Knoxfield, WFT training manual and national WFT Newsletters
- WFT National research team outputs on resistance management and TSWV transmission
- Beneficial insects advice and information from James Altmann, Loxton and Marilyn Steiner and Stephen Goodwin, NSW Agriculture and Paul Horne, commercial consultant
- InFinder farm chemical database and ChemCert manual, Primary Industries
- Geoff Furness, SARDI, spray coverage and fluorescent dye technology expert
- HARDI Spraying Equipment (Steve Norton) and Agricair for supply and demonstration of spray application equipment with fluorescent dye on field crops

We found that the basic principles for WFT management were clearly established in existing publications and well presented in the WFT Training manual. There was also clear and precise information available on pesticides, including resistance management, with-holding periods, registrations and permits and, spray coverage technology.

Information on the use of natural enemies for thrips management became available and free supplies of the Aussie 1 predatory mite (*Montdorensis* mite) were obtained for crop trials. These predators were trialed at the Waite (faba beans) and in the Greenhouse Modernisation Project (tomatoes) with technical support for WFT management from SARDI. Although pesticides were not required the actual predator levels and their relationship to WFT suppression were inconclusive.

The training manual was very useful for explaining and illustrating the core technical principles for improved management of WFT, but there was a lack of definitive information on some details and their implications for pest control. This qualified our confidence about how well the research and IPM theory would translate to commercial cropping situations.

This included unresolved questions about:

- WFT mobility across production areas
- WFT pupal persistence in the soil
- effectiveness and practicality of the 3 sprays strategy, especially with regard to withholding periods during harvest
- a clear protocol for basing spray decisions on monitoring results (action thresholds)
- the choice of ‘soft’ pesticides to conserve natural enemies
- the limited insecticide options for rotation in an effective Integrated Resistance Management strategy

A further major difficulty was the lack of data and case histories on the performance of recommended practices in a commercial setting, including the integrated management of multiple pests and diseases.

Uncertainties about the details and effectiveness of WFT management made it hard to estimate the levels of benefit that could be expected from recommended practices. There was insufficient reference information to establish clear cost-benefit management priorities in the mind of growers. Along with the industry's unfamiliarity with modern integrated management practices aimed at continuous improvement, these problems presented a substantial barrier to adoption. Growers invariably still asked for a solution for WFT in terms of ‘a chemical or something that would instantly fix the problem’.

These realities suggested that it would be difficult to immediately promote a simple program of action. We concluded that the extension program needed to start with the basics and not assume too much about the effectiveness of this technology or its uptake.

Businesses and individuals that became involved through the above activities became a network that was kept informed about program developments and provided main street contact points with industry.

4.4 Project promotion phase

4.4.1 “Low input activities”

A range of strategies using printed material and contact visits were used to begin providing WFT management information and promoting program activities. Some of these were continued throughout the project. *See Appendix 5 for a more detailed listing with dates of issue.*

Media releases were used to promote the project's progress through various outlets including the local paper (The Bunyip), The Grower, Good Fruit and Vegetables, The Advertiser (in brief) and an ABC country radio program.

Local and national industry newsletter reports were used to update these networks in more detail on project progress, including Virginia Horticulture Centre newsletters, the National WFT newsletter and a “Bug ‘Er Off” newsletter mailed direct to our grower network.

Growers also received mail-outs on several issues including WFT workshops, participation in a regional monitoring grid, access to free WFT resistance testing, views about action required for weed control, and provision of case histories from their farm.

WFT information and program activities were posted at local businesses: the initial program introduction posters grew to become a series of information and promotion posters in main street businesses dealing with key issues, especially weed control. *See Appendix 6 for a portfolio of these posters.*

Liaison with local businesses also led to WFT information boards at 5 local resellers

- DiManno Seeds and Chemicals
- P and P Agricultural Supplies
- Virginia Irrigation Supplies
- Stoef Greenhouse supplies
- Virginia Nurseries

4.4.2 “High input activities”

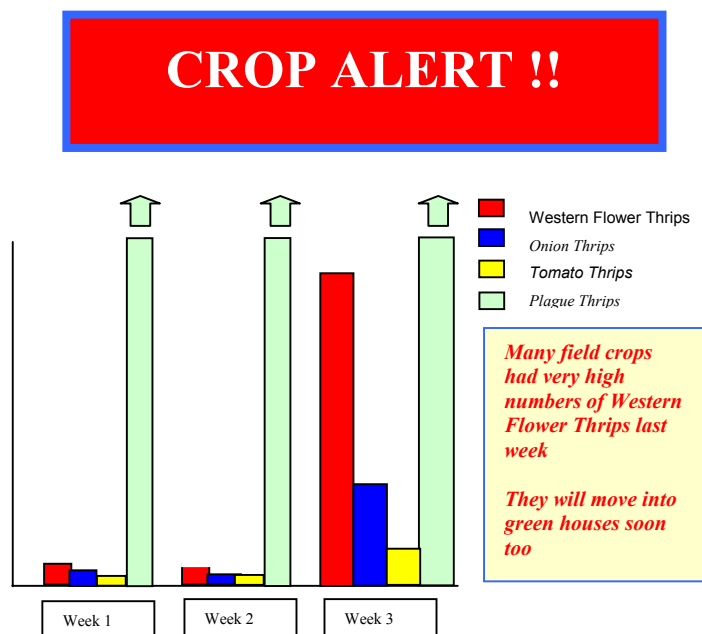
Late in the 2000/01 season we had to accept that it had been difficult to recruit growers into workshops and the situation was not going to improve quickly enough without a fresh approach. We needed to establish the program's image and relevance more strongly.

The program now had some local training and networking history experience that could be used to promote what was happening at the local level to complement the technology message. We also looked at some new activities to lift interest and participation by reaching a wider audience about the programs relevance, activities and progress.

A regional monitoring grid (spring 2001): It was felt that many growers had little real awareness of the changing WFT activity levels in and around their crops, except in response to spray applications, and did not distinguish WFT from other thrips. We set out to generate local data about thrips activity and use this to provoke interest in the project and simultaneously introduce growers to the use of pest monitoring.

Local data on WFT activity levels was collected from a regional monitoring grid during spring in 2001. Four

predominant thrips species (WFT, *Thrips tabaci*, *Thrips imaginis* and *Frankliniella schultzei*) were monitored using one sticky trap per farm on 10 farms across the region. The sticky trap sampling methods were not rigorously designed and did not allow for grower activity (spraying) that may affect results. Nevertheless week to week data indicated broad trends across the region due to weather events and the differing exposure to thrips flights between field and greenhouse crops. It also showed clearly the different activity levels of the four thrips species. A secondary benefit was the opportunity to alert participating growers about increasing or persistent WFT populations.



The thrips activity was graphed over a three month period and highlighted the connection to weather (*see Appendix 6*). Thrips activity graphs were displayed at the four local business outlets and generated a lot of interest and comment from growers.

Monitoring clinics (spring-summer 2001): Four local businesses were approached to host a weekly sticky trap clinic where growers could bring sticky traps for microscope diagnosis.

P and P Agricultural Supplies expressed strong interest in the program and weekly morning sessions were commenced in the 'reception area' where Vietnamese growers entered the business and often had morning tea.



Gabriella Caon (SARDI), examining growers sticky trap

Diagnostic work was done variously by PIRSA staff (Michael Nguyen), Cavallaro Horticultural services (Maria Siguenza) and a SARDI technical officer (Gabriella Caon).

Growers were given free sticky traps and advice on how to use them and submit them for a free thrips diagnostic service. Growers were given on-the spot information about trap results, WFT management practices and training opportunities.

The "Bug 'Er Off" program launch (18/9/01): Current and potential program supporters (Horticulture Australia, SARDI executive and technical staff, FarmBis, leading growers and local business staff) were invited to attend the launch of the Bug 'Er Off program. This was being done to give the program a memorable identity and to promote and illustrate what their support was achieving as well as the potential for further initiatives.

Guests were invited to view a sticky trap monitoring session and "Bug 'Er Off" information display at P. and P. Agricultural Supplies and visit the Greenhouse Modernisation Project crop trial of biological pest control. A brief session followed at the Horticulture Centre including the presentation of acknowledgment awards to project sponsors by the SARDI Executive Director Mr. Rob Lewis. This was followed by explanation of the monitoring grid using a regional map and a summary of project activity followed by lunch.

Several other presentations were given on invitation:

- A program introduction at the Virginia Horticulture Centre sponsored industry seminar on 'Taking Control' (20/6/01)
- A program presentation to Primary Industries staff at the Lenswood precinct (9/01)
- A report to the National WFT meeting at Virginia (31/10/01)
- A program presentation at the NIASA conference in Adelaide (March 2002)
- Two Greenhouse Modernisation Project IPM presentations (2001-2002)

4.4.3 Discussion of promotional activity impacts

By far the best initial recruitment results came through liaison with local businesses. They were the earliest point for grower contact and recruitment into the pilot workshops for both English speaking and Vietnamese growers.

Information display boards created regular discussion at the point of display in local businesses. This industry interaction together with a series of weed control posters seems to have had a significant impact on weed clearance practices that greatly exceeds the workshop attendances. Based on observations from driving through the area and talking with local retail staff there was a small increase in weed control on local farms in the 2001/02 season compared with 2000/2001. Weed control activity increased much further in the current season (2002/03), so that at least half of the greenhouse growers have been clearing their weeds prior to planting and are maintaining clearance.

Most field growers already kept their properties clear of weeds, but some left the road verges alone. It is now observed that the field growers are all clearing their road verges.

Partnerships with local industry have also produced specific collaborations, eg a major seed company helped to recruit about 40 growers for a crisis meeting to deal with an outbreak of tolerance breaking TSWV in capsicums.

Press releases, radio interviews and mail-outs created very little identifiable response from growers. Their impact is difficult to assess, but they may have increased background awareness of the program. Some replies were received from interstate growers, mostly Queenslanders, in response to published articles in "The Grower" and "Good Fruit and Vegetables".

Broad surveys by mail or public media achieve very little if they are reliant on individual responses. Mail-out of targeted surveys to growers with whom a level of contact had already been established (eg existing grower steering group and selected referrals by the local industry network and workshop graduates), did get a good response. This was used to collect local grower case histories on WFT Management practices and industry opinion on weed control issues.

The Monitoring grid information raised the program profile considerably with the growers directly involved, the businesses who displayed the results and the growers purchasing from these premises. Monitoring results, although not surprising, provided a much more interesting and tangible way to present information about WFT and overall thrips activity to growers in their local context.

The sticky trap clinics at P and P Agricultural Supplies brought in 64 Vietnamese grower contacts with about half returning traps for diagnosis over the 2.5 months of weekly morning sessions. Growers showed considerable interest in the microscope, but none began regular monitoring or kept their own records. Recruitment for training was greatly increased and closer contact established with many Vietnamese growers. The business manager noted how grower reactions to our presence changed over time from dismissive to sustained interest and acceptance.

The "Bug 'Er Off" Launch publicised a program title that was a confirmed attention getter. Guests at the launch commented that the program was interesting, innovative and deserving of their continuing support. Program information boards were upgraded to identify the new program name and incorporate the monitoring grid results.

Presentation to other audiences outside of the immediate industry found clear recognition of the challenge and importance of promoting WFT management in vegetable crops through IPM principles. Quite a few people showed interest in the extension resources being used and discussed extension issues in an industry that is reliant on pesticides. They confirmed the industry ownership ethos as a vital part of an effective adoption strategy, but commented on the general lack of resources to drive this process. There was broad confirmation that IPM

adoption is in its infancy in most crops and would need to progress to multiple-pest strategies to bring sustained reduction in chemical use.

4.4.4 Conclusions about promotional strategies

It was not easy to interest growers to participate in training by simply advertising that training for WFT management had arrived. The most common comment about grower practices was 'Surely they can see the value of it. Why don't they do it !?' Instead growers were asking for information about a new chemical that would 'do the job'. This is what was expected, but instead we were talking about cost and labour increases in the form of weed clearance, monitoring and spray rotation. Although we (the project team) understood that we were confronting a serious problem with necessary new technology, the skills and habits required were well outside the current practice of most growers in the region.

In this context early communication strategies achieved modest, but adequate outcomes that enabled the extension program to get started, including the pilot training groups for English and Vietnamese speaking growers.

Publicity and information displays may have had a much greater background impact on grower awareness than can be demonstrated with the current data. This is borne out by the increase in weed control.

More intensive efforts to raise the local profile of the program created significant benefits by linking locally relevant information with direct contact with growers. This was the case with both the English speaking and the Vietnamese communities. In the case of the Vietnamese community the sticky trap clinics at their preferred retailer provided us with the first real point at which we began to gain acceptance and break through the cultural 'barriers'.

Future IPM programs in other regions should find the promotional stage easier to accomplish based on the positive outcomes of this project. The ground has been broken in terms of proving the benefits achieved on 'low-tech' commercial farms when paying attention to correct implementation of basic WFT management practices. The capacity to build industry awareness and recruitment for IPM extension through consultative and promotional networks has been demonstrated.

4.5 The Workshop and IPM Seminar Phase

Workshops

From December 2001 to April 2002 five formal extension workshops were delivered. Each workshop consisted of five to six evening sessions of 2.5hrs and 1 farm demonstration of spray coverage management.

The workshops were delivered to six groups totalling fifty two growers in the following order:

- Group 1: Dec 2000 – Jan 2001. English speaking lettuce growers (5 growers + 1 chemical reseller)
- Group 2: May – June 2001. English speaking greenhouse and nursery growers (7 growers + 1 chemical reseller)
- Groups 3,4,5: July 2001 – April 2002 Vietnamese greenhouse and shadehouse growers (3 groups totalling 35 growers)
- A stand alone spray coverage demonstration was delivered to 15 English speaking field growers (May 2002), only 5 of whom were under the levy.

Attendance levels were quite good at about 72% for all groups.

The final 2 Vietnamese workshops were recruited after the initial 3 pilot programs and funded by industry and FarmBis. There is currently a waiting list for two more Vietnamese WFT workshops.

The Vietnamese sessions were also supported by a translation of the WFT management manual, and a small amount of promotional material.

Delivery of the technical information developed into 7 themes, or messages as follows:

1. The basic biological facts of WFT, TSWV vectoring and host/reservoir components of crop damage
2. The need for weed clearance to reduce pest & virus pressure
3. The need for good spray technology
4. The need for effective routine pest monitoring
5. The value of crop management planning (hygiene, timing of planting, crop placement, plant tolerance)
6. The need for record based management of pest control
7. Alternative pest control through biological control options

We also covered the need for co-operation with neighbours to reduce threats from weeds and old crops and the need for change at a regional level. These relate to building the awareness and responsibility of key players - other growers, local business, local council to manage threats from inappropriate land usage.

These sessions resulted in the development of additional extension materials which are summarised in (*Appendix 7*).

As the program progressed and developed more session resources and local experience our delivery could focus more confidently on interaction with growers around their core issues.

In the early stages both the presenters and the growers were struggling to come to terms with technical information and practices that were unfamiliar to them. It was not so much that the concepts were difficult to understand as apparently demanding, costly and unproven in a commercial setting.

By the time we were finishing the first Vietnamese program the workshops had expanded from four-five sessions to five-six sessions to accommodate the strengthening grower interest and deliverable content.

The involvement of an experienced and respected local horticultural consultant, and a well trained and dynamic Vietnamese translator, were invaluable in keeping growers engaged until we had worked through this period. The translator was able to clarify technical issues and facilitate fine tuning of content delivery. This resulted in strong interactive participation, especially in the Vietnamese groups that has transferred to ongoing involvement in grower meeting on a range of crop management issues.

Nine course evaluations were completed by English speaking growers from the first two groups, using the Werribee course evaluation sheet (*see Appendix 3*). Everything was ranked by the growers as good to excellent in the check boxes. A few comments were made on five of the questionnaires, mostly regarding program strengths. Several commented briefly on the value of the information to their pest management program and two made suggestions for improvements to the program as follows:

- need to have a physical demonstration of the insect (we did not have WFT samples at this first workshop, only pictures)
- too much peripheral information, possibly overriding the several key points

IMP seminars

IPM information seminars have been conducted as follows:

- Two introductory WFT management seminars at the GMP (12 English speaking growers and 8 Vietnamese at two separate sessions) (March 2001)
- A brief talk on WFT management to greenhouse growers at Murray Bridge (7 English speaking growers) (June 2002)
- A TWSV management seminar conducted jointly with Rijk Zwann for capsicum growers concerned about an outbreak of tolerance breaking TSWV (nearly 40 growers attended) (June 2002)

Comments on participation by different grower groups

Although recruitment to workshops and seminars began slowly it increased significantly through expanded promotional efforts and the developing reputation of the program.

Involvement in formal training by English speaking greenhouse growers and field growers has been hard to generate, but their attendance and interest levels at the IPM seminars has been increasing. They are beginning to follow up seminars with repeat attendance or purchase of reference material, eg:

- 45 growers buying the IPM field pocket guide from NSW Agriculture
- 12 growers enrolling for insect ID workshops
- six growers buying “The Good Bug Book”

Although field growers of lettuce and bunch lines often suffer significant damage from WFT their weed control and spray program practices were generally at a much higher standard than the greenhouse growers, who are mostly Vietnamese. Unless their spray coverage/rotation is at fault, it is difficult to generate further benefit for field growers without changing the practices of neighbouring land-holder management of host weeds and old crops. There is no immediate prospect for using beneficial insects in field crops.

We did not expect to see Vietnamese growers so strongly represented in the program. This outcome probably stems partly from the fact that all of them are greenhouse growers covered by the levy and the technology has a greater impact on reducing WFT pressure in protected cropping. There are not nearly as many English speaking greenhouse growers. The few larger hydroponic growers have also been slow to respond, but are beginning to show interest by attending the seminars. Some of these businesses are already trialing IPM on their own.

Assessment of post training adoption outcomes

Ten farm assessment interviews were used to gauge implementation levels, issues and benefits. The interviewed growers demonstrated consistent adoption of recommended management practices in all areas except monitoring and spray records. This included more efficient spray use, better resistance management (chemical rotation) and close attention to crop protection through a range of recommended non chemical practices.

The interview process was able to fully review each of the management areas of concern and record an outcome that could be verified on farm and clarified in any important details with the grower.

Eight graduate Vietnamese growers were surveyed ‘On Farm’. Seven more joined these in a group session for WFT graduates where we reviewed the results of the farm implementation survey and invited them to comment on their implementation difficulties and results. There was no apparent difference between the levels of adoption and success from those surveyed on farm. All growers reported a large reduction in pest damage, with none losing more than 5% of their crop and some approaching nil damage.

This contact also led to the formation of a Vietnamese IPM grower group in early 2002.

Six English speaking grower graduates were relevant to the survey (i.e. levvied growers; 5 lettuce and one greenhouse). All were visited and interviewed over the phone prior to designing the survey format. One lettuce grower and the greenhouse grower were surveyed in detail on property. The other lettuce growers had given similar informal results to the one surveyed. They were all very conscious of managing host weeds and rotating chemicals. Several of them implemented a sticky trap program at certain times to identify pest pressure from neighbouring crops/weeds, but not as part of a monitored spray program.

The English speaking greenhouse grower interview produced similar results to the Vietnamese growers, except for his weed control, where little change had occurred. See the summary of results below.

Summary of ten (10) grower farm interviews:

Management tactic surveyed	Green House (9)	Field Lettuce (1)
	No. of growers adopting the tactic	
Good weed clearance	8	1
Development of crop planning strategies to minimise threats	6	1
Roguing infected plants, clearing old crops properly, not moving from contaminated crop areas to cleaner/newer ones	7	1
Rotating sprays	9	1
Spray Coverage improvements (where needed)	5	1
Monitored spray program with sticky trap/plant monitoring records	0	0
Evidence of increase in informal monitoring knowledge and practice – without records	6	1
Spray records	7	1
Greenhouse improvements to exclude pests	6	N/A
Taking account of neighbours practices	6	1

All graduating growers had adopted (already, or after training) weed clearance at a very high and consistent level. Most growers were roguing out TSWV infected plants and had developed a clear understanding of practical ways to minimise the sources of pest and virus for their crops.

None were using sticky traps themselves or keeping monitoring records as part of their spray program.

All were rotating their sprays, most with 3-4 different active groups. Some had found ways to significantly improve spray coverage and reduce chemical output, by replacing worn spray jets and changing their application movements. Most were keeping spray records. Some were using their records to refer to, mostly to assess spray rotation decisions.

Some were making improvements to their greenhouse design concerning ventilation and screening.

We also found that some of the growers were actively seeking to develop co-operation with their neighbours and most were interested in developing their capacity to implement biological control.

See Appendix 3 for the pro forma used to record interview results.

4.6 Consolidation of longer term IPM initiatives

Because of the high profile generated by the project and the extensive networks that were developed we were able to identify further opportunities to develop support for IPM adoption. Most of these developed their momentum in the latter stages of the project.

4.6.1 Beneficial Insect technology

Biological Services and then NSW Agriculture were approached for assistance with beneficial insects and technical support in the Greenhouse Modernisation Project as a demonstration of their efficacy and to obtain technical experience in a local growing system.

Beneficial insects were used to control thrips (Aussie 1), whitefly (*Encarsia formosa*) and fungus gnats (*Hypoaspis sp*) in two tomato crops. These crops were successfully harvested without the use of insecticides or miticides. Pest levels remained low. Whitefly parasitism by *Encarsia* was confirmed, but no Aussie 1 were found on the plants leaving its role in WFT control inconclusive.

This work has led to ongoing liaison with IPM specialists including a visit by Paul Horne and James Altmann after the conclusion of this project.

4.6.2 IPM adoption Vietnamese grower group

An IPM adoption Vietnamese grower group was established in early 2002 and meets almost monthly. These meetings have an attendance of 10 –15 with a few women beginning to attend as well. Total recurrent involvement is around 25 growers.

There is a stable leadership within this group who have contributed to technical presentations to their peers across a wide range of production technology needs.

Members of this group plan to support trialing of beneficial insects in their crops

This development was facilitated by the Vietnamese extension interpreter who was aware of grower interest in learning more about IPM and crop management. He exercised a leadership role in facilitating two early meetings and then supported the group in establishing their own leadership and priorities.

4.6.3 Regional weed control issues

Grower concern about uncontrolled host weeds on neighbouring properties has been a long-standing issue that is thoroughly relevant to IPM practices and principles.

Earlier efforts, prior to this project, to get the local council to implement property orders for weed clearance have been unproductive. Legislative avenues through seeking proclamation of WFT or salvation jane as a notifiable pest/weed were also unsuccessful.

The project has consulted extensively on weed management alternatives. Successful roadside revegetation trials by a local revegetation consultant, using native saltbush, have motivated new efforts to establish working partnerships on the issue. We have now formed a working group including representatives from Landcare, SARDI and the Animal and Plant Control Board and an independent revegetation consultant. This group also incorporates a close working relationship with local council staff and volunteers concerned with native vegetation and weed control issues.

We have been working with the council to obtain funding for a research project linking entomological research to revegetation trials that may reduce the problem of broadleaf weeds and increase the activity of beneficial insects. If funding is received this group will provide the basis for a strong regional network addressing this issue.

There still remains a need to build the resolve of local council and other relevant parties to take action on irresponsible land-holders who jeopardise the income of local growers.

4.6.4 Responding to an outbreak of tolerance breaking TSWV

Late in the 2001/02 season a crisis meeting for capsicum growers was conducted to provide information to those affected, or concerned, by an outbreak of tolerance breaking strain of TSWV in capsicum. The issue was raised by a major seed company (Rijk Zwaan), who co-facilitated the meeting with their local technical officer and national manager.

This partnership has created access, through the seed company, to free pathology testing for the tolerance breaking strain of TSWV. The Queensland Department of Primary Industries pathologist is intending to visit the Northern Adelaide Plains in 2002 and study the host crop dynamic of this virus strain further.

This work is of significant benefit to the industry and creates additional extension opportunities for the management of TSWV.

4.6.5 The prospect for establishing long term IPM consulting services is as yet unclear.

There are a number of encouraging signs though:

- The Vietnamese greenhouse grower group has begun investing small amounts of money in their shared activities and are interested in establishing a regular consultant to the group
- A group of Murray Bridge greenhouse growers are interested in organising a voluntary contribution project with Domenic Cavallaro to trial biological control of pests
- Northern Adelaide Plains growers are interested in trialing beneficial insects with a view to producing pesticide free crops
- Several large hydroponic growers on the Northern Adelaide Plains are establishing links with the project and are looking for a high level of technical interaction

Further progress will probably depend on the successful completion of costed trials with beneficial insects. Commercial delivery of scouting/monitoring services are unlikely to expand without this technical advancement.

Joint planning is being conducted with the Greenhouse Modernisation Project to provide a comprehensive greenhouse skilling and adoption program, including access to technical services.

4.7 Summary of main outcomes

The following clear outcomes strongly support the conclusion that both the WFT management technology and the technology transfer methods were very effective in achieving the project's aims:

- 1. Successful development and delivery of pilot workshops and other extension strategies to support technology transfer**
- 2. Excellent technology adoption outcomes and results on graduate farms**
- 3. Progressive and significant increase in weed clearance by growers across the region**
- 4. Excellent Vietnamese participation in workshops and IPM activities**
- 5. Increasing involvement by English speaking vegetable producers throughout the program, including the possible future involvement of larger hydroponic businesses around the use of beneficial insects**
- 6. A range of technical and extension IPM support networks and partnerships at industry, regional and national level**
- 7. Widespread interest by the industry and technical experts in promoting the use of beneficial insects and other non-chemical pest control strategies**

5. *RECOMMENDATIONS*

It is recommended that other horticultural regions affected by WFT are advised of the success of this project in achieving adoption of basic IPM for Western Flower Thrips and are supported to achieve transfer of this technology to their growers using similar extension strategies including:

- a funded extension worker(s),
- a collaborative Action Learning approach between growers, technical experts and other industry stakeholders that can develop the local relevance and support for the program and serve to bring in additional resources, and
- the training resources available to the NAP pilot program, translated and interpreted where necessary to meet the needs of NESB growers.

It is also recommended that research, development and extension are undertaken to improve IPM adoption in protected crops and field crops as follows:

- demand from other horticultural regions under threat from WFT is addressed through transfer of this technology using similar extension strategies,
- IPM development and extension work continues to further improve strategies for multiple pest management, especially WFT, including the use of beneficial insects,
- there is further development/testing of chemical control options and other non-chemical pest control strategies compatible with the commercial use of beneficial insects to control pests in vegetable crops,
- priority is given to developing effective and commercially sustainable crop monitoring strategies, especially for Western Flower Thrips,
- trialing and demonstration of these technologies on commercial farms is undertaken to design grower friendly extension strategies and resources and provide information to assist the fine tuning of research efforts,
- advanced IPM training and mentoring support is made available for crop consultants, and
- consideration is given to developing communication strategies amongst IDO's, consultants, researchers and extension workers that would improve regional IPM adoption initiatives.

Appendix 1.

Project team and support partnerships

INITIAL PROJECT TEAM

Dr Peter Bailey

Senior SARDI Entomologist.

Program Leader with nearly 30 years of experience in entomological research and technical advice to industry, including field studies of WFT activity on the NAP since 1997.

Peter provided technical and planning oversight to the project until retirement in October 2001 when his role was taken over by Dr. Greg Baker and then Dennis Hopkins from SARDI

Mr Greg Baker

25 years of experience in the development and delivery of agricultural pest management systems.

Dennis Hopkins

30 years of experience in entomology research and technical advice in agriculture and horticulture.

Mr Tony Burfield

SARDI project officer.

IPM Extension co-ordinator for the project.

20 years experience as an adult educator in labour market programs.

Mr Robert Kennedy

Virginia Horticulture Centre.

Industry Development Officer – Production.

Rob has engaged the NAP industry in a long term restructuring process around education, training and self determination. He is very familiar with the local profile of production, industry skills and technology and cultural demographics and is a strong advocate for change in the industry.

Mr Craig Feutrill

Vegetable Industry Development Officer – South Australia.

Craig has been involved from the inception of the project supporting various aspects, including advice on strategic issues and assistance with publication of project articles and reports.

EXPANDED PROJECT TEAM

Gabriella Caon

SARDI Entomology unit

WFT and IPM Technical support

Extensive experience with Western Flower Thrips identification and technical information

Training provider for Thrips identification.

Gabriella provided regular technical support and advice, including frequent sticky trap diagnosis and crop monitoring input for beneficial insect trials in the Greenhouse Modernisation project.

Domenic Cavallaro:

Commercial horticulture consultant with 20 years experience in Primary Industries and now in private enterprise providing technical services to the industry

Worked with growers to introduce biological control agents for of Two Spotted Mite prior to the introduction of WFT into the area

Delivers a range of horticultural training courses in IPM, Soil and Plant Nutrition, Irrigation and land management and horticultural training through the Virginia Horticulture Centre

Has provided the principal technical support for training delivery
Provided strategic advice on industry liaison

Nhieu Nguyen:

Degree in Agricultural science
Fluent in Vietnamese and English
Self employed technical advisor and Vietnamese interpreter
Key contact person with Vietnamese growers for general liaison, recruitment and activity co-ordination
Facilitator of Vietnamese IPM grower group
He is committed to improving the business and production skills of Vietnamese growers

Elisa Kaeslar

SARDI casual technical assistant
Support with field monitoring of WFT
Review of technical information on WFT
Assistance with graphic materials

SIGNIFICANT PARTNERSHIPS SUPPORTING THE PROJECT

WFT Grower committee:

Mr. Boris Stoeff,
Mr. Morris Nicol
Mr. Romeo Giangregorio
Mr. Vandy Yon
Mr. Danny Deleso
Mr. Paul Pezzaniti
Mr. Dino Musolino
Mr. Gino Guidotto
Mr. John Papadopoulos,
Mr. H.T. Do

WFT communications team at Knoxfield

Provision of training manual and related extension support for establishing the workshop programs
Provision of National WFT Newsletter

National network of WFT researchers

Provision of technical information related to WFT management

Paul James and Michael Nguyen

PIRSA staff previously involved in WFT support to the industry
Historical background
Strategic advice on industry liaison and extension

Local industry :

Network of grower contacts developed from project communication activities

WFT monitoring grid (spring 2001): Ten growers providing monitoring sites for the regional monitoring grid

Key local businesses for display of information and recruitment of growers

- DiManno Chemical supplies
- P and P Agricultural
- Boris Stoeff Greenhouse Supplies
- Virginia Irrigation

Several local packing sheds displayed promotional information, but are not yet active in any further involvement

Rijk Zwaan Seeds:

Very active in promoting virus management amongst their growers, including virus testing (via Dr. Dennis Perseley), and supporting IPM seminars

Dr. Dennis Persley

Virologist

Queensland Department of Primary Industries (Queensland Department of Primary Industries)

Provided support with pathology testing and related technical advice for a tolerance breaking strain of TSWV

Biological control in greenhouses

Alec Townsend:

Project Manager, Greenhouse Modernisation Project

14 years of experience in horticultural production systems management, including IPM systems. Alec is committed to the promotion of IPM and has facilitated the trialing of biological control agents in the Greenhouse project.

James Altmann:

Biological Services – Loxton

Supply and technical advice for beneficial insects used in Greenhouse Modernisation Project trials

Ongoing liaison re IPM strategies

NSW Agriculture:

Drs Marilyn Steiner and Stephen Goodwin

Supply and provision of advice for use of Aussie 1 in the Greenhouse Modernisation Project trials

Ongoing liaison re IPM strategies

Regional IPM working group:

SARDI Entomology: Glenys Wood and Dr. Nancy Schellhorn – technical input and development of project proposals

Playford Council: parks and vegetation unit staff – liaison over regional vegetation project proposals

Alan Arbon :Animal and Plant Control Board – liaison over regional vegetation project proposals

Glenn Christie: revegetation consultant and educator – liaison over regional vegetation project proposals

Domenic Cavallaro – Landcare co-ordinator for the Northern Adelaide Plains.

FarmBis

Provision of training subsidy for delivery of two WFT workshops to Vietnamese growers

This resource is now unfortunately drastically reduced.

Appendix 2.

Action Learning as an extension strategy to build the capacity for change

Due to the inability of conventional pesticides to control Western Flower Thrips (WFT) the vegetable industry is experiencing continuing significant crop losses and rapid movement of this pest into new crops and growing regions. Although relevant technical information in the form of recommended Integrated Pest Management (IPM) strategies has been available to the industry for several years there has been little apparent adoption of these strategies by affected growers.

Growers need more than technical information about recommended strategies to implement IPM. The shift to IPM is a shift from a simple reliance on regular use of broad spectrum pesticides to an integrated range of strategies that complement chemical control with non-chemical measures. Management of these strategies requires a very different approach, including forward planning and continual data gathering to inform management decisions about the appropriate response from a range of options. This requires a significant uptake by growers of more complex knowledge, skills and behaviours that are unproven in the commercial cropping contexts they are familiar with.

It seems that the capacity (and therefore the necessary confidence) to make these changes is simply not present in the industry and has to be developed. The whole framework of philosophy, information, products and services underpinning industry practices are involved in making an effective change. This task includes all of the wider networks through which these things are delivered to industry and requires much more than new technical information and formal training activities. To facilitate change we found that we had to build new learning relationships between growers, facilitators, technical experts and other industry representatives. In our view a shared learning strategy has increased the industry's capacity for basic IPM adoption because it involved all stakeholders in generating the local information, beliefs and practices required.

Capacity Building is widely recognised as an important strategy for facilitating sustainable community change. In presenting an argument for "Capacity Building" in communities Cavaye (Cavaye, J. 2000, p3) refers to the barriers to community ownership and participation in change inherent in traditional technical service delivery when he says "Federal and state governments design programs or services and 'deliver' them into communities from 'outside'. Control remains outside the community, experts have authority, and issues are largely technical or economic (p3 citing Fear et. al., 1998)". He further quotes Brown (1980) as arguing that technical assistance in itself does not address a communities capacity to manage the assistance it receives (p4).

Cavaye advocates (p8) capacity building partnerships between agencies and target communities. "agencies can help communities build capacity by providing a vehicle for local people to express and act on existing concerns ... that allow motivated people to come together, and implement action. As a result people build networks, organisation and strategic thinking."

Contained within a participatory strategy for change there must be a learning process that empowers the stakeholders to achieve their goals. Action learning is a participatory learning model for creating change where complex information and issues need to be worked through, rather than just acquiring knowledge and skills to 'top up' old practices. It is based on recognising the range of stakeholders that influence the target situation and including them in a learning process according to their interest and capacity to contribute. According to professor Reg Evans (web page IFAL Canada) "such [learning] partnerships actually create themselves when different people with different ideas engage wholeheartedly with each other to resolve each others problems." and "There is a profound shift from dependence on available expertise ... to learning from and with fellow learners..."

Action Learning is an adult learning process that "integrates research, learning and action into a single activity and develops an attitude of questioning and reflection to help individuals and organisations change..." (web page IFAL UK).

This is accomplished by:

- taking a collaborative, communication based view of an issue and its stakeholders
- accepting that the facilitators are also learners who adapt to these developments
- seeking to identify and begin where people are at with their needs, issues and readiness to learn
- using continual review to refocus priorities, resources and strategies according to the developing needs, opportunities and outcomes
- recognising relevant progress rather than just focusing on pre-determined final outcomes

Action Learning is a good way of understanding the work of this extension team in testing and developing methods for transferring IPM. It is reflected in the methods used in this project, ie:

- A local network of stakeholders was initiated to deal with the WFT threat to their industry
- Adequate resources were obtained to fund a program of activities
- The core extension content was available from several complementary sources
- An extension team was drawn from this network
- The extension team worked with growers to facilitate learning that was relevant to them rather than impose good expertise on them
- A range of communication strategies were employed such as, posters, published articles, mail-outs, seminars etc.
- A profile of local was built for the project around local crop information and issues to establish the relevance of the extension content to the local industry
- The project progressed toward future and regional opportunities in weed management, multiple pest management and learning about total crop health

We believe that this broadly collaborative project strategy was the key to increasing the capacity of industry and industry partners for adopting IPM. The formation of a Vietnamese IPM farmers group and regional weed management initiatives and the regional weeds and vegetation working group are good examples of this outcome. These groups enabled participants with a common interest to achieve far more in terms of strategic planning, problem solving and resource acquisition than if they operated in isolation.

We found that Action learning provided the following advantages:

- ◆ it's applied nature meant that learning outcomes at every stage of project development were confirmed and further opportunities, needs and factors made apparent.
- ◆ the open ended and continuous nature of Action Learning allowed the project to expand and develop in content, participation and direction
- ◆ group training and seminar activities provided certain efficiencies at a general learning level while giving some support at the individual grower level (on farm) provided detailed practical insights for the learning group
- ◆ the ongoing 2-way communication with a range of stakeholders enriched the content and quality of learning activities and outcomes

This extension project has established a local Action Learning framework that will support further IPM learning and adoption opportunities. Individual growers will need to increasingly adopt an action learning approach to move toward more comprehensive IPM systems. This can be encouraged using intensive trials on local farms to test and develop advanced IPM strategies, including the use of Beneficial Insects, thus taking the 'local content' of the extension effort to a deeper and more detailed level.

There is an identified need to change traditional approaches to extension in a way that mirrors our experience and views quite closely. These issues are discussed in depth in a Rural Society paper "Agricultural Extension in the Context of Environmental Degradation by Vanclay and Lawrence (no date given).

Action Learning differs from more traditional methods because it provides a way through the barriers between learner and expert identified in these papers as a major issue in traditional horticultural extension.

Action Learning and Evaluation

Action learning affects the approach to evaluation. The focus on informal communication, confidence building, collaboration etc., means that this learning is based on a dynamic relationship of exchange between learner, facilitator, learning context, activities and resources. This is not conducive to formal data gathering and analysis.

In this project we found that information gathering on the learning outcomes, based on routine, detailed grower input is not very effective and can actually become an obstacle to facilitating learning. It is not easy to conduct formal evaluation within workshops with grower groups. They are very practically and verbally oriented. They do not respond well to frequent or detailed questionnaires or homework. This limited the amount of formal information gathered from the workshops.

This is in part because there is a real difference between a learning subject that is still being developed in its detail and credibility with the learners and one that can already be taken for granted as relevant, necessary and fully cost-effective. It is much easier to apply systematic formal evaluation to the latter because its goals, outcomes and methods are well established and can be efficiently and clearly addressed.

There were three or four lines of evaluation demand to deal with: 1. the WFT training manual had already developed evaluation formats, 2. new priorities and approaches were considered during the course of the project, 3. FarmBis requirements added another layer of mandatory participant input, 4. we were training Vietnamese growers where the language barrier presented another obstacle to routine formal evaluation where the evaluation process must be mediated through the interpreter, which complicated evaluation further and demanded more resources.

Grower meetings sometimes proved a difficult place to develop planning and review information until we recognized the difference between issue groups and learning groups. Issue groups are often in reaction mode and want direct action now, and they usually have determined an external problem or culprit, so ownership is difficult to achieve. This mind set makes it difficult to reflect on issues and create alternatives without a very well constructed process and modest expectations. This may explain why very few Western Flower Thrips steering committee members participated in extension activities, while graduates of the workshops often sustained their involvement.

Action learning with a receptive group of learners can produce the results that are needed to establish a basis of confidence in new practices. This can be used as capital to transform other issues focused groups into a learning groups.

In spite of these problems we are able to confidently report the project's success because we now also understand that Action Learning provides a way out of this problem, although it takes longer and is initially more resource intensive. Action Learning counters this by providing higher quality outcomes and more development of additional benefits in the learning culture and involvement of stakeholders

The ongoing two-way communication and review process of Action Learning overcomes the difficulties presented by formal evaluation, provided the group maintains its objectives and evaluates its progress inside a flexible collaboration and sharing of resources. This requires facilitation and leadership which itself may be flexible and shared according to who can contribute to each area.

These issues are well recognised according to Murray (Murray, P 2000, 493-642)

Several quotes from his paper will serve to illustrate this perspective:

Murray claims that Agricultural Extension is no longer seen as a vital conduit for new agricultural information but as "facilitatory and participatory in nature with outcomes focused on the empowerment of local people." (p522, citing Chambers 1992)

Farming Systems Research is "participatory and involves cycles of observation, diagnosis, planning, action and evaluation." (p523, citing Petheram and Clark 1998)

Evaluation methods designed for 'top down' extension, and the familiar funding bodies, may be unsuitable for participatory extension (Murray, p522)

"Outcome focused evaluation, particularly where the focus is on predetermined, externally imposed criteria can be stifling to genuinely participatory extension approaches" (Murray, quoted from)

"Among the major challenges facing participatory and process centred approaches is the need to achieve recognition for results". (p519 citing Petheram and Clark 1998)

Murray's paper raises pertinent questions in relation to the challenges in evaluating extension based on Action Learning, but makes no firm conclusions. He concludes that practice in participatory approaches is developing, but the evaluation is lagging behind. (p525, citing Roling, 1990). Although evaluation practice is not clarified by Murray in any final sense we believe that good evaluation is achieved if the following things are kept in place:

1. the learning group has a strong common interest, in this case an economic and a scientific imperative
2. the group has resources and process in place to:
 - ◆ meet as required
 - ◆ plan relevant action
 - ◆ take such action
 - ◆ collect and share necessary information to support action and review of outcomes
 - ◆ evaluate the outcomes of their actions
 - ◆ reformulate goals and strategies in response to outcomes

In spite of the different nature of evaluation within Action Learning we recognise that consideration must also be given to appropriate ways of gathering more quantitative data on project outcomes without impairing the dynamic learning processes. This will need to move beyond assessing adoption levels to focus on the measurable outcomes from IPM adoption. The relevance of this to growers can be established through using benchmarking to define cost-benefit comparisons. The biggest challenge will be securing comparisons with farms that are not adopting recommended IPM practices.

The Action Learning approach to facilitating change is a new and productive technique for us and I am sure that our ability to use this methodology will continue to develop.

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Appendix 3.

Summary of Primary Data Collection tools used/developed

RESOURCE	ATTACHMENT
1. Grower case history survey	Y
2. Invitation to growers participate in several program activities	Y
3. Survey of grower opinions on weed control	Y
4. Before and after training survey of grower views on WFT management	Y
5. Post training course feedback (Werribee form) (source – WFT communications team training resources)	Y
6. Course evaluation form (WFT national communications team training resources)	Y
7. WFT Management farm assessment interview form	Y
8. Managing Western Flower Thrips course certificate (non-accredited)	Y
9. Grower data base - Access 2000	N

**SURVEY OF GROWER
ACTION TO CONTROL
WESTERN FLOWER THIRPS**

Tony Burfield
Virginia Horticulture Centre
PO Box 847
VIRGINIA
SA 5120

Ph: 8282 9200
Waite: 8303 9580
Mob: 0401 120 857

Dear Kevin,

From our conversation I know that you have made significant changes to your crop management to reduce the threat from Western Flower Thrips. Thank you for agreeing to share your knowledge and experience in dealing with the Western Flower Thrips menace to crops.

I am intending to present a collection of growers comments with their names in workshops, seminars and newsletters dealing with Western Flower Thrips. I am sure that this will encourage other growers to see that it is worth following a continuous learning/improvement path with their pest and farm management as you are doing.

Please feel free to either respond to the subject headings below, or comment in any other way you want to on the next page. A reply paid envelope is enclosed for your convenience and mine !

What crop(s) are you growing and how (field, greenhouse, nursery etc.) ?

What changes have you made to your crop management to reduce damage from Western Flower Thrips

What persuaded you to do these things ?

What benefits have you seen from doing these things ?

Are there other things you are looking into doing to improve your pest management position further

Do you see any ways in which growers and other groups could help each other and the industry to reduce the pest pressure on the Northern Adelaide Plains ?

Yours sincerely in Pest Management !

Tony Burfield

27/2/01

To All Vegetable Growers

Here is some information to bring you up to date with what is happening with the Western Flower Thrips (WFT) control project at the Virginia Horticulture Centre.

- **An initial group of WFT control workshops will soon been completed with lettuce growers.**
- **A field manual to assist in controlling Western Flower Thrips is near completion**
- **More workshops are planned so growers can deal with thrips this season and plan for next season. We expect that these workshops will obtain Farmbis funding. (A flier for the workshops is enclosed.)**
- **A weather watch warning for WFT has been enclosed. WFT are increasing now the weather is milder. Some capsicum crops have been heavily hit already.**

What's next ?

1. We now need 8 growers to be part of a 4-6 month s project on WFT control. These growers will have all monitoring costs met by the project and will be supported to get a WFT control program developed on their farm.
2. We are going to set up **a monitoring grid** around the Northern Adelaide Plains to keep everyone up to date with WFT numbers. All **related monitoring costs will be covered** for growers participating in this activity and **results will not identify individual farms.**

Free resistance testing !

If anyone has large WFT numbers and wants them tested for resistance in New South Wales I can take samples from about 5 or 6 farms. This information will be released as a guide to which sprays are working best around Australia without identifying individual growers.

On the tear off section below please tick the boxes that you are interested in and send them to me at the address below. I will get back to you quickly ! Thanks.

.....
As a grower I would like to know more about:

1. Western Flower Thrips Control workshops []
2. The Western Flower Thrips Field Manual []
3. I am interested in being part of the 4-6 months WFT control project on my farm []
4. I am interested in being part of the Monitoring Grid []
5. I am interested in having free Resistance testing done []

Name

Ph:

Address **Postcode**

Tony Burfield (Extension Facilitator – Western Flower Thrips, NAP)

Ph: 0401 120 857 or 8282 9200 at Virginia or 8303 9580 at the Waite Adelaide

Postal: P.O. Box 847 Virginia SA 5120

VEGETABLE INDUSTRY VIEWS ON EFFECTIVE WEED CONTROL

Contact Name Business Name.....

Phone/Contact Service provided.....

Why weed control is important to my farm business:

.....
.....
.....
.....

What I think needs to be done to protect farm businesses:

.....
.....
.....
.....
.....

Who I think needs to be involved in weed control and what they need to do:

.....
.....
.....
.....

Other comments:

.....
.....
.....

Signed: Name..... Date .../.../....

PRE COURSE EVALUATION
CONFIDENTIAL

1. What benefits do you expect to get out of this course?

2. What crops do you grow ?

How many years have you been growing each crop?

<hr/>	<hr/>
<hr/>	<hr/>
<hr/>	<hr/>

3. How do you feel about WFT? (please tick one)

- Don't care
- Bit worried
- Worried
- Very worried

4a. Do you currently have or have you ever had WFT on your property?

- Yes
- No
- Don't know

4b. If yes, what control methods did you use against WFT?

5. Are you involved in decision making about control methods on your property?

6a. Do you currently have any WFT prevention strategies in place on your property?

Yes

No

6b. If yes, what strategies do you have in place?

6c. How effective do you think these strategies have been ?

Not much difference, probably won't keep them up

Probably did some good, but hard to tell

Significant improvement – will definitely keep them up

POST COURSE EVALUATION

CONFIDENTIAL

1. What did you get out of this course ?

2. How do you feel about managing WFT now ? (please tick one)

- Pretty positive
- More positive than before
- No change since beginning the course
- More worried

3. Do you currently have WFT on your property?

- Yes
- No
- Don't know

4. What are 3-5 things you are going to do differently to help fight WFT& TSWV?

5. How effective do you think these strategies will be in the long run ?

Probably not much difference

Might do some good – worth a try

Should turn things around significantly

EVALUATION

Western Flower Thrips and Tomato Spotted Wilt Virus Training Course

Could you assist us by filling in this evaluation? We'd appreciate any comments, suggestions or constructive criticisms you might have.

(tick a box)

<u>Overall:</u>	<u>Yes</u>	<u>Partly</u>	<u>No</u>
1. Was the information presented useful to you? Comments.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Was the information presented clearly? Comments.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Was the venue comfortable and could you see and hear clearly? Comments.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Did you like the format of the workshop (4 evenings rather than 2 x1 day sessions)? Comments.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Did the course meet your expectations? Comments.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Week 1. Introduction

Was the pace of the session

- too slow?
- just right?
- too fast?

Comments

Were the explanations

- very clear and concise?
- clear?
- not clear?

Comments

Was the content

- very clear and understandable?
- clear and understandable?
- not clear and understandable?

Comments

How valuable do you think the concepts will be to you on-the-job?

- very valuable
- valuable
- not valuable

Comments.....

Week 2. Monitoring and Identification

Was the pace of the session

- too slow?
- just right?
- too fast?

Comments

Was the content

- very clear and understandable?
- clear and understandable?
- not clear and understandable?

Comments

Were the explanations

- Very clear and concise
- clear
- not clear

Comments.....

How valuable do you think the concepts will be to you on-the-job?

- very valuable
- valuable
- not valuable

Comments.....

Week 3. IPM and cultural management

Was the pace of the session

- too slow?
- just right?
- too fast?

Comments

Were the explanations

- Very clear and concise
- clear
- not clear

Comments.....

Was the content

- very clear and understandable?
- clear and understandable?
- not clear and understandable?

Comments

How valuable do you think the concepts will be to you on-the-job?

- very valuable
- valuable
- not valuable

Comments.....

Week 4. Chemical management

Was the pace of the session

- too slow?
- just right?
- too fast?

Comments

Were the explanations

- Very clear and concise
- clear
- not clear

Comments.....

Was the content

- very clear and understandable?
- clear and understandable?
- not clear and understandable?

Comments

How valuable do you think the concepts will be to you on-the-job?

- very valuable
- valuable
- not valuable

Comments.....

Any **general comments** about the workshop content, the presenters, the facilitators, or other aspects of the course?

.....

.....

.....

Do you think you will be able to use information from this workshop to improve operations in your workplace? (tick a box)

<u>Yes</u>	<u>Partly</u>	<u>No</u>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Why / why not?

.....

Was this workshop good value for money? (tick a box)

Why / why not?.....

.....
..

Thank you for taking the time to fill this in. We appreciate it.

WFT MANAGEMENT: PRIORITY IDENTIFICATION, ACTION TAKEN, ADDITIONAL SUPPORT NEEDS

PRIORITIES AREAS	ACTION TAKEN	ACTION SOON	DIFFICULTIES (cost, labour, equpt.)
Crop planning ➤ What to plant, where & when			
Weed Control when, where, how			
Green House structure ➤ Repair ➤ improvements			

WFT MANAGEMENT: PRIORITY IDENTIFICATION, ACTION TAKEN, ADDITIONAL SUPPORT NEEDS

PRIORITIES AREAS	ACTION TAKEN	ACTION SOON	DIFFICULTIES (cost, labour, equpt.)
<p>Planting & crop care (quarantine, hygiene, fertilising etc.)</p> <ul style="list-style-type: none"> ➤ preparation and planting ➤ developing crop ➤ mature crop (harvesting) ➤ end crop (disposal) 			
<p>WFT Monitoring program</p> <ul style="list-style-type: none"> ➤ what data collection system ? 			
<p>WFT Spray program:</p> <ul style="list-style-type: none"> ➤ when spray/ when not spray ? ➤ pesticide selection & rotation plan ➤ spray equipment changes ➤ calibration checking ➤ application method changes 			

.....*Draft Copy Only*
has
SUCCESSFULLY COMPLETED THE
FOLLOWING TRAINING PROGRAM:

Managing Western Flower Thrips and

Course Contents:

Pest and virus Biology

- ◆ *Pest life cycle and Virus facts*
- ◆ *Virus transfer from host plants*

Non-chemical risk reduction

- ◆ *Controlling host vegetation*
- ◆ *Crop hygiene management*
- ◆ *Property quarantine principles*
- ◆ *Pest exclusion from greenhouses*
- ◆ *Communicating with neighbours*
- ◆ *Developing a risk reduction crop plan*

Monitored Pesticide Strategies

- ◆ *Resistance management principles*
- ◆ *Spray coverage principles and demonstration*
- ◆ *Developing a pesticide selection and rotation plan*
- ◆ *Pest monitoring strategies and spray decisions*
- ◆ *Keeping monitoring/spray records*

Course conducted and assessed by the Virginia Horticulture Centre through: Tony Burfield, Domenic Cavallaro and Nhieu Nguyen (2002)

Gerry Davies..... (Centre Director) / /

Appendix 4.

“Sequence of Extension Activities”

A. PROJECT ESTABLISHMENT	
1. Establishing project support and direction	Nov 2000
<ul style="list-style-type: none"> • Sessions with initial grower working group and industry consultants • Establishing technical support • Establishing liaison with local stakeholders 	
2. Establishing profile	Dec 2000
<ul style="list-style-type: none"> • Main street posters • Press and radio releases • Newsletters, local, National • Mailouts 	
3. Formal extension activities begin	Feb 2001
<ul style="list-style-type: none"> • First pilot - English speaking lettuce field growers • Second pilot - mixture of English speaking greenhouse (capsicum) and nursery growers 	
4. Vietnamese training begins	July 2001
<ul style="list-style-type: none"> • Third pilot - Vietnamese greenhouse/shadehouse growers (capsicum & cucumber) 	
B. PROJECT CONSOLIDATION	
5. Program profile boost	Aug 2001
<ul style="list-style-type: none"> • P&P Agricultural Supplies sticky trap clinics (28/9/01 - 7/12 2001) • WFT monitoring studies and local case histories (12/9/01 - 19/12/01) • “Bug ‘Er Off” Launch (18/9/01) • Presentations and attendances at various IPM forums • Town signage concepts 	
6. Vietnamese training continues	Nov 2001
<ul style="list-style-type: none"> • FarmBis funded workshops - 2 Vietnamese greenhouse/shadehouse growers (capsicum & cucumber) 	
7. Farm assessments begin	Feb 2002
C. FURTHER DEVELOPMENT & FUTURE CONSIDERATIONS	
8. Regional partnership building	Feb 2002
<ul style="list-style-type: none"> • Regional weed control liaison commences • Weed and vegetation management Working group formed 	May 2002
9. Revisiting field grower support	May 2002
<ul style="list-style-type: none"> • Field grower spray demonstration 	
10. Addressing future directions	
<ul style="list-style-type: none"> • Industry input via grower input at training sessions & farm visits, business 	From Nov 2001
<ul style="list-style-type: none"> • Submission for HA Multiple Pest IPM funding 	Feb 2002
<ul style="list-style-type: none"> • Vietnamese grower group WFT review & planning sessions 	May 2002
<ul style="list-style-type: none"> • Negotiating FarmBis package 	June 2002

Appendix 5.

Communication And Extension Outputs Summary

PUBLIC INFORMATION AND MAILOUTS

Item	Approx date	Poster/ display	Public distibn	Fliers	Mail- outs	Attached Copies
WFT Workshop flier "Your Turn to Call the Shots !"	November 2000			Y	Y	Y
Weather alert for WFT	December 2000	Y			Y	Y
Invitation to contribute case histories	May 2001				Y	See App 3
Clear Those Weeds Before They Seed	June 2001	Y				Y
Broadleaf Weeds Means More Disease	August 2001	Y				Y
Invitation for Monitoring Grid volunteers	August 2001				Y	See App 6
Invitn to monitoring clinics – Viet	September 2001		Y	Y		N
Save \$\$ Monitor for WFT	October 2001	Y				Y
Graphs of Monitoring Grid results	Oct–Dec 2001	Y				See App 7
Crop alert for WFT	November 2001	Y				Y
Western Flower Thrips can be controlled	December 2001			Y	Y	Y
Pest monitoring saves \$\$ & time	January 2002	Y	Y			Y
Field vegetable spray demonstration	February 2002	Y	Y	Y	Y	Y
Invitation to contribute industry views on weed clearance to lobby council	February 2002				Y	See App 6
Weed clearing pays off !!	June 2002	Y				Y

MEDIA RELEASES

Featured in VegLink SA in "The Grower"	December 2000	Appointment of Extension facilitator
Local newspaper (Bunyip)	January 2001	Large article re the program with paid advert outlining WFT management
Featured in VegLink SA in "The Grower"	September 2001	High danger season warning
Release to Advertiser	August 2001	High danger season warning - very brief article
Release to Landline	October 2001	Not featured
ABC National - Country Hour	February 2002	Brief interview aired about WFT issues and management
Featured in VegLink SA in "The Grower"	March 2002	Good outcomes from project and biological control in GMP
Three VHC newsletters	2001, 2002	Three brief reports on program results
WFT Newsletters	Nos. 21 – 27 March 2001 – Sept. 2002	

MEETINGS

English speaking growers

WFT grower steering group - priorities	Nov 2000	6	Reviewing priorities and obstacles to implementing WFT management practices
WFT steering group Bug Er Off prepn	Sept. 2001	5	Planning to launch Bug Er Off !
TSWV information meeting with Rijk Zwaan	June 2002	25	Advice to growers re managing tolerance breaking TSWV

Vietnamese growers

Graduate growers	March 2002	15	Meeting to review WFT outcomes
Graduate growers and new recruits	April 2002	11	Priorities brainstorm and formation of grower IPM group
Graduate growers and new recruits	May 2002	15	IPM review and technical presentation by a grower (Het Truong)
Graduate growers and new recruits	June 2002	18	Brainstorm with VHC centre staff re GMP priorities
TSWV information meeting with Rijk Zwaan	June 2002	12	Advice to growers re managing tolerance breaking TSWV

Other meetings

Local industry retailers	October 2001	4	Support for WFT control, including weed control initiatives
Regional weed control meeting No. 1	April 2002	5	Establishing interested partners
Regional weed control meeting No. 2	May 2002	7	Planning for project funding

PRESENTATIONS AND SEMINARS

GMP open day display	March 2001	13	Growers and other visitors
WFT presentation to growers for VHC 'Taking Control' seminar series	June 2001	12	Growers and other visitors
Project presentation to PIRSA staff	Sept. 2001	15	Primary Industries technical and extension staff
Bug Er Off Launch	Sept. 2001	26y	Various invited guests
Project presentation to NIAISA conference	March 2002	18	Conference participants from the nursery industry
IPM presentation at GMP	March 2002	23	15 English speaking and 8 Vietnamese growers

WORKSHOPS

Group 1. English lettuce	Dec – Jan 2001	5 (6)
Group 2. English protected cropping	May – June 2001	7 (8)
Group 3. Vietnamese GH	July 2001	11
Group 4. Vietnamese GH	Oct 2002	13
Group 5. Vietnamese GH	Feb 2002	11
Group 6. English field crop spray demo	May 2002	5 (15)

APPENDIX 6 – COPIES OF EXTENSION POSTERS AS LISTED IN APPENDIX 5

So Join the War on WFT !

FOUR WORKSHOPS (2 & 1/2 hrs each)
COVERING HOW TO:

1. Reduce the risk of outbreaks of Western Flower Thrips & Tomato Spotted Wilt activity in your crops
2. Monitor reliably for signs of attack by Western Flower Thrips and Tomato Spotted Wilt
3. Get on top of any outbreaks with effective spraying
4. Develop a reliable and affordable farm plan to make control easier

WHEN: 12 or more growers have registered we will arrange workshop times.

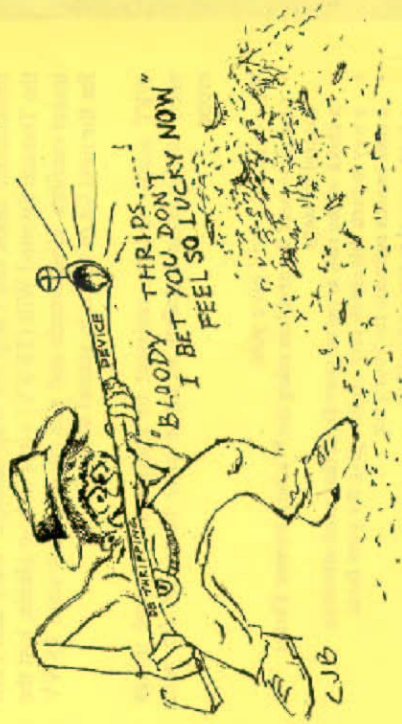
TO REGISTER: phone Virginia Horticulture Centre on 8282 9200 (or visit us at Old Port Wakefield Road Virginia) and leave your details.

Program co-ordinator *Tony Burfield:*
Mobile: 0410 120 857



Controlling Western Flower Thrips !

YOUR TURN TO CALL THE SHOTS



Four Workshop Sessions

For a future that returns your profits to you
by making your farm too hard for
Western Flower Thrips

SARDI



SOUTH AUSTRALIAN
RESEARCH AND
DEVELOPMENT
INSTITUTE



PRIMARY INDUSTRIES
AND RESOURCES SA



HRDC

VIRGINIA
HORTICULTURE
CENTRE



VIRGINIA
HORTICULTURE
CENTRE

What can this Workshop do for You ?

Growers can return to 80-90% productivity by following a Western Flower Thrips (WFT) control strategy. This has been done in Western Australia and also by some local growers who have followed their lead.

Insecticides alone can't stop the crop damage. They don't kill the Tomato Spotted Wilt (TSWV) virus in host plants, just the insect carriers. Host weeds and sick crops plants store TSWV for the next lot of thrips to spread around.

WFT easily become resistant to sprays too. Several things need to be done together to make your farm safe for your crops.

This workshop will give you:

- A way to beat the problem using the Western Flower Thrips control strategy
- a check of the risk areas on your farm that need attention
- a way to turn this check into a battle plan for your farm
- a cost-benefit estimate for your plan
- a field manual to use on the farm
- connections to our ongoing support as you put the plan into action



Some Important Questions

- **How do I set up a WFT Control Program for my farm ?**

4 workshops (2 & ½ hrs each) will explain and demonstrate this



(see back page for details)

- **How much time and money will it take to control a problem that threatens your whole investment ?**

It pays for itself as you save on lost crops and chemicals going down the drain.

Benefits increase and costs reduce every year. It even helps with other pests.

- **What about changing other people, like neighbours with weeds ?**

Many others will listen and follow because they will want the results they see from growers with a control plan.

Growers also have more power when they work together, for example getting 'off-label' permits.



Notice to Growers!!

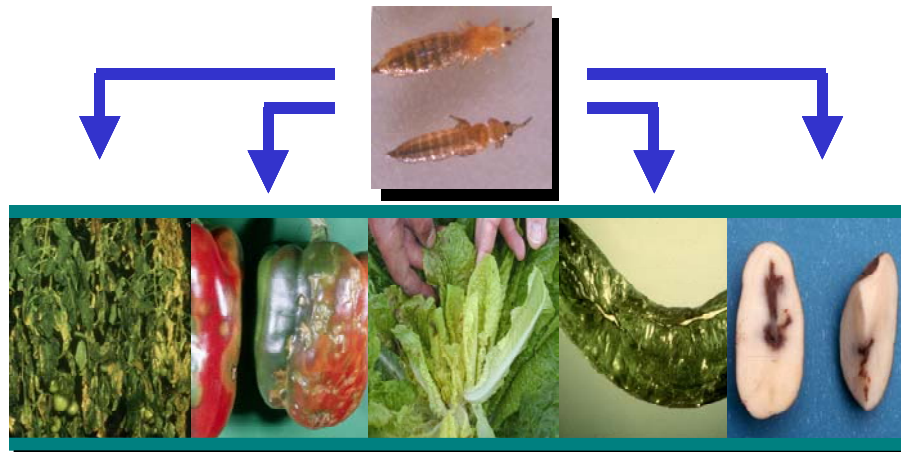
Weather Alert for

Western Flower Thrips

Until now the hot dry weather seems to have kept thrips numbers low for most growers. However with the recent break in hot weather they are likely to take off in a big way, including Western Flower Thrips (WFT).

To avoid a sudden rise in Tomato Spotted Wilt and thrips feeding damage in your crops it is recommended that growers of vulnerable crops take action now!

1. Watch crops closely for an increase in Thrips numbers and outbreaks of Tomato Spotted Wilt.



2. Monitor with sticky traps weekly and check for thrips in flowers.



3. Rogue out any sick crop plants before the virus spreads.

4. Be ready to spray immediately when Thrips numbers or Tomato Spotted Wilt increases in your crops.

For more information contact
Virginia Horticulture Centre on
8282 9200 or program coordinator
Tony Burfield on 0401 120 857



MAKE LIFE HARD FOR WESTERN FLOWER THRIPS

Clear Those Weeds before They Seed !

- ◆ Clear flowering weeds NOW while it's easier
- ◆ Once they flower they become a thrips plague factory
- ◆ No weeds means less thrips in spring & less weeds to clean up next year



- ◆ Clear At least 10m around every glasshouse or crop – the whole farm is even better !
- ◆ Flowering weeds on or near to your farm are where Western Flower Thrips breed up in spring
- ◆ Many flowering weeds also hold Tomato Spotted Wilt Virus for the thrips to carry onto your crops
- ◆ Many weeds have very small flowers, but still contain thrips, including ground covering weeds
- ◆ Generally grasses are fairly safe, but can provide thrips with temporary homes

Images from Top Crop 'Weeds: The UTE Guide' 1996 (PIRSA)

BROADLEAF WEEDS MEANS MORE DISEASE !

Weeds create more trouble for your crops than breeding Western Flower Thrips. They also build up TOMATO SPOTTED WILT VIRUS on your farm waiting for thrips to spread it !

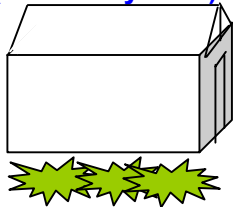
Protect your crops by clearing weeds to:

- reduce thrips
- reduce virus
- reduce other pests and diseases like white fly



WHEN CLEARING WEEDS WATCH OUT FOR:

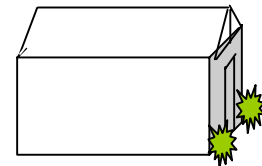
1. Weeds too close (10m away best)



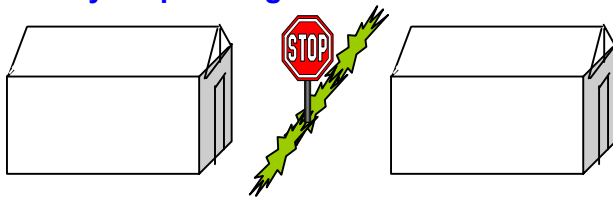
2. Thin rows of weeds up against greenhouse



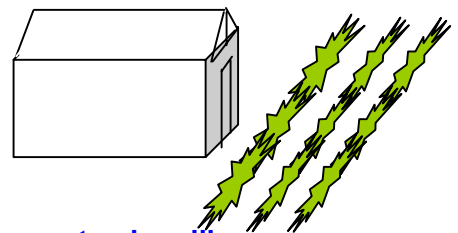
3. Weeds at doorway



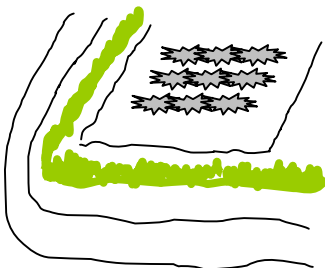
4. Weed banks which staff could walk through and carry thrips into green house on clothes



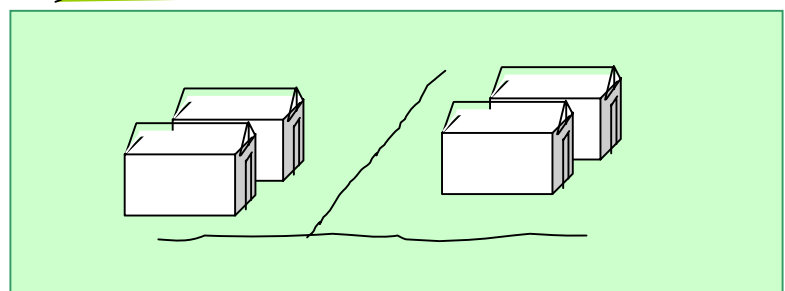
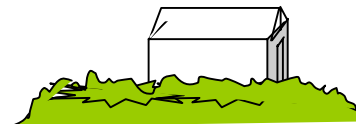
5. Weeds in vehicle tracks



6. Weed rows along road verges



7. Weeds in difficult areas to clear like earth mounds



Prepared by Tony Burfield for the Western Flower Thrips Management program Ph 0401 120 857 or 8282 9200 at the Virginia Horticulture Centre

SAVE \$\$\$!! Monitor for Western Flower Thrips

1. PLACE STICKY TRAPS JUST ABOVE PLANT TOPS



2. REMOVE AFTER ONE WEEK



4. RECORD MONITORING RESULTS AND SPRAY USE

Keep a record of ALL sprays used

Monitor again to find out how well they worked

Use old records to improve your pest management plan



Keep a weekly record of pest levels in each crop site.

Base your spray decisions on pest levels



3. GET TRAPS CHECKED



5. REDUCED PEST DAMAGE TO CROPS = \$\$\$\$ SAVED !!



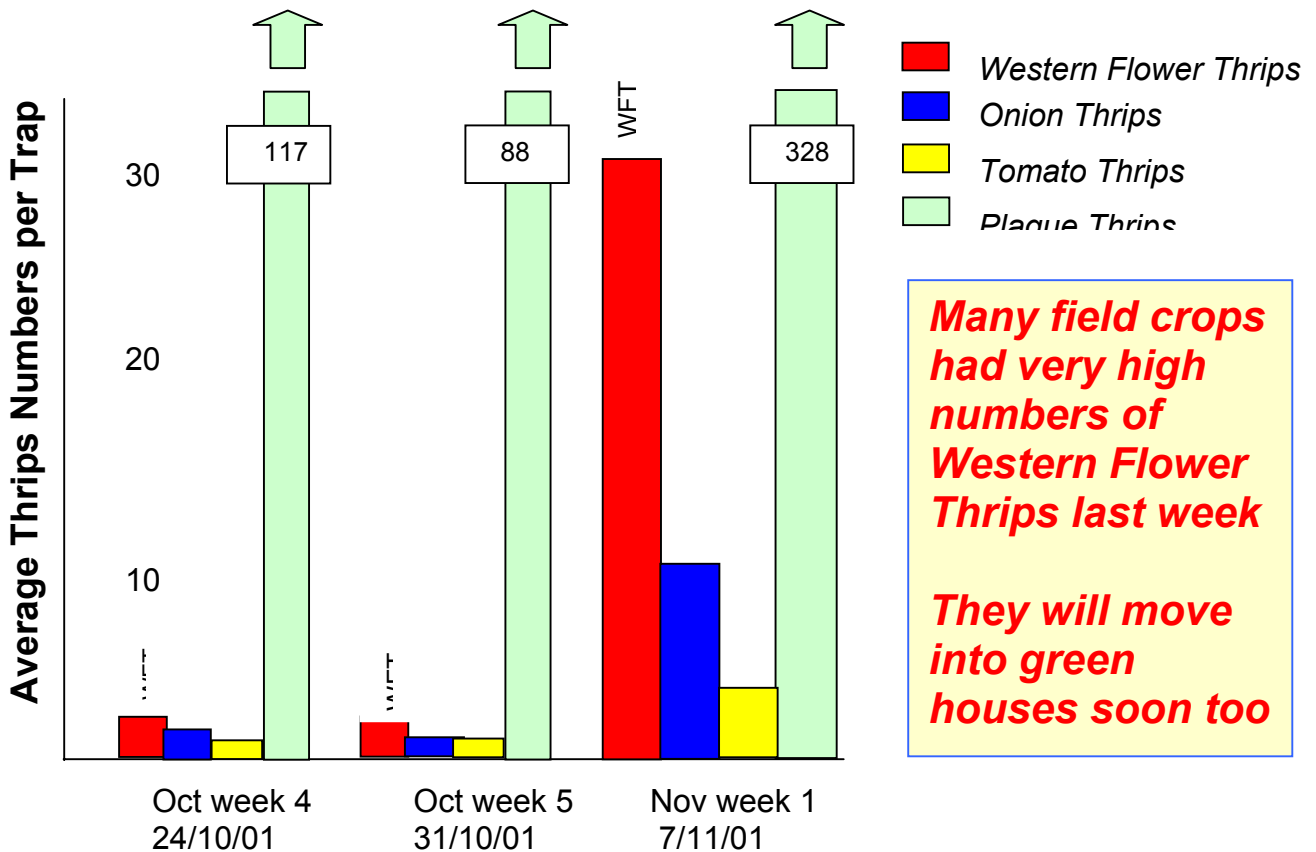
6. DO A PEST MANAGEMENT TRAINING COURSE !



CROP ALERT !!

Western Flower Thrips

BIG INCREASE IN THRIPS LEVELS IN LOCAL CROPS



- Weeds have started dying and warmer weather is diving thrips from weeds to crops
- Check crops for thrips to see when spraying is needed and to make sure you are killing them
- For advice and information contact Tony Burfield on 0401 120 857 or your crop consultant

Prepared by Tony Burfield for the Western Flower Thrips Management Program
 Ph: me on 0401 120 857 or the Virginia Horticulture Centre on 8282 9200



Western Flower Thrips Can be Controlled !

**Find out how through a FarmBis Course
At the Virginia Horticulture Centre**

Successful growers have learnt these things:

- ◆ *How to get less thrips and virus with effective weed control*
- ◆ *How to spray more effectively*
- ◆ *How to plan and care for a crop to reduce damage*
- ◆ *How to keep simple pest management records that can save you time and \$\$\$*

A Vietnamese tomato grower who did the course has saved a lot of time and money. He has not had to spray for thrips for three months since planting ! He began harvesting in late October & still has used no pesticide !

When: New year - on demand
Times: 6 nights, 6.00 – 8.00pm.(with food)
Where: Virginia Horticulture Centre
Cost: \$135.00
To enrol:Ph: Tony Burfield on 0401 120 857



*Prepared by Tony Burfield for the Western
Flower Thrips Management Program
Ph: me on 0401 120 857 or the Virginia
Horticulture Centre on 8282 9200*



PEST MONITORING SAVES \$\$ and Time

A tomato grower who did the Western Flower Thrips Management course tried using yellow sticky cards to monitor for thrips. In a small test crop **he has not sprayed for 5 months** since planting ! He began harvesting in late October. On Monday Dec. 5th he still has not sprayed because he has almost no thrips !

Below: The grower's son in the crop



CROP SIZE:
5,000 tomatoes

TIME SAVED:
2hrs average per
weekly spray

MONEY SAVED:
\$40.00 average
per weekly spray

- **FOR MANY GROWERS THERE MAY BE 2-5 MONTHS OF THE YEAR WHEN THEY COULD REDUCE THEIR SPRAY PROGRAM FOR THRIPS**
- **YOU NEED GOOD MONITORING TO DO THIS SAFELY**
- **IMAGINE THE SAVINGS IN A MUCH BIGGER CROP !!**

FIELD VEGETABLE SPRAY DEMONSTRATION

& Free B.B.Q. !!

*Getting the best possible spray coverage is the key to
better pest control and saving time and money.*

Register now !

The demonstration includes:

- ◆ Coverage results on open leaf & hearting vegetable crops
- ◆ Spray booms, including HARDI spray equipment
- ◆ Aerial spraying demonstration
- ◆ Different jet settings and application conditions
- ◆ Fluorescent night dye to show up coverage details

When: FRIDAY May 3rd

Starts 5.00pm with a B.B.Q.

Spray results viewing 6.00pm – 7.15pm

Where: Tom Musolino's, Brown's Road, Port Gawler

Register your interest by contacting Tony Burfield: 0401 120 857

Domenic Cavallaro: 0417 839 082

or the Virginia Horticulture Centre: 8282 9200

SPONSORED by



WEED CLEARING PAYS OFF !

Some growers cleared winter weeds very well, but let summer weeds take over = **THRIPS BACK !**



This one controlled summer weeds = low thrips numbers. He has **ONLY SPRAYED ONCE** this crop !



Western Flower Thrips
"Bug 'Er Off" program

Virginia Horticulture
Centre



VIRGINIA
SOUTH AUSTRALIA

SARDI



SOUTH AUSTRALIAN
RESEARCH AND
DEVELOPMENT
INSTITUTE



Horticulture Australia



Controlling Tomato Spotted Wilt Virus in Capsicums

VIRUS TOLERANCE IS AN ADVANTAGE NOT A GUARANTEE !

Virus Tolerant capsicums are much less likely to get sick, but sometimes they will.

Tolerant plants are stronger, but you must still control virus spreading thrips, (especially Western Flower Thrips, Onion Thrips and Tomato Thrips), and the weeds that thrips and virus come from.

Two things can cause a breakdown in crop protection:

1. New virus strains that appear from time to time.
2. Crops being attacked by too many thrips because ...
 - ◆ *weeds are out of control and breeding thrips with virus*
 - ◆ *the spray program is ineffective for some reason*

To keep your crop safe you must:

1. Clean up weeds before they flower in spring
2. Monitor your crop for pest levels
3. Overhaul your spray program to make sure it is effective
4. Properly destroy virus infected plants

A good pest control program will reduce chemical use and improve pest control. Training and advice is available to make this easier for you. Contact details are below.

Prepared by Tony Burfield for the Western
Flower Thrips Management Program
Ph: me on 0401 120 857 or the Virginia
Horticulture Centre on 8282 9200



Appendix 7.

“Summary of Workshop Sessions”

<u>Session</u>	<u>Topics</u>	<u>Presenters</u>	<u>Key resources developed</u>
1.	Overview of key pest/host/crop damage facts	Tony Burfield	<ul style="list-style-type: none"> • Images of pests and associated plant damage • Seasonal graph of local thrips numbers
2.	Farm and crop hygiene	Tony Burfield	<ul style="list-style-type: none"> • Hypothetical farm risk audit • Images of host plants with pests (weeds, sick crop plants) • Illustrated weed clearance principles • Resistance management spray planner
3.	Pest monitoring	Tony Burfield and Horticulture consultant	<ul style="list-style-type: none"> • Individual farm site plans • Microscope • IPM insect poster guide • Detailed thrips diagnostic guides • Sticky traps and hand lenses • Monitoring record sheets
4.	Farm and crop hygiene	Tony Burfield	<ul style="list-style-type: none"> • Hypothetical farm risk audit • Images of host plants with pests (weeds, sick crop plants) • Illustrated weed clearance principles • Resistance management spray planner • TSWV management guides
5.	Managing an effective spray program	Horticulture consultant	<ul style="list-style-type: none"> • Chemical Fact sheets • Technical material relating to spray technology
6.	Spray coverage demonstration	Horticulture consultant	<ul style="list-style-type: none"> • Demonstration crop • Fluorescent dye • UV lighting • Comparative jets, spray fittings, hand movements and pressure settings

Summary of training resources used

Key resources supplied through the National WFT Management Strategy:

- *Western Flower Thrips Tomato Spotted Wilt Virus Training Manual*, Alison Medhurst and Bernadette Swanson, Department of Natural Resources and Environment, Victoria, 2002
- (*) *TSWV table of management strategies*, Roger Jones, Department of Agriculture Western Australia
- (**) *Fact sheets for resistance management*: Grant Herron, NSW Agriculture

Additional resources developed through the pilot program:

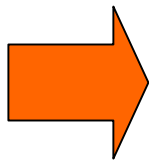
RESOURCE	ATTACHMENT
Identifying WFT threats to your farm:	
• <i>Seasonal cycles</i>	Y
• <i>Sources of trouble</i>	Y
• <i>Tom and Maggies farm</i>	Y
Monitoring Grid results graph	Y
Monitored Spray Programs	Y
Spray rotation planner	Y
Spray coverage assessment sheet	Y
Weed management visuals:	
• <i>Broad leaf weeds and grasses</i>	Y
• <i>Typical local broadleaf weeds</i>	Y
• <i>Weed clearance posters</i>	See Appendices 6 & 7

WEEDS LET THRIPS EAT YOUR TIME AND MONEY

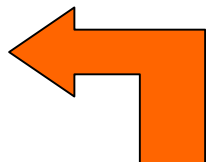
THRIPS SPEND WINTER IN GREENHOUSE CROPS



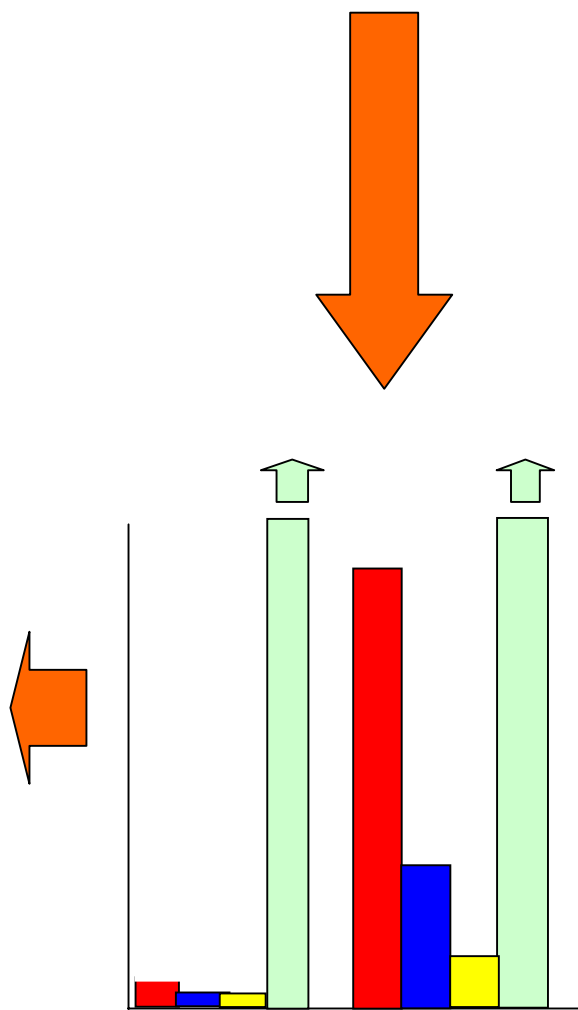
THRIPS MOVE TO WEEDS IN EARLY SPRING



DAMAGE STARTS IN NEW CROPS !



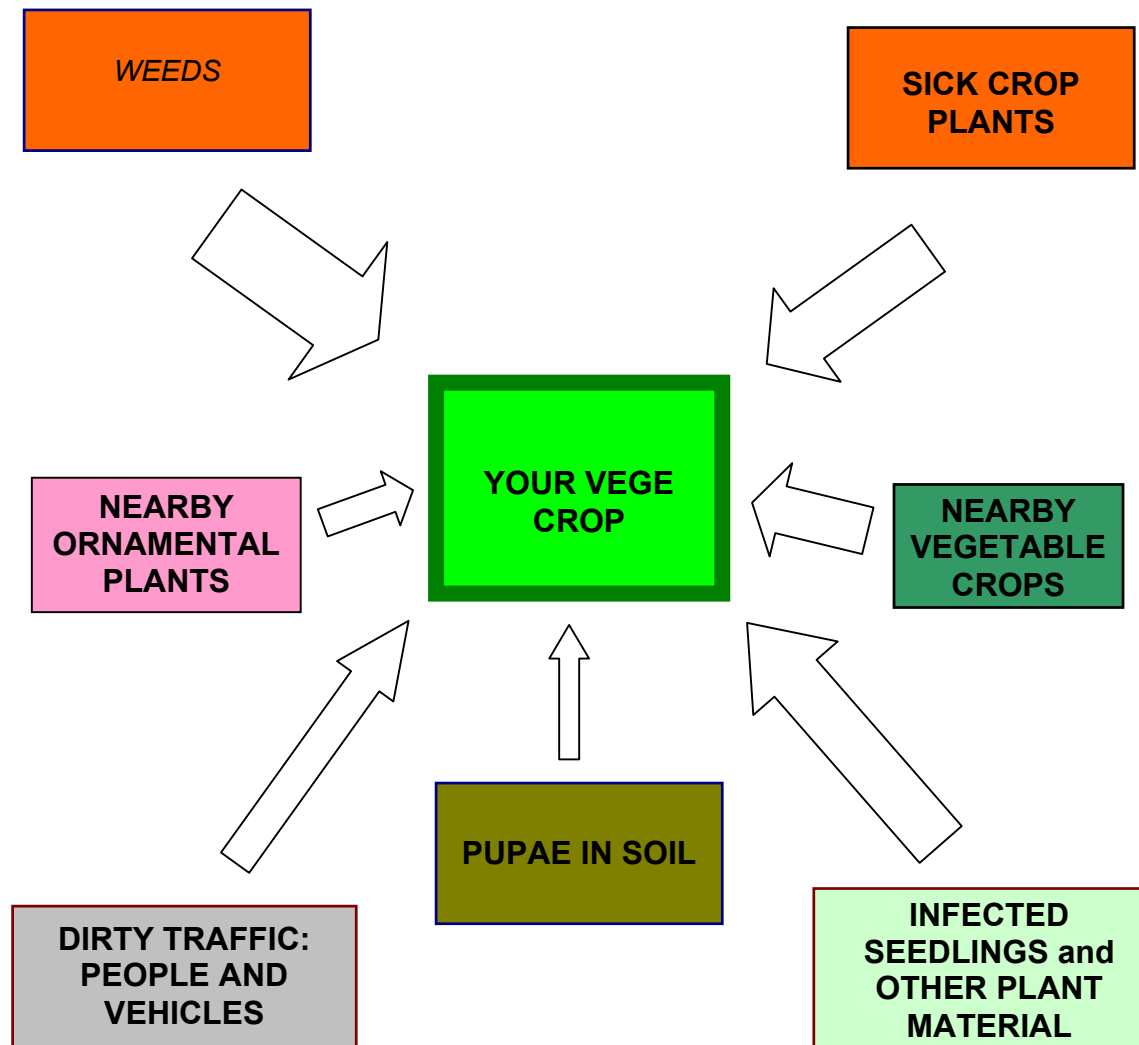
THRIPS ENTER HEALTHY NEW CROPS



WARM WEATHER DRIVES THRIPS FROM DYING WEEDS

RISK ASSESSMENT HINTS

SOURCES OF TROUBLE



HIGHER RISK SITUATIONS

WFT AND TSWV SOURCES

- Flowering reservoir or host plants at peak or dying back
- Crops close to host plants

CLIMATE

- Steady prevailing wind from direction of hosts
- Mild to hot weather (late Spring, Summer & early Autumn)
- Moisture in soil

FARM PRACTICES

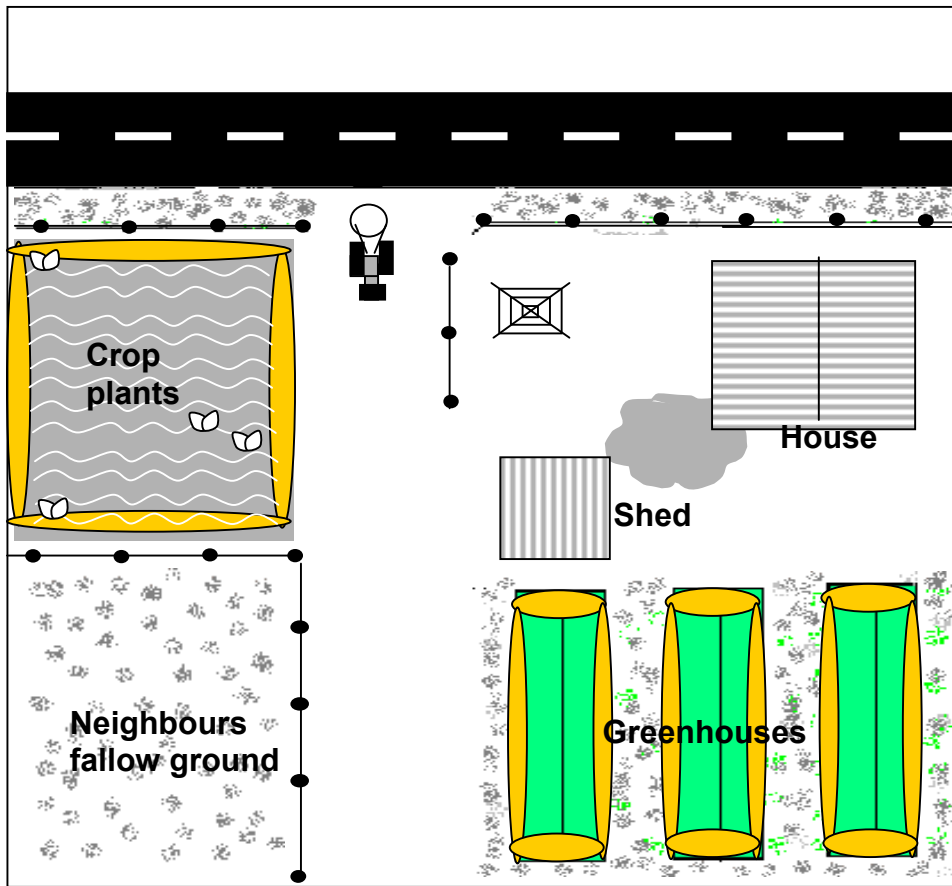
- Ineffective monitoring
- Uncontrolled traffic (plants, people, vehicles)
- Ineffective spraying

CROP WEAKNESSES




- Non resistant crop plants
- Younger crop plants
- Unhealthy plants

EXAMPLE OF A FARM AUDIT

Tom and Maggie's Farm



Key to diagram

-  Weeds
-  Plants with tomato spotted wilt virus (TSWV)
-  Hot spots where trouble tends to start

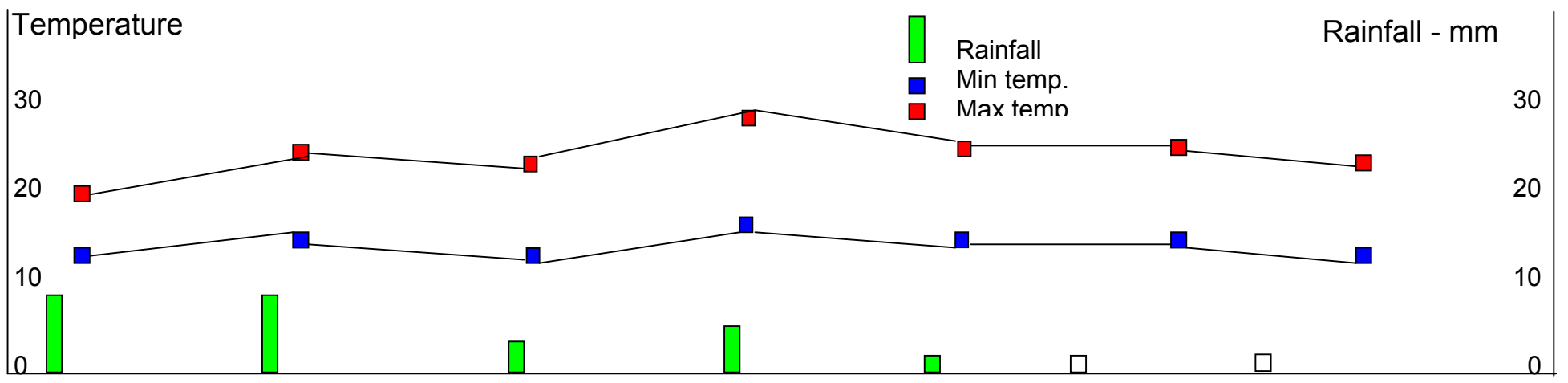
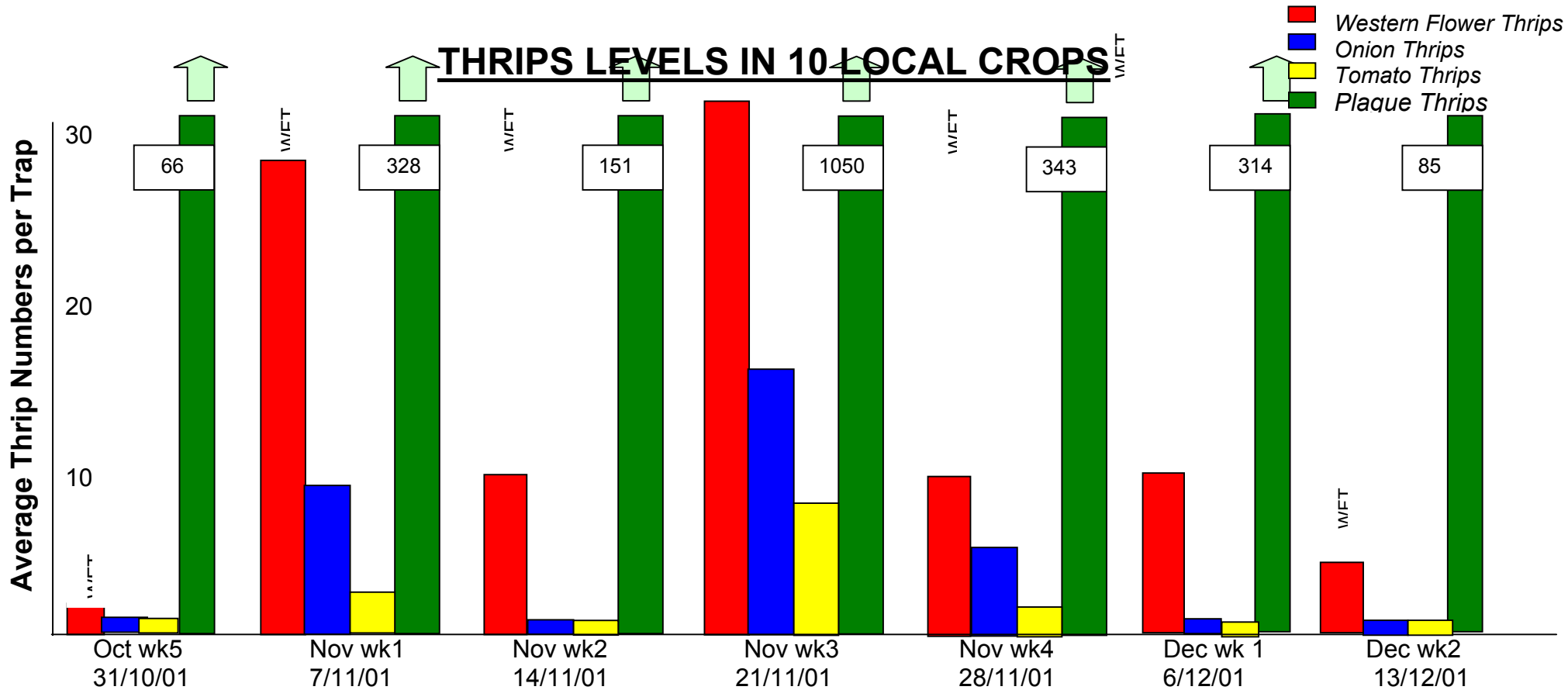
Tom and Maggie found the following threats on their farm:

- weed patches on boundaries
- weed patches near to greenhouse crops
- slasher entering property with fresh weed cuttings on
- sick plants in field crops
- garden flower beds
- cover crops, including in hydroponics

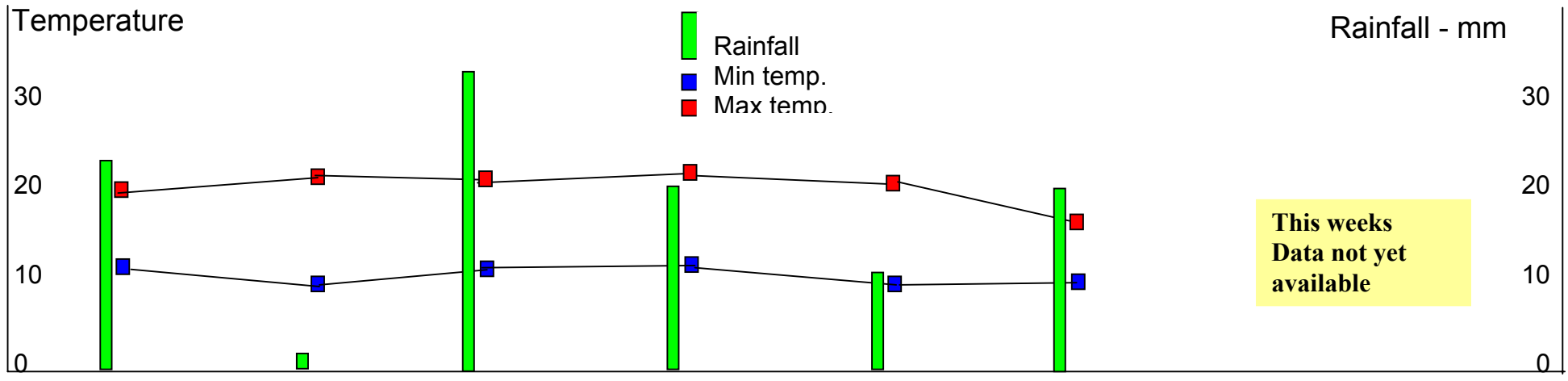
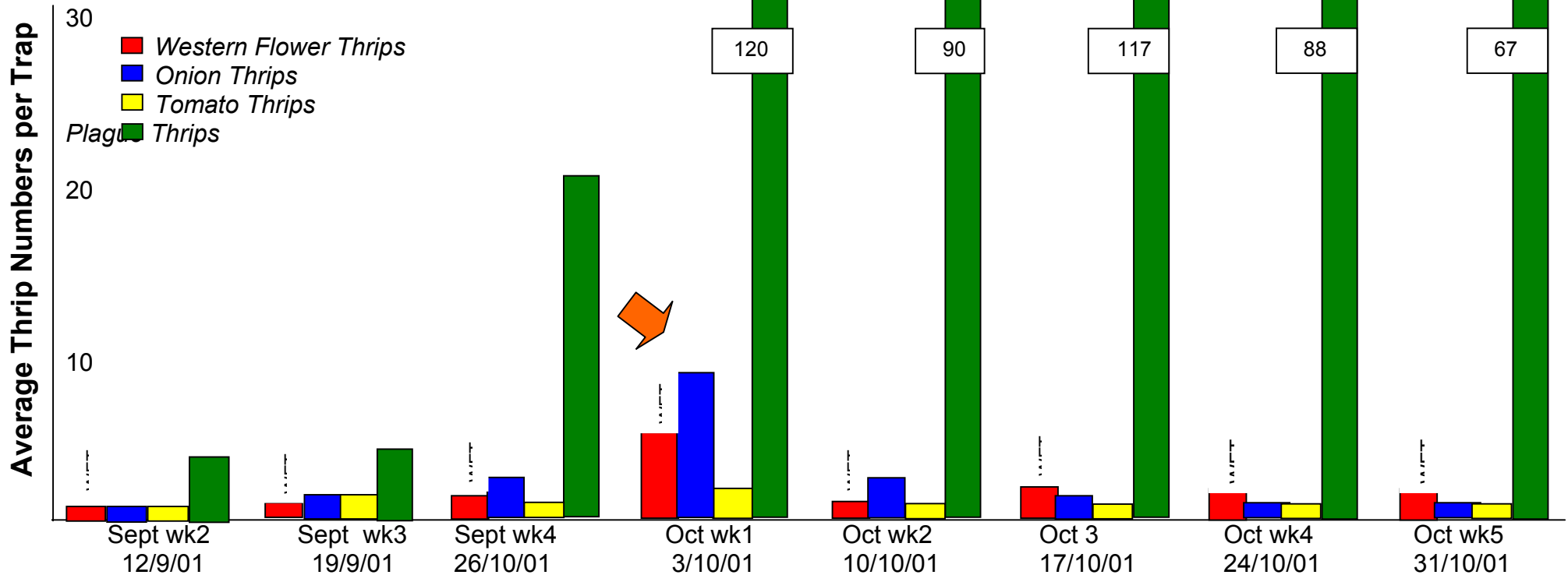
Other less visible threats they found were:

- old crops in greenhouses
- virus infected seedlings
- not monitoring for outbreaks of WFT
- errors in spraying program

THRIPS LEVELS IN 10 LOCAL CROPS



THRIPS LEVELS IN 10 LOCAL CROPS



MONITORED SPRAY ACTION CYCLE

1. MAKE SPRAY PROGRAM IMPROVEMENTS:

5. INFORMATION / ADVICE ON:

- ◆ possible resistance
- ◆ possible spray program errors

2. STICKY TRAP MONITORING PROGRAM:
(to detect changes in pest levels)

3. SPRAY IF PESTS TOO HIGH:
(implement spray plan when pests reach thresholds)

4. LEAF & FLOWER CHECK DAY AFTER SPRAYING TO SEE IF:

- ◆ if Nos. very low
(monitor plants & flowers for one week to see if they return quickly)
- ◆ if Still high = possible spray error or insecticide resistance

Crop Monitoring Sheet

Name:- _____ Date:- _____

Crop:- _____ Site/Block no.:- _____

INSECTS		Site								Total
		1	2	3	4	5	6	7	8	
Thrips	Total									
	WFT									
	Plague Thrip									
	Onion Thrip									
	Tomato thrip									
Aphids										
Leaf Hopper										
Other										
Predators										
Weeds emerging										

DISEASES

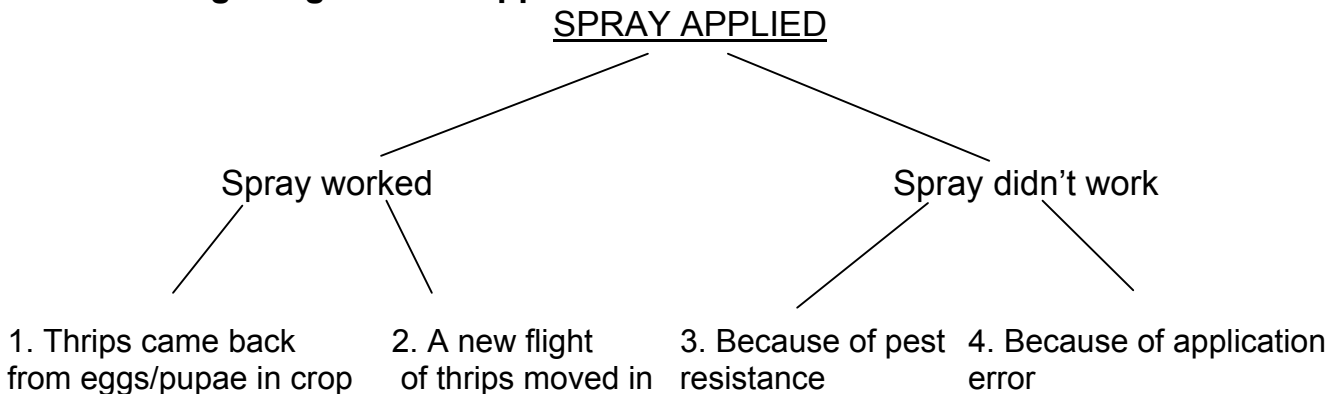
Summer Diseases										
TSWV										
Purple topped wilt										
Other viruses										
Winter Diseases										
Downy Mildew										
Soft Rot										
Sclerotinea										
Anthracara										
Black leaf spot										
Big Vein										
Other diseases										

Weather Conditions:- hot/mild/cool dry/wet sunny/cloudy
 Wind direction:- today _____ previous 3 days if known _____

ASSESSING OUTCOMES OF SPRAY APPLICATIONS

HOW DO YOU KNOW IF THE SPRAY HAS WORKED AND WHAT TO DO NEXT ?

The following things could happen:



Each of these situations needs to be handled differently as follows or you will not control pests and will waste time and money with hit and miss:

- | | | | |
|--|------------------------------|--|--|
| 1. Need to spray 2-3 times close together in total | 2. Need another single spray | 3. Need to find another chemical or control method ! | 4. Need to correct spray application error |
|--|------------------------------|--|--|

But how do you know which situation you have ? If you found thrips on the sticky traps a week after spraying this wouldn't tell you what happened in between !

The only way to overcome this important problem is to NOT wait for a week to begin checking results on the next sticky trap

As well as using sticky traps you must check thrips numbers in flowers/on plants just before, and 1 day after spraying, and for one further week to see how the pest population reacts to being sprayed.

These thrips numbers can't be compared to sticky trap counts for several reasons:

- ◆ this is a different counting system
- ◆ when plants begin flowering pests are less likely to go to traps and will stay in flowers
- ◆ you will only see flying adults on traps, whereas plants will also have non flying larvae.

To do effective monitoring you need to know how to:

1. set up and use sticky traps
2. do plant and flower checks
3. keep and interpret records

Below is a summary of how to interpret the results you will get from your pest monitoring.

SPRAY WORKED
Thrips numbers very low
but soon more thrips hatched or flew in

SRPAY DIDN'T WORK WELL ENOUGH
Thrips numbers not reduced sufficiently
because of pest resistance or technical error

1. New hatching in crop

What you might see

Thrips begin increasing within 2-6 days.

Young thrips larvae will be much lighter in colour than adults before the spray. *They will not have wings and will not fly onto traps ! They will only be found on plants and in flowers*

What it means

This indicates that eggs and pupae are still in the crop

This is most likely if you have had difficulty controlling them giving them time to breed !

Further action:

Need to spray 1 or 2 more times for a total of 2-3 sprays.

Sprays should be 2-3 days apart in hot weather and 5-6 in very cool weather.

2. New flight into crop

What you might see

Thrips reappear after one week

What it means

A new flight of thrips have found their way in or have bred up from a small area that survived the spray

Further action

Spray again and check the day after to be sure it worked.

Note:

A flight may come in the day after spraying making it hard to tell if they have hatched from eggs and need 2 more sprays, or just 1 for a new flight.

Take note of thrips colour as in 1. before and after sprays to give you some clues.

3. Resistance to chemical

What you might see

Sprays have been gradually losing their effect on pests.

What it means

This suggests that the pest population has been steadily becoming resistant.

Resistance can appear more suddenly if resistant pests come from another crop.

A gradual reduction in pest kill could also be due to equipment wear and tear causing poor coverage – see 4.

Action for resistance

Change chemical or other product used to treat pests.

4. Spray application error

What you might see

Previous sprays worked very well.

What it means

Indicates an error in spray application methods.

Action for likely spray error

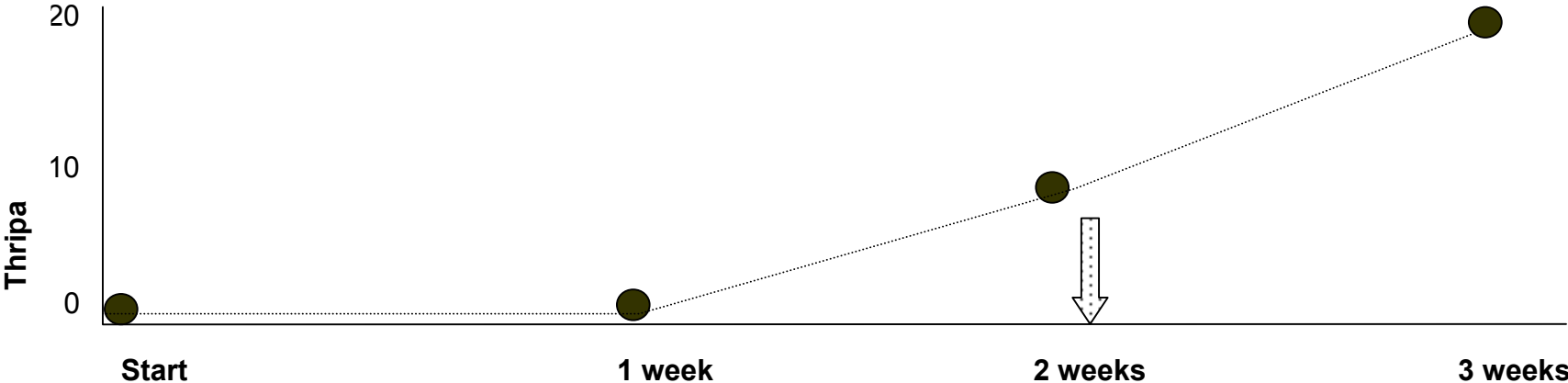
Check concentrations and volumes, chemical expiry date, water quality, effect of other additives combined with spray , time of day for synthetic pyrethroids etc.

Talk to your chemical seller or consultant.

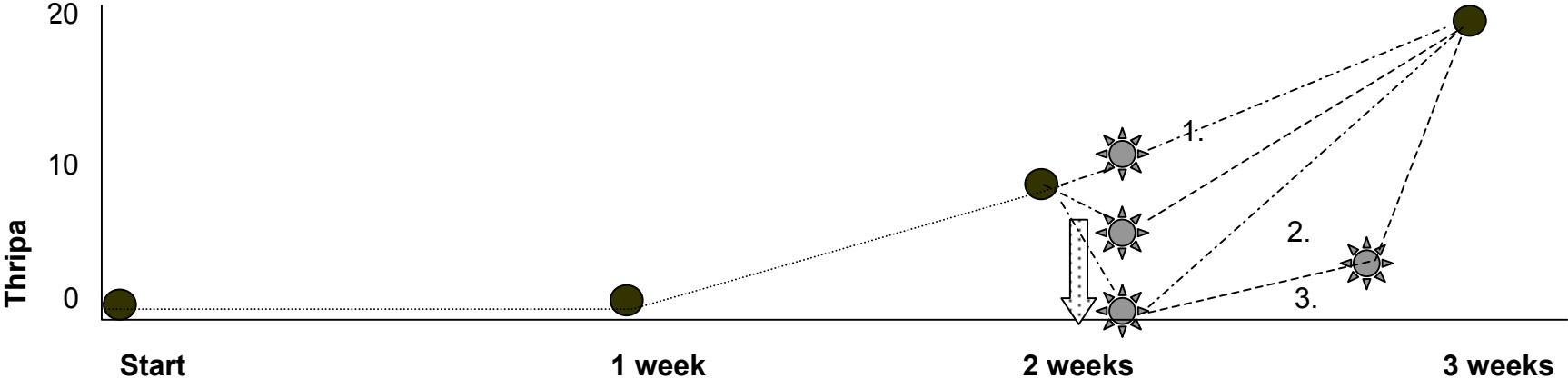
See graph 3. & spray history

USING PEST MONITORING TO DIAGNOSE SPRAY RESULTS

Weekly sticky trap results only:



Possible interpretations of results !



 Sticky trap Results
  Pesticide applied
  Possible numbers between traps

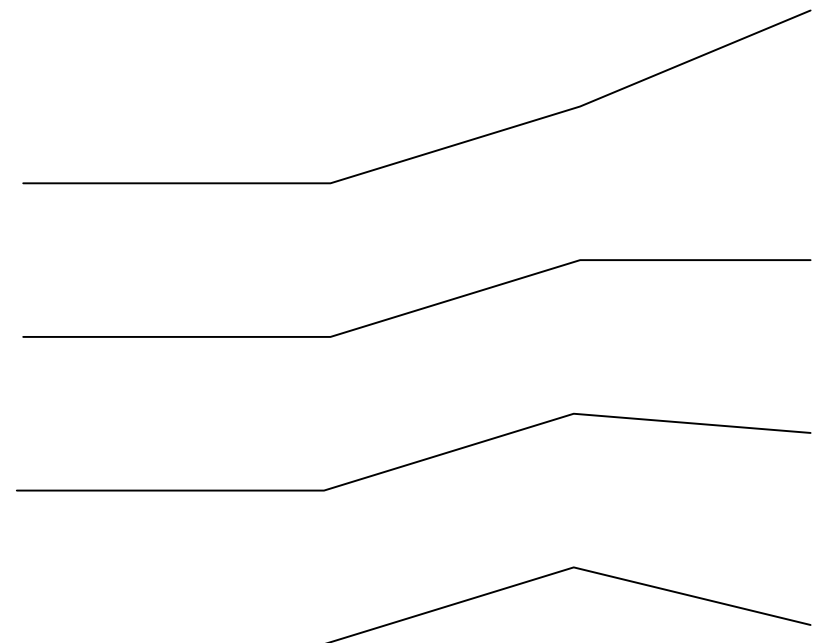
**** Use flower and leaf checks before and after sprays to judge spray effectiveness in killing thrips !**

DIAGNOSING MONITORING RESULTS FOR THRIPS

1. Draw what you think your monitoring results would look like over a full crop cycle on the left below:



1. Analyse your imaginary data and what you could do.



2. analyse the above results

SPRAY CALENDAR PLANNER

Crop 1.

Chemicals with permits for this crop:

Active ingredient	Chemical group	Available brands
1.
2.
3.
4.

Calendar plan:	1. Main chemical	2. Backup chemical (same group as first choice)
July
August
September
October
November
December
January
February
March
April
May
June

Reserve chemical for infrequent use on heavy infestations:

.....

Crop 2.

Chemicals with permits for this crop:

Active ingredient	Chemical group	Available brands
1.
2.
3.
4.

Calendar plan:	1. Main chemical	2. Backup chemical (same group as first choice)
July
August
September
October
November
December
January
February
March
April
May
June

Reserve chemical for infrequent use on heavy infestations:

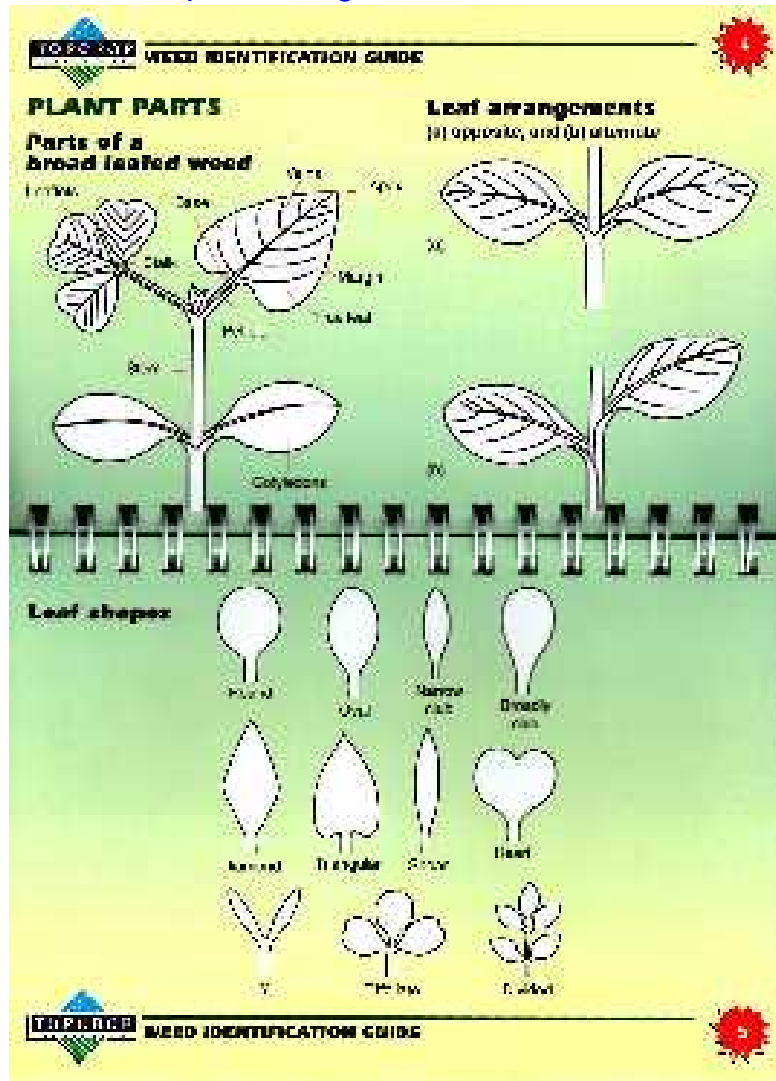
.....

BROADLEAF WEEDS vs GRASSES

BROAD LEAF WEEDS *

Host thrips and often virus

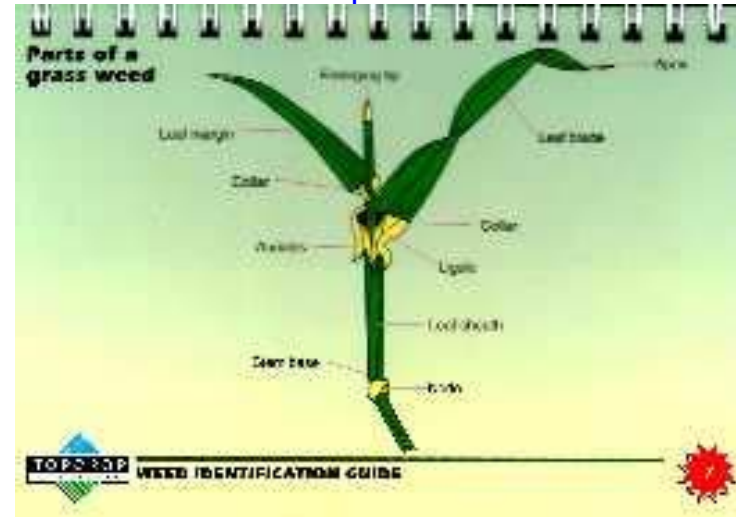
Have more pollen, larger, richer leaves



GRASSES *

Do not host many thrips and very few hold TSWV (wheat does)

Not as suitable for thrips



MIXED GRASS AND BROAD LEAF ** (*Still Dangerous !*)



Images copied from

* *'Noxious Weeds of Australia'*
Parsons & Cuthbertson, Inkata Press 1992

** *'UTE Weed Guide'*,
GRDC, Top Crop, PIRSA, SARDI AgVic 1998

COMMON WEED HOSTS for Western Flower Thrips

(Northern Adelaide Plains)



Salvation Jane *



Common Sow Thistle



Mustard and Turnip weeds



Capeweed / Dandelion ***



Mallow weed ****



Dock *



Stinging Nettle ****



**Prickly thistles, e.g.
Wild Artichoke ***



Common Heliotrope *



Soursob *



Wireweed **



**Solanum weeds *
(including deadly nightshade)**



Caltrope *

Images copied from:

* *'Noxious Weeds of Australia'* Parsons & Cuthbertson, Inkata Press 1992

** *'UTE Weed Guide'*, GRDC, Top Crop, PIRSA, SARDI AgVic 1998

*** *'Crop Weeds'* Wilding, Barnet & Armor, Inkata Press 19993

**** *'Weeds'* Auld and Medd' NSW Dept of Ag, 1987