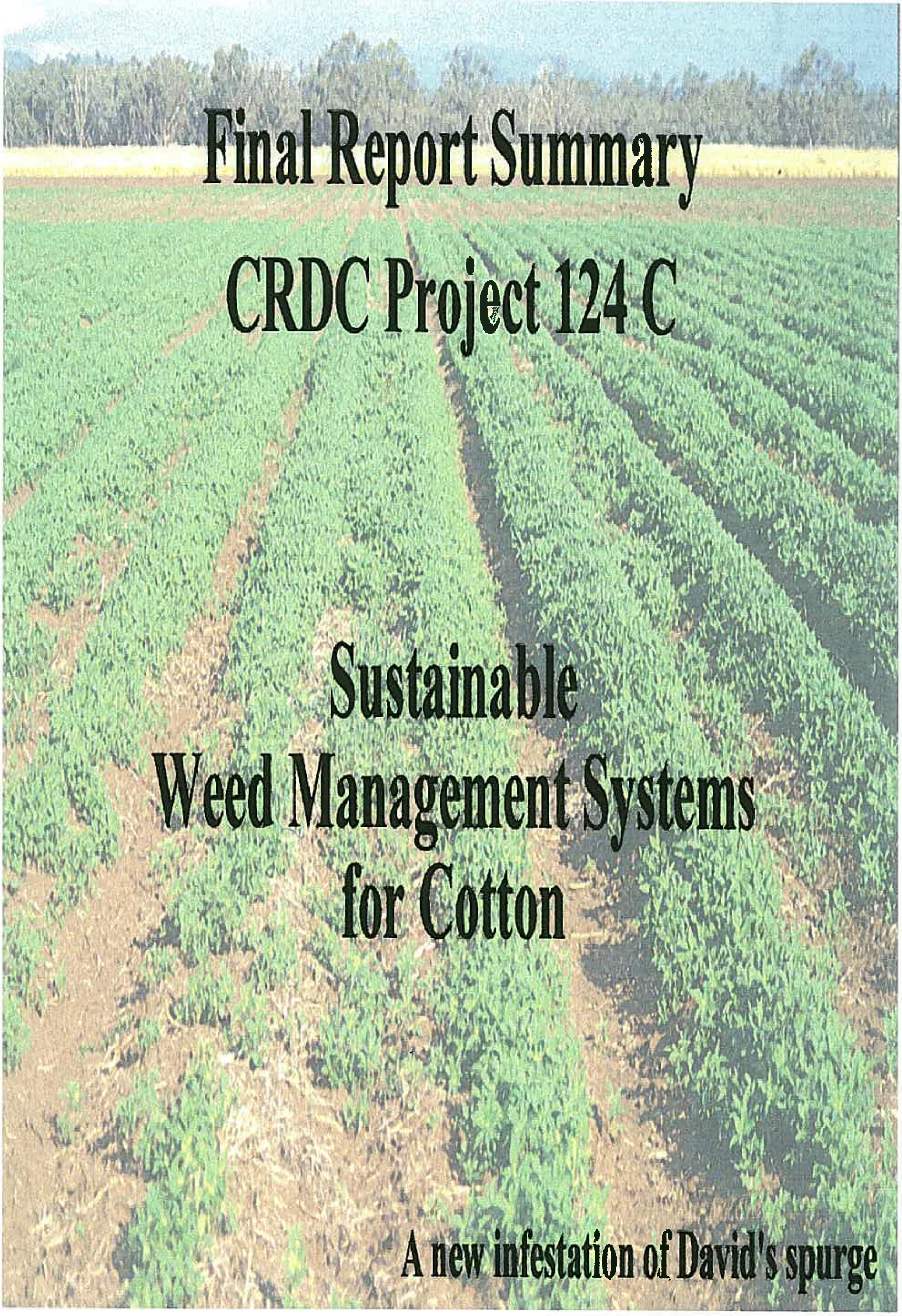
Final Report Summary
CRDC Project 124 C
Sustainable
Weed Management Systems
for Cotton
A new infestation of David's spurge

# January, August & Final Reports

# REPORTS

## *Part 1 - Summary Details*

*Please use your TAB key to complete part 1 & 2.*

**CRDC Project Number:** **124C**

| | | |
|---|---|---|
| **January Report:** | ☐ | Due 29-Jan-01 |
| **August Report:** | ☐ | Due 03-Aug-01 |
| **Final Report:** | ☒ | Due within 3 months of project completion |

**Project Title:** Sustainable Weed Management Systems for Cotton

**Project Commencement Date:** July 98 **Project Completion Date:** June 01

**Research Program:** Diseases Weeds

## *Part 2 – Contact Details*


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**Organisation:**
**Postal Address:**
**Ph:** **Fx:** **E-mail:**


**Signature of Research Provider Representative:** Graham Charles

# *Part 3 – Final Report Format*

## 1. Outline the background to the project.

A review of the cotton industry in 1988 concluded that lack of weeds research was a major hole in the research focus at that time. In response to this review, Mr Charles was appointed to Narrabri in late 1988 with CRDC funding. With the creation of the CRC for Sustainable Cotton Production, weeds research has again been identified as an area receiving inadequate funding and a second research position has been created at the ACRI, with the appointment of Mr Grant Roberts in mid-1996. This position focuses on the development of sustainable, low input, cotton weed management systems for low weed pressure situations.

Since 1998, Mr Charles has concentrated on the development of a sustainable management strategy for cotton, focussing primarily on nutgrass ecology and management. The nutgrass management strategy that he has developed combined herbicides, cultivation and rotation crops and has shown that a dedicated approach to nutgrass control will allow cotton production and high yields on nutgrass infested land, while controlling the weed population. This research, on what is considered to be the world's worst weed has resulted in a number of publications and the development of the nutgrass management package "Controlling nutgrass in Cotton" with CRC support.

The scope of the project has been expanded over the last couple of years. The project is now working closely with the CSIRO cotton breeding team, bringing expertise in weed management into the evaluation and development of herbicide tolerant, transgenic cotton varieties. This season the project is working with 2,4-D tolerant, Roundup Ready and BXN (bromoxynil tolerant) cotton varieties. Basta tolerant material will be included next season and other material if, and when it becomes available. Assisting the breeding team has been seen as a priority of this program.

## 2. List the project objectives and the extent to which these have been achieved.

### Objectives:

- To further examine and develop the sustainable weed management systems experiment for cotton established on ACRI Field C4, aiming to maximise cotton yield while minimising herbicide inputs.
- To commence examination of the ecology and management of peachvine, developing management packages for this and other problem weeds. Work to continue on polymeria takeall management and nutgrass ecology and management.
- To continue monitoring weed pressure and diversity on the CRC cropping systems experiments, assessing the impact of systems and interactions with weeds.
- To continue monitoring changes in weed pressure and diversity on cotton in reduced tillage systems on grower's fields, identifying problems with the systems and trends in the weed populations.
- To develop further weed management packages for cotton.

### Achievements:

All objectives have been largely achieved, within the time limit of a 3 year period (most work is ongoing).

Objective 1 identified a number of problems with potential herbicide interactions and was expanded to examine these interactions and to include stubble retention systems. This experiment is not yet completed.

Extensive work has been undertaken on peachvine and work continues with takeall and nutgrass. Work on all 3 weeds continues.

Weed pressure continues to be monitored on the CRC trials (only 1 trial remains) and growers fields. Nutgrass and peachvine continue to be major problems for growers, but otherwise the systems appear to be largely stable and manageable. The impact of Roundup Ready cotton will need to be assessed.

A lot of material has been collected for weed management packages. Collation and development of this material will be undertaken this year for inclusion in WEEDpak.

## 3. How has your research addressed the Corporations three outputs: Sustainability, profitability and international competitiveness, and/or people and community?

The research directly addresses the issues of sustainability and profitability.

Objective 1 assesses a range of weed management options to determine the optimum (most profitable) systems using old and newer technologies including transgenic cotton, stubble retention and permanent beds.

Objectives 2, 3 & 4 examine issues of sustainability, developing management packages for problem weeds which threaten sustainability, and assessing the sustainability of current production and farming systems.

## 4. Detail the methodology and justify the methodology used.

Experiments were undertaken in the field and glasshouse using standard techniques, with full replication. Data were analysed in Genstat using REML and regression using the Poisson model. These methods give the most reliable results.

Experiments undertaken included:

- Weed incidence was monitor on the 3 CRC rotation experiments
- Weed incidence was monitored on fields on 6 cooperating permanent bed
- Yields and weed incidence was monitored on the permanent bed experiment at ACRI, incorporating stubble retention, Roundup Ready, bromoxynil and Basta tolerant material
- Weed management on 4 fields receiving reduced rates of pre-planting residual herbicides
- Peachvine management and ecology experiments were undertaken as described in Appendix 1
- Nutgrass management in Roundup Ready cotton as ACRI
- The efficacy of herbicides on *Cyperus rotundus*, *C. bifax* and *C. victoriensis*
- 3 polymeria takeall field experiments on Colly Farms
- 3 glasshouse experiments to look at the effect of additives and surfactants to improve glyphosate efficacy for polymeria control
- 5 glasshouse experiment on herbicides for Buddah pea and sesbania control
- 1 glasshouse study of herbicides for velvetleaf control
- 4 field experiments evaluating herbicides for weed control in pigeon pea
- 2 field experiments on herbicides for lipia control
- 1 field experiment on herbicides for David's spurge control

## 5. Detail results including the statistical analysis of results.

After discussion with CRDC, it was agreed that results would be provided in a full Final Report due in September 2002. A summary of the results of the peachvine work has been included in Appendix 1.

## 6. Discuss the results, and include an analysis of research outcomes compared with objectives.

A full discussion of results and outcomes will be provided by September 2002.

## 7. Provide an assessment of the likely impact of the results and conclusions of the research project for the cotton industry. Where possible include a

**statement of the costs and potential benefits to the Australian cotton industry and future research needs.**

The weed management systems work is yet to be completed, requiring at least a further 2 seasons results. When completed, this work will need on-farm verification and quantification. This verification can be undertaken in parallel with the completion of the trial. Results to date indicate significant scope to reduce herbicide inputs on cleaner fields. This work is partly being taken up by Ian Taylor. A saving of 50% of herbicide on 30% of the cotton area is quite possible. If we assume a cost of $80/ha for herbicides, this would give a total saving of around $6 million per year, as well as an environmental saving of herbicide input. There will also be an associated increase in yield and reduction in replanting due to reduced seedling damage from residual herbicides.

The impact of management systems for problem weeds is large on those farms adversely affected by these weeds. Management systems will be quickly adopted by the most severely affected growers.

There is an obvious need to continue this work to achieve the full benefit from the research. The overall direction for future weeds research will be indicated through a study to be undertaken later this year.

## 8. Describe the project technology (eg. commercially significant developments, patents applied for or granted licenses etc).

Nil

## 9. Provide a technical summary of any other information developed as part of the research project. Include discoveries in methodology, equipment design, etc.

NA

## 10. Detail a plan for the activities or other steps that may be taken;

### (a) to further develop or to exploit the project technology.

### (b) for the future presentation and dissemination of the project outcomes.

Information arising from the project is being developed and disseminated during the current 12 month period. Information will be included in WEEDpak and presented in the Australian Cotton Grower, and at field days and other opportunities.

## 11. List the publications arising from the research project.


Charles G. W. (2001). Weed management. *In*. Australian Dryland Cotton Production Guide. Narrabri, NSW: CRDC.

Charles G. (2001). Herbicide options for weed control in pigeon pea trap crops. Lower Namoi Field Day notes, pp. 2.

Charles G. (2001). Weed management in cotton production. *In* Macintyre Valley Cotton Field Day. pp 3.

Charles, G. (2001). Sustainable weed management systems for cotton. *In proceedings of the* Cotton Consultants Dalby Meeting. pp 7.

Charles, G. David's Spurge: a new weed in cotton. *The Australian Cottongrower* **21, (5):** (in press).

Charles, G. (2001). Herbicide options for weed control in pigeon pea trap crops. *In* Upper Namoi Valley Cotton Trials, pp 4.

Charles, G. (2001). Herbicide options for weed control in pigeon pea trap crops *The Australian Cottongrower* **21, (5):** (in press).

Charles, G. (2000). Managing polymeria takeall. Proceedings of the Tenth Australian Cotton Conference, Brisbane, Qld, pp. 337-342.

Johnson, J, Charles, G. and Sindel B. (2000). The emerging problem of cotton related weeds (Family Malvacae). Proceedings of the Tenth Australian Cotton Conference, Brisbane, Qld, pp. 335-336.

Charles G. (2000). Weed management in farming systems. *In* Proceedings of the Farming Systems Forum, Dalby, Qld, pp. 2.
Charles G. (2000). Growing experience with Roundup Ready cotton. *The Australian Cottongrower* **21, (5):** 24 - 29.
Charles G. (2000). Weed management in cotton. AgFact (In press).
Charles G. (2000). The future for transgenic cotton. Aventis Workshop, pp 3.
Charles, G. (1999). Weed management systems for cotton production. Proceedings of the First Cotton CRC Research Conference, Narrabri, NSW, pp. 178-185.
Charles, G. (1999). Opportunities for collaboration with the CRC for Sustainable Cotton Production. Planning Weed Management Research, Development and Extension for the Northern Grain Region, a GRDC Sponsored Workshop, Brisbane, Qld.
Charles G. (1999). Velvetleaf: a potentially serious weed. *The Australian Cottongrower* **20, (3):** 70 - 71.
Charles G., Mensah, R. & Cook, T. (1999). Lucerne strips for managing cotton pests. *The Australian Cottongrower* **20, (4):** 16 - 18.
Charles G. (1999). Weed alert: Budda pea. *The Australian Cottongrower* **20, (5):** 18 - 20.
Charles, G., Hickman, M., Llewellyn, D. and Constable, G. (1998). Field evaluation of transgenic 2,4-D tolerant cotton. Proceedings of the Ninth Australian Cotton Conference, Broadbeach, Queensland, pp. 193-201.
Charles, G. (1998). Weed management in farming systems. Proceedings of the Cropping Systems Forum, Narrabri.
Charles G. (1998). The economics of chipping large weeds. *The Australian Cottongrower* **19, (2):** 42 - 44.
Charles G. (1998). Sorting out cotton weed control options. *The Australian Cottongrower* **19, (4):** 13 - 17.
Charles, G., Hickman, M., Llwewllyn, D. and Constable, G. (1998). 2,4-D tolerant cotton in the field. *The Australian Cottongrower* **19, (5):** 44 – 46

**Information dissemination:**

**During the life of the project, information was presented at the following meetings and workshops:**

Herbicides for weed control in pigeon peas Field Day, Emerald, Qld, February 1 2001.
Extension Team Field Day, ACRI, February 20 2001.
Macintyre Valley Cotton Field Day, Goondiwindi, February 28 2001.
Walgett Field Day, Walgett, March 9 2001.
Lower Namoi Field Day, ACRI, March 16 2001.
Weeds Sub-Program Planning Meeting, Orange, March 20-21 2001.
Collaborative weeds project review meeting, Narrabri, May 22 2001.
Polymeria Takeall Field Day, Colly Farms, January 14 2000.
Roundup Ready management guide meeting, TIMS Sub-Committee. July 3-14 2000.
The future for transgenic cotton. Aventis workshop, Coolum, Qld, July 20-21 2000.
Weeds Working Group, Brisbane Qld. August 15 2000.
CRC Systems Trials Working Group, Brisbane Qld. August 15 2000.
Northern Farming Systems Working Group, Brisbane Qld. August 15 2000.
Farming Systems Forum, Dalby, December 5-6 2000.
Weed seminar, UNE Certificate in cotton production, ACRI, February 19 1999.
Dryland cotton production field day, Edgeroi, March 10 1999.
Lower Namoi field day, ACRI, March 11 1999.
Tandou cotton production field day, Tandou, March 18 - 19 1999.
GRDC DAN 262 Northern Panel Weeds planning meeting, Brisbane, March 24 - 26 1999.
Cotton extension team workshop, Bribie Island, July 1 1999.
CRC Cotton Research Conference, Narrabri, July 21-22 1999.
CRC Weeds Working Group meeting, ACRI, August 24 1999.
UNE Plant Protection course, ACRI, September 8 1999.
ACRI Open Day, ACRI, December 8 1999.
9th Australian Cotton Conference, Broadbeach 11-14 August 1998.
CRC 5th stage review, ACRI, August 20 1998.
CRC Program 3 planning meeting, ACRI, August 26 1998.
Weed Management Section, Cotton Production Course, Post-Graduate Certificate in Rural Science, Department of Agronomy and Soil Science, University of New England, ACRI, August 26 1998.
Weed control options for cotton in a wet spring. Seminars at Warren and Nevertire, September 23 1998.
Controlling Nutgrass, Field Day, Glen Prairie, Moree, October 30, 1998.
Farming systems forum, ACRI, December 1 1998.
Best Management practices forum, ACRI, December 1 1998.

Weed management in farming systems, Cropping systems forum, ACRI, December 2 - 3 1998.
Opportunities for further research in the North, GRDC Planning Meeting, Sydney, December 10 1998.

## 12. Are changes to the Intellectual Property register required?

No

## *Part 4 – Final Report Plain English Summary*

Research has been undertaken into:

- the development of sustainable weed management systems using combinations of herbicides (residual and post-emergent), transgenic, herbicide tolerant cotton and retained stubble. Cotton lint yield and weed control has been assessed on a series of treatments. Initial results show that some of the commonly used herbicide combinations are antagonistic, reducing both cotton yield and weed control. Clearer identification of these combinations and an understanding of the reasons for the problems will enable growers to select better combinations, resulting in improved weed control, improved yields and reduced problems with seedling damage.
- the examination of the ecology and management of problem weeds of cotton production including peachvine, polymeria takeall, nutgrass, budda pea, velvetleaf and lipia. Management packages for these weeds are being developed. Packages will be released in 2002 with the launch of WEEDpak.
- assessing the sustainability of weed management in cotton production and cropping systems. Weed management has been assessed on 3 cropping systems experiments and fields on 6 properties since 1995. Results have shown that weeds are manageable on a range of systems, but that problem weeds such as peachvine and nutgrass are difficult to manage in all systems where they are present.
- developing herbicides for weed management in pigeon peas. A permit for the use of a range of residual and over-the-top grass herbicides in pigeon pea refuge crops has been obtained from the NRA.

Results from these trials are being integrated with a range of other material for inclusion into WEEDpak in 2002.

**Appendix 1**

# Herbicides for managing peach vine


## Summary

Herbicide options for peachvine management have been explored using a variety of field and glasshouse experiments, some of which are on-going.

None of the herbicides gave acceptable pre-emergence control of peachvine. Dual gave reasonable control of peachvine and warrants further evaluation. Field experiments this season will give more information on pre-emergence control.

Post-emergence, diuron and prometryn consistently gave the best control of peachvine of the herbicides normally used in cotton. Results with Staple were consistently poor. Enfield, a new post-emergence, over-the-top broad-leaf herbicide gave inconsistent results, apparently being more effective on older, rather than younger plants. This experiment is being repeated.

Of the potential transgenics, both Basta and Ioxynil are effective in controlling peachvine, although neither is well translocated, and give no residual control. Roundup performed poorly in the field, and gave inconsistent results in the glasshouse, where rates of at least 2 to 4 L of Roundup CT were required to achieve 90% control. This control will be valuable in Roundup Ready cotton, but will not be adequate as an 'alone' treatment. The use of different glyphosate formulations and additives gave little improvement in control. The use of diuron/Roundup mixes warrants further evaluation for use with over-the-top applications in Roundup Ready and UNR, and directed sprays in Roundup Ready cotton


## Conclusions

A peachvine management system using diuron or prometryn pre-planting, possibly Dual at planting, Roundup post-emergence and prometryn or diuron at layby appears to be the most satisfactory strategy for managing peachvine in-crop with herbicides.

## Results from field studies

### Myola autumn 2000 – over-the-top herbicides and combinations for peachvine

A wide range of herbicides and herbicide combinations were assessed in a fallow situation. Many of these herbicides could not be used in cotton, but might be used in fallow or rotation crops.

Table 1 shows percentage kill of peachvine plants that emerged on the border of a field following rain in March. Peachvine had emerged over the following weeks and a range of plants ages and sizes were present. Most peachvine were actively growing but some were moisture stressed at the time of spraying.

Herbicide was applied on April 3 and the effect assessed on April 13 and May 1. Control was assessed as 0 (no control) to 10 (100% of peachvine plants killed). Many peachvine plants were not completely dead at this time and it is difficult to be certain that treatments had killed all plants. Later assessment was prevented by a frost that killed all peachvine plants.

Many of the herbicides and herbicide combinations gave effective control of peachvine. The best control was given by Oxytril, diuron and atrazine, and the higher rates of Basta and Grazon. Of these, only diuron has reasonable safety with cotton, at least until transgenic, Basta or Oxytril cotton becomes available. Generally, the combinations gave control equivalent to the best of the components in the combination. The effectiveness of Zoliar could not be assessed from this trial, where the herbicide was not incorporated into the soil, and no follow-up rain occurred to activate the product.

The safety of diuron as a post-emergence directed spray needs to be explored. Extrapolation of the data indicates that diuron at 0.5 L or even less may give acceptable control of peachvine in the field. The level of damage to cotton from an over-the-top application of 0.5 L of diuron needs to be examined. Could diuron be applied at 2 L post-emergence as a directed spray in combination with a 0.5 L over-the-top application?

Table 1

| Treatment | Visual Observation 1-May-00 | | |
|---|---|---|---|
| Herbicide rate | 1X | 2X | 4X |
| Oxytril 0.5 L | 9.0 | 9.7 | 10.0 |
| Diuron 1 L | 10.0 | 9.7 | |
| Atrazine 2 L | 9.7 | 9.7 | |
| Basta 0.5 L | 6.3 | 8.0 | 9.3 |
| Grazon 125 ml | 5.7 | 4.0 | 9.0 |
| Gesagard 1 L | 8.7 | 8.7 | |
| Simazine 1L | 5.0 | 8.0 | |
| Roundup CT (450 g/L) 2 L | 2.0 | 5.3 | |
| Starane 0.25 L | 2.0 | 2.0 | 4.3 |
| Zoliar 1.5 kg | 3.0 | | |
| MSMA (800 g/L) 1 L | 0.7 | 2.7 | |
| **Herbicide combinations** | | | |
| Basta 1 L + Diuron (800 g/L) 2 L | 9.7 | | |
| Diuron 2 L + MSMA 1 L | 9.7 | | |
| Gesagard 1 L + Grazon 100 ml | 9.7 | | |
| Gesagard 2 L + MSMA 1 L | 9.3 | | |
| Basta 0.5 L + Gesagard 1 L | 9.0 | | |
| Roundup Ct (450 g/L) 2 L + Diuron (800 g/L) 2 L | 9.0 | | |
| Basta 1 L + Grazon 100 ml | 8.7 | | |
| Roundup Ct (450 g/L) 2 L + Gesagard 2 L | 8.7 | | |
| Basta 1 L + Zoliar 1 kg | 8.0 | | |
| Zoliar 1 kg + Grazon 100 ml | 2.3 | | |
| Zoliar 1 kg + Starane 0.25 L | 1.7 | | |
| Roundup CT 1 L + Grazon 100n ml | 1.3 | | |
| Untreated | 0.7 | | |
| Max s.e. | 1.8 | | |

## Results from glasshouse studies

### Results from Glasshouse experiment 61 – pre-emergent residual herbicides for peachvine

Table 2 shows germination percentage of peachvine sown into herbicide treated soil.
None of the herbicides controlled peachvine, with 30 – 50% of sown seeds eventually merging on all treatments. However, there was evidence that diuron, Gesagard, Cotoran and Dual all suppressed (delayed) emergence of peachvine for the first 8 to 12 weeks after planting.

Table 2

| Herbicide | Rate (L/ha) | Cumulative % seedling emergence | | | |
|---|---|---|---|---|---|
| | | 4 weeks | 8 weeks | 12 weeks | 14 months |
| Cotoran | 4.0 | 6 | 12 | 22 | 34 |
| Diuron (500 g/L) | 3.0 | 7 | 14 | 24 | 42 |
| Gesagard | 4.0 | 9 | 15 | 24 | 32 |
| Dual | 2.0 | 3 | 11 | 19 | 32 |
| Stomp | 4.0 | 16 | 21 | 31 | 47 |
| Trifluralin | 2.8 | 22 | 29 | 33 | 53 |
| Untreated | | 22 | 24 | 30 | 50 |

### Results from Glasshouse experiment 60 – broadleaf residual herbicides applied over-the-top of peachvine

Table 3 shows percentage seedling survival 4 weeks after herbicide application. Herbicides were applied to seedlings at the 4 leaf stage.

Diuron had the best activity against peachvine at the rates used and gave excellent control.

**Table 3**

| Herbicide | Rate (L/ha) | 4 weeks after spraying % seedling survival |
|---|---|---|
| Cotoran | 2.8 | 100 |
| Diuron (500 g/L) | 1.8 | 5 |
| Gesagard | 2.2 | 60 |
| Staple | 120 g | 100 |
| Untreated | | 100 |

**Results from Glasshouse experiment 56 - broadleaf residual herbicides applied over-the-top of peachvine**

Table 4 shows percentage seedling survival and number of alive leaves per plant 4 weeks after herbicide application. Herbicides were applied to seedlings at the 11 leaf stages.

Gesagard and diuron both effectively controlled peachvine at this growth stage, killing 94 to 100% of seedlings and effectively suppressing surviving seedlings.

**Table 4**

| Herbicide | Rate (L/ha) | 4 weeks after spraying 11 leaf plants | |
|---|---|---|---|
| | | % seedling survival | Leaf number per plant |
| Gesagard | 2.2 | 0 | 0.3 |
| Diuron | 1.8 | 6 | 0.3 |
| Cotoran | 2.8 | 75 | 6 |
| Staple | 120 g | 100 | 30 |
| Untreated | | 100 | 63 |
| | Max s.e. | 5 | 2 |

**Results from Glasshouse experiment 55 - broadleaf herbicides applied over-the-top of peachvine**

Table 5 shows percentage seedling survival 6 weeks after herbicide application. Herbicides were applied to seedlings at the 2, 4, 6 and 12 leaf stages.

Staple and Roundup at the 1 and 2 L rates were both largely ineffective in controlling peachvine. Of the broadleaf residual herbicides, Gesagard was the most effective even at the lower rate. Basta and Oxytril were equally effective in controlling peachvine.

**Table 5**

| Herbicide | Rate (L/ha) | % seedling survival 6 weeks after spraying | | | |
|---|---|---|---|---|---|
| | | 2 leaves | 4 leaves | 6leaves | 12 leaves |
| Cotoran | 2.8 | 75 | 63 | 25 | 50 |
| | 5.6 | 25 | 0 | 0 | 38 |
| Diuron | 2 | 25 | 38 | 0 | 50 |
| | 4 | 25 | 0 | 0 | 25 |
| Gesagard | 2.2 | 0 | 0 | 0 | 0 |
| | 4.4 | 0 | 0 | 0 | 0 |
| Staple | 30 g | 100 | 100 | 100 | 100 |
| | 60 g | 100 | 100 | 100 | 88 |
| | 120 g | 100 | 75 | 100 | 100 |
| Basta | 1 | 0 | 0 | 0 | 0 |
| | 2 | 0 | 0 | 0 | 0 |
| | 4 | 0 | 0 | 0 | 0 |
| Oxytril | 1 | 0 | 0 | 0 | 0 |
| | 2 | 0 | 0 | 0 | 0 |
| | 4 | 0 | 0 | 0 | 0 |
| Roundup CT | 1 | 100 | 50 | 88 | 88 |
| | 2 | 100 | 50 | 88 | 13 |
| | 4 | 0 | 13 | 13 | 0 |
| Untreated | | 100 | 96 | 100 | 100 |
| | Max s.e. | 5 | 5 | 5 | 5 |

**Results from Glasshouse experiment 59 – the addition of MSMA to broadleaf herbicides for peachvine**

Table 6 shows percentage seedling survival 6 weeks after herbicide application. Herbicides were applied to seedlings at the 3, 7 and 10 leaf stages.

Gesagard and diuron killed all peachvine seedlings at all growth stages and application rates. Cotoran was less effective in controlling peachvine, with better control at the higher rate. Control of peachvine with Cotoran was improved when MSMA was added. MSMA of itself gave only poor control of peachvine, and only improved control with Cotoran. The improvement with the addition of MSMA did not appear to be sufficient to justify its use in this application.

**Table 6**

| **Herbicide** | **Rate (L/ha)** | **% seedling survival 6 weeks after spraying** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **Nil** | | | **MSMA 1L/ha** | | | **MSMA 2 L/ha** | | |
| | | **3 leaves** | **7 leaves** | **10 leaves** | **3 leaves** | **7 leaves** | **10 leaves** | **3 leaves** | **7 leaves** | **10 leaves** |
| Cotoran | 1 | 50 | 50 | 50 | 25 | 38 | 50 | 0 | 25 | 25 |
| | 2 | 50 | 38 | 13 | 0 | 13 | 25 | 0 | 13 | 0 |
| Gesagard | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Diuron | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Untreated | | 100 | 100 | 100 | 100 | 100 | 100 | 88 | 88 | 75 |
| | Max s.e. | | 5 | | | 5 | | | 4.7 | |

**Results from Glasshouse experiment 52 – potential transgenic herbicides**

Table 7 shows percentage seedling survival 8 weeks after herbicide application. Herbicides were applied to seedlings at the 2 leaf and 10 leaf stages. The centre 20 cm of plants in one treatment sprayed at the 10 leaf stage were covered to simulate the effect of partial herbicide coverage and shielded applications to plants emerging in the cotton row.

All herbicides gave good control when applied at 2 L or more. None of the herbicides appeared to translocate very well, but Roundup CT gave the best control of partially covered plants.

**Table 7**

| **Herbicide** | **Rate (L/ha)** | **% seedling survival 6 weeks after spraying** | | |
|---|---|---|---|---|
| | | **2 leaves** | **10 leaves** | **10 leaf covered** |
| Basta | 2 | 0 | 0 | 88 |
| | 4 | 0 | 0 | 63 |
| Bromoxinal | 2 | 0 | 25 | 100 |
| | 4 | 0 | 0 | 100 |
| Roundup CT | 1 | 13 | 75 | 100 |
| | 2 | 0 | 0 | 38 |
| | 3 | 0 | 0 | 25 |
| Untreated | | 100 | 100 | 100 |
| | Max s.e. | 5 | 5 | 5 |

**Results from Glasshouse experiment 53 – contact herbicides for peachvine**

Table 8 shows percentage seedling survival 8 weeks after herbicide application. Herbicides were applied to seedlings at the 2, 9 and 22 leaf stages. Plants in one treatment sprayed at the 22 leaf stage were ½ covered to simulate the effect of partial herbicide coverage to plants emerging in the cotton row. The central 20 cm of each plant was covered.

Staple and Bromoxinal gave poor control at all rates. The 2 L Roundup rate gave reasonable control, while Basta gave good control at both rates, although it translocated poorly.

**Table 8**

| Herbicide | Rate (L/ha) | % seedling survival 8 weeks after spraying | | | |
|---|---|---|---|---|---|
| | | 2 leaves | 9 leaves | 22 leaves | 22 leaves covered |
| Basta | 1 | 0 | 0 | 0 | 88 |
| | 2 | 0 | 0 | 0 | 75 |
| Bromoxinal | 1 | 88 | 88 | 88 | 75 |
| | 2 | 100 | 63 | 25 | 88 |
| Roundup CT | 1 | 38 | 88 | 75 | 100 |
| | 2 | 50 | 13 | 13 | 88 |
| Staple | 60 g | 100 | 100 | 88 | 100 |
| | 120 g | 75 | 100 | 88 | 100 |
| Untreated | | 100 | 100 | 88 | 88 |
| | Max s.e. | 5 | 5 | 5 | 5 |

**Results from Glasshouse experiment 50 – Enfield herbicide for peachvine control**

**Table 9**

| Herbicide | Rate (g/ha) | 6 weeks after spraying | | | |
|---|---|---|---|---|---|
| | | % plant survival | | Number of alive leaves | |
| | | Size at spraying | | Size at spraying | |
| | | 3 leaves | 24 leaves | 3 leaves | 24 leaves |
| Enfield | 5 | 100 | 100 | 9 | 70 |
| Enfield | 10 | 100 | 25 | 20 | 16 |
| Enfield | 15 | 100 | 25 | 10 | 5 |
| Enfield | 20 | 100 | 0 | 2 | 0 |
| Untreated | | 100 | 100 | 10 | 57 |
| | Max s.e. | 5 | 5 | 1.6 | 4.2 |

Table 9 shows percentage seedling survival and number of alive leaves 6 weeks after Enfield application. Enfield was applied to seedlings at the 3 and 24 leaf stages.

Enfield was less effective on smaller plants, but completely killed larger plants when applied at the 20g rate. The leaf data shows that the peachvine plants were suppressed by the 20g rate when applied to the 3 leaf plants.

This result is unexpected, as herbicides are generally far more effective against smaller plants. The application is being repeated and again Enfield has not killed small peachvine plants (trial not yet completed).

**Results from Glasshouse experiment 51 – glyphosate formulations and additives for peachvine control**

Table 10 shows percentage seedling survival 6 weeks after herbicide application. Herbicides were applied to seedlings at the 4 and 14 leaf stages.

None of the glyphosate formulations appeared to be any more effective than Roundup CT, although the addition of Turbo Plus, a non-ionic surfactant, did improve control, especially at the lower rate.

**Table 10**

| Herbicide | Rate (L/ha) | Additive | Rate (%) | % plant survival weeks after spraying 6 | |
|---|---|---|---|---|---|
| | | | | Size at spraying | |
| | | | | 4 leaves | 14 leaves |
| Roundup CT | 2.2 | | | 75 | 75 |
| Roundup CT | 2.2 | Turbo Plus | 0.2% | 63 | 50 |
| Roundup CT | 2.2 | Turbo Plus | 1% | 50 | 88 |
| Roundup CT | 2.2 | Pulse Penetrant | 0.2% | 88 | 88 |
| Roundup CT | 2.2 | Pulse Penetrant | 1% | 88 | 88 |
| Roundup CT | 2.2 | Boost | 2% | 75 | 100 |
| Roundup CT | 2.2 | Boost | 5% | 75 | 88 |
| Roundup CT | 2.2 | Urea | 2% | 75 | 100 |
| Roundup CT | 2.2 | Urea | 5% | 75 | 100 |
| Roundup Max | 2.0 | | | 88 | 100 |
| Roundup Ready | 1.4 | | | 75 | 100 |
| Credit & Bonus | 1.9 | | | 88 | 100 |
| Untreated | | | | 100 | 100 |
| | | | Max s.e. | 5 | 5 |

Table 11 shows the leaf number per plant 6 weeks after herbicide application, for the plants shown in Table 9. This data indicates the degree of suppression achieved by the various herbicides.

None of the glyphosate formulations appeared to be any more effective than Roundup CT. The addition of Turbo Plus, Pulse Penetrant and Boost (ammonium sulphate), all improved control, or gave control equivalent to the Roundup CT formulation.

These results will be further evaluated, as there appears to be some possibility of improving the kill rate using additives, without exceeding the Label rate of glyphosate allowed with Roundup Ready cotton.

**Table 11**

| Herbicide | Rate (L/ha) | Additive | Rate (%) | Leaf number 6 weeks after spraying<br>Size at spraying<br>4 leaves | <br><br>14 leaves |
|---|---|---|---|---|---|
| Roundup CT | 2.2 | | | 2.0 | 1.0 |
| Roundup CT | 2.2 | Turbo Plus | 0.2% | 2.0 | 0.9 |
| Roundup CT | 2.2 | Turbo Plus | 1% | 1.3 | 1.8 |
| Roundup CT | 2.2 | Pulse Penetrant | 0.2% | 4.3 | 4.6 |
| Roundup CT | 2.2 | Pulse Penetrant | 1% | 2.1 | 1.6 |
| Roundup CT | 2.2 | Boost | 2% | 3.0 | 4.5 |
| Roundup CT | 2.2 | Boost | 5% | 1.8 | 2.0 |
| Roundup CT | 2.2 | Urea | 2% | 4.3 | 6.5 |
| Roundup CT | 2.2 | Urea | 5% | 3.9 | 4.0 |
| Roundup Max | 2.0 | | | 3.0 | 4.9 |
| Roundup Ready | 1.4 | | | 1.9 | 2.8 |
| Credit & Bonus | 1.9 | | | 3.1 | 4.6 |
| Untreated | | | | 8.4 | 14.9 |
| | | | Max s.e. | 1.0 | 1.1 |

**Additional experiments that are on-going or have not yet been analysed**

**Field**

Herbicides for in-crop control of peachvine. 1. Waverley. Trial lost due to November 2000 rains.
Herbicides for in-crop control of peachvine. 2. Bloomvale, Moree. On-going.
Herbicides for in-crop control of peachvine. 1. Clyde, Dirranbandi. On-going.

**Glasshouse**

Exp 50 – the use of Enfield for peachvine control.
Exp 51 – the use of glyphosate formulations and additives for peachvine control
Exp 513 – the effect of Cotoran, Stomp, Dual, Zoliar, and Staple in combination with Roundup sprayed on 2 and 6 leaf peachvine and Roundup Ready cotton.
Exp 514 – the effect of Diuron and Gesagard in combination with Roundup sprayed on 2 and 6 leaf peachvine and Roundup Ready cotton.

# Peach vine ecology

**Summary**

A heavily infested field may have around 1000 to 2000 peachvine seeds per $m^2$. These seeds occur predominantly near the soil surface, with 80% in the 0 to 30 cm soil zone.
Peachvine are very hard-seeded, with up to 10% of seeds germinating in any 1 year. Emergence occurs all year round following rain or irrigation, although most emergence is in the warmer months. Peachvine seedlings and plants are not frost tolerant. Flowering can occur all year round.
Peachvine will be a long-term problem weed, as large numbers of viable seeds may remain in the soil seedbank for many years.
Seed movement in irrigation water is not an issue, except for infestation of previously clean fields.
Remaining issues include the viability and longevity of seeds in the seedbank and the impact of cultivation on germination.
Current variability in the estimate of the weed seedbank is inherent in the sampling process, and may reflect real variability in the soil. Variability will become less important over time.

**Conclusion**

Peachvine will not be easily controlled by running down the soil seebank. Nevertheless, opportunity may exist to better manage the weed than is the current normal practice.

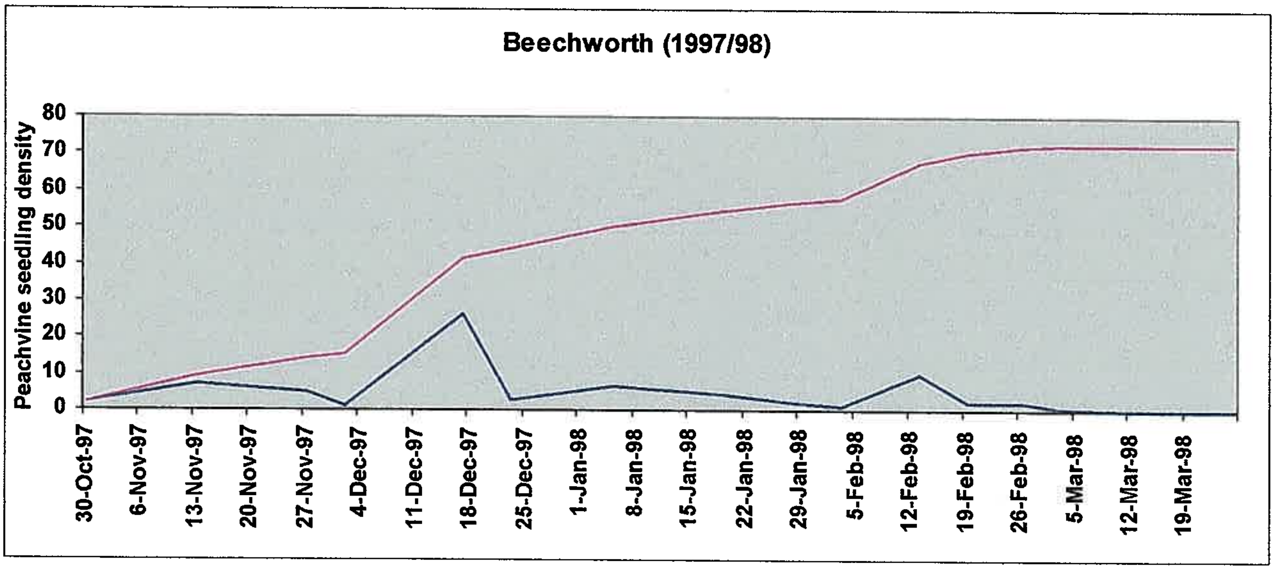
**Results from Glasshouse experiments 54, 58 & 512 – response of peachvine germination to age and scarification**

Germination of peach vine seeds collected over 3 years was tested at 15 – 35°C in the glasshouse. Seeds were mechanically scarified at 3 levels, with the heaviest scarification removing approximately 60% of the seed coat.
Germination was poor for all seed ages and treatments averaging 9%, with a maximum of 19% emergence observed. Scarification did not consistently improve germination. Heavy scarification reduced germination.

**Results from Beechworth in 1997/98 – peachvine seedling emergence**

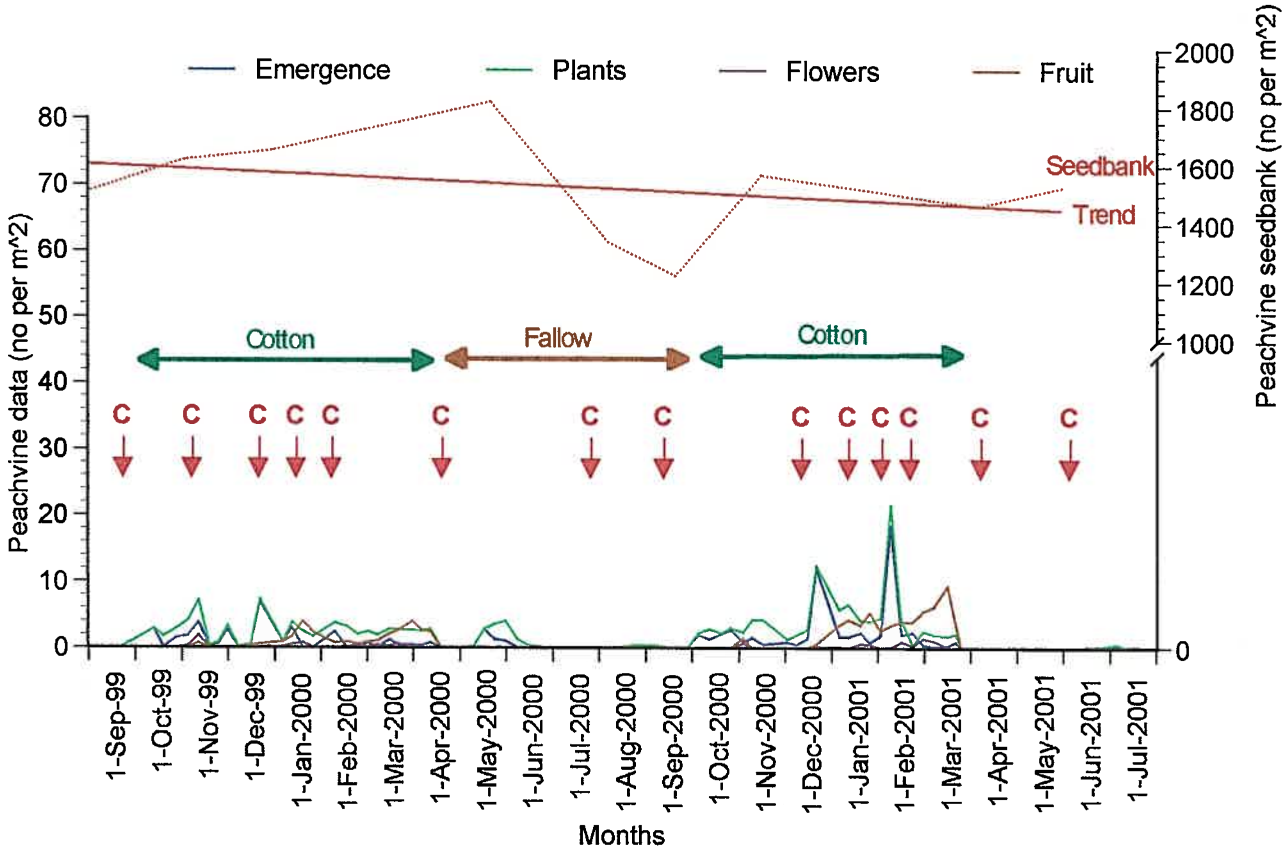
Emergence of peachvine seedlings was monitored weekly in cotton from Oct 30 1997 to Mar 19 1989, using 12 micro-plots each of 0.24 $m^2$.
The maximum emergence observed was 26 seedlings/$m^2$ on Dec 17.
A total of 72 seedlings/$m^2$ emerged over the season as seen in Figure 1.

**Figure 1**



**Results from Beechworth in 1999/01 – peachvine seed-bank and seedling emergence in 3 farming systems**

## Fig 2. Continuous cotton




## Fig 3. Cotton / fallow rotation

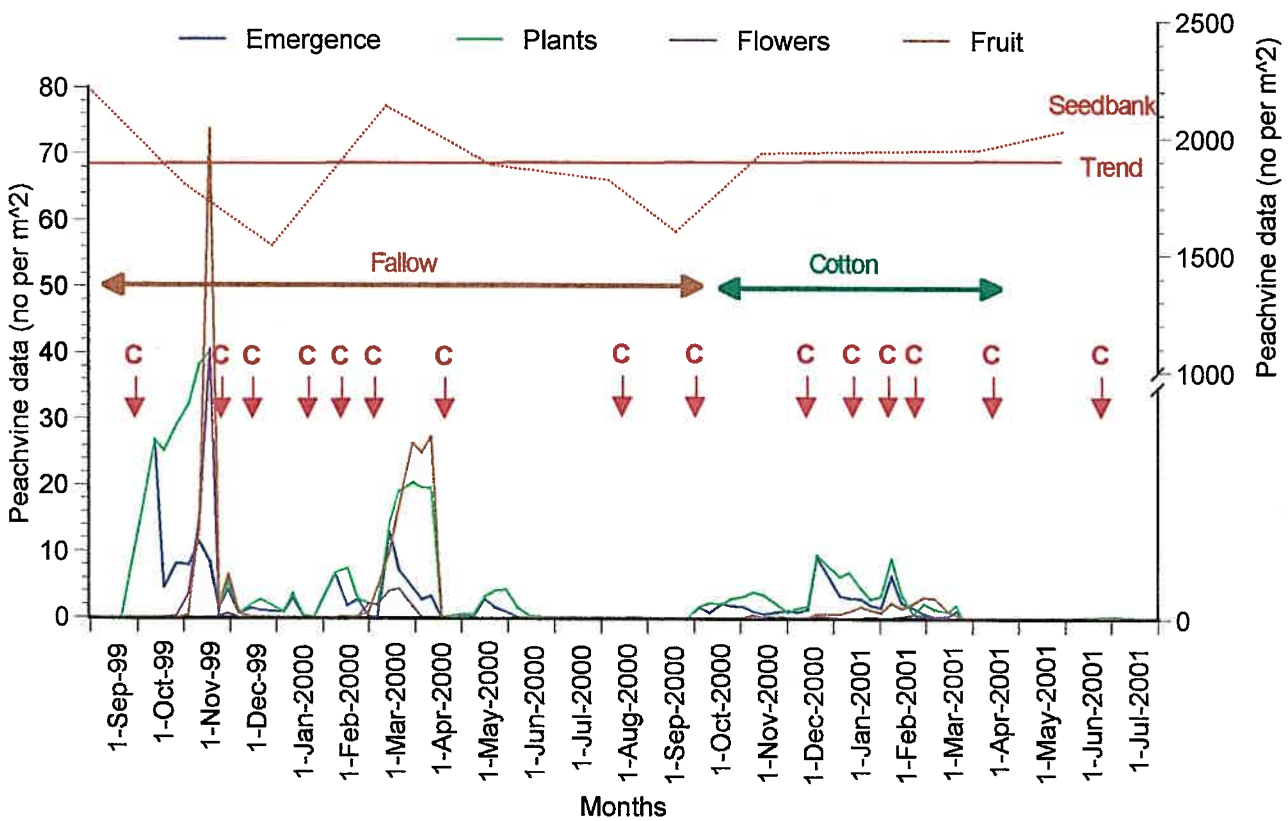
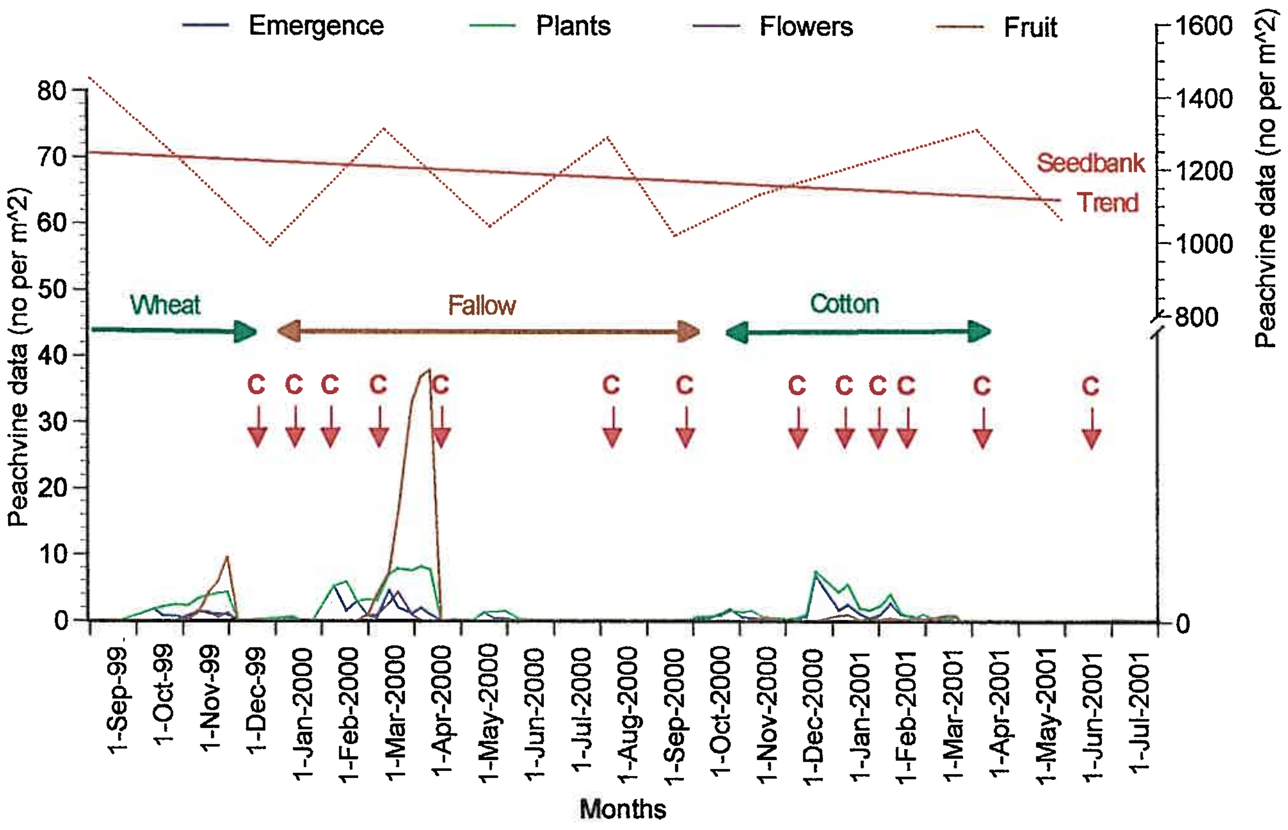


Fig 4. Cotton / wheat rotation




Emergence of peachvine seedlings was monitored weekly from Aug 30 1999 using 20 fixed position quadrats each of 0.5 $m^2$, in three of the systems of the CRC farming systems experiment. These were: 1 continuous cotton, 2 cotton/long fallow, and 3 the cotton/wheat rotation. Two replicates of each treatment were observed. Soil cores were also taken from the quadrat positions every 2 months. Cores were 7cm diameter, and 30 cm in depth. Soil was washed from the cores to determine the number of peachvine seeds in the seedbank.

Results are presented in Figures 1, 2 and 3. 'C's indicate cultivation events. Actual seedbank estimates are shown, as well as the 2 year trends.

The results from the figures are summarised in Tables 1 and 2.

**Table 1**

| Treatment | Seedbank (seeds per $m^2$) | | Trend in seedbank | |
|---|---|---|---|---|
| | 26 Aug 99 | 24 May 01 | Actual | % of seedbank |
| **Continuous cotton** | 1517 | 1528 | - 156 | - 9.7 |
| **Cotton/fallow** | 2197 | 2030 | + 17 | + 0.9 |
| **Cotton/wheat** | 1447 | 1064 | - 127 | - 10.3 |

**Table 2**

| Treatment | Seedling emergence | | New seeds produced | |
|---|---|---|---|---|
| | actual | % of seedbank | actual | % of seedbank |
| **Continuous cotton** | 95 | 5.9 | 36 | 2.2 |
| **Cotton/fallow** | 174 | 9.3 | 117 | 6.2 |
| **Cotton/wheat** | 55 | 4.4 | 51 | 4.1 |
| Average | 108 | 6.5 | 68 | 4.2 |

The estimates of the seedbank fluctuated over the 2 year period, partly due to experimental error caused by the relatively small size of the samples used. Soil cores are 7 cm in diameter, or 0.004 $m^2$ each, with a total area of 0.08 $m^2$ sampled in each treatment on each occasion. Nevertheless, the overall trends in the data indicate small reductions (~10%) in the seedbank on the continuous cotton and cotton/wheat systems, with no change in the cotton/fallow system, where seedling emergence was the greatest, but seed production was also the greatest.

Peachvine seedlings emerge all year round when soil moisture is adequate (after rain or irrigation), although emergence occurs predominantly during the warmer months. Peachvine is not frost tolerant and seedlings that emerge during the winter months are normally killed by frost before they flower.

Total seedling emergence over the 2 year period was surprisingly small, given the size of the seedbank, representing on average only 6% of seed. Similarly, seed production was large in terms of a potential weed problem, with 36 to 117 new seeds $m^2$ added over 2 years, but this represents just 2% of the seedbank on average.

The biggest seed production events over the 2 years occurred during the fallow periods, indicating the need for closer attention to peachvine management in the fallow phase. This period also appeared to offer the most potential to reduce the seedbank, with many seedlings emerging during the fallow phase. Results from the fallow work indicates that the lack of seedling emergence during the cropping phase is probably due to the combined effects of shading and herbicides inhibiting germination.

**Results from Exp 510 - peachvine seed distribution in the seedbank**

Soil cores to 1 m depth were taken from Beechworth in autumn 1998. Cores were taken from both the hill and the furrow. Cores showed a total of 1974 seeds/m2 remaining in the seedbank.

50% of seeds were in the top 10 cm, with 20% and 10% in the 10-20 and 20 to 30 cm zones.

Seed density in the top 10 cm was proportionally greater in the furrow than the hill, with 80% of seeds in the top 30 cm in both field areas.

**Results from Exp 57 – seed movement in irrigation water**

"Socks" were placed over irrigation siphons at Beechworth during the 1999/2000 season to determine seed movement in irrigation water over the duration of a full irrigation. On average 0.4 to 1.4 seeds were captured per siphon per irrigation. This is a very small number compared to the density of peachvine in the field. Seed movement in irrigation water may be important in infesting a previously clean field, but is not an important source of infestation as such.

**Results from Beechworth in 2000/01 – peachvine seed-bank and seedling emergence under a range of herbicide systems**

On the basis of the results from the previous work, a 2nd experiment was established to look at the effect of a range of herbicide systems on the change in the seedbank over time. These systems were established beside the CRC farming systems site and do not use irrigation, but do allow a long-term opportunity to explore the effects of the various systems. Herbicides were applied during the season in parallel to a normal farming system.

Comparison was made between:

- A 'standard' herbicide system
- A 'heavy' system, using the more effective herbicides previously identified
- An 'alternate' system, using a different range of herbicides
- A 'light' herbicide system
- A 'zero' residual system, with seedlings controlled every 2nd month
- A 'zero' residual system, with seedlings controlled every month

Soil cores were taken at the same times as in the previous experiment.

Results are shown below in Figures 5 to 10, and the figures have been summarised in Tables 3 and 4.

Fig 5. Standard herbicide - Pre-planting - 2 L Diuron
Planting - 3 L Stomp & 4 L Cotoran
Layby - 4.5 L Gesagard

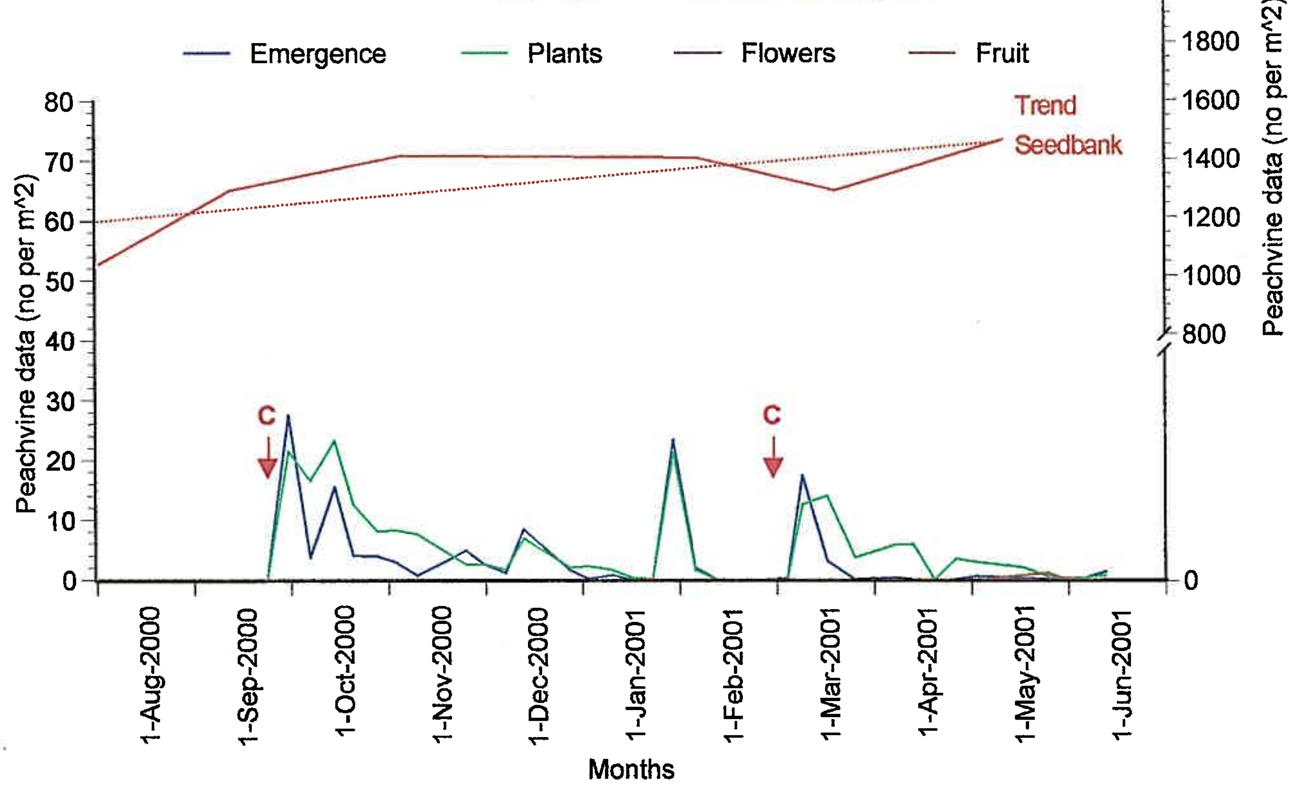



Fig 6. Heavy herbicide - Pre-planting - 3 L Diuron
Planting - 2 L Dual & 4.5 L Gesagard
Layby - 4.5 L Gesagard

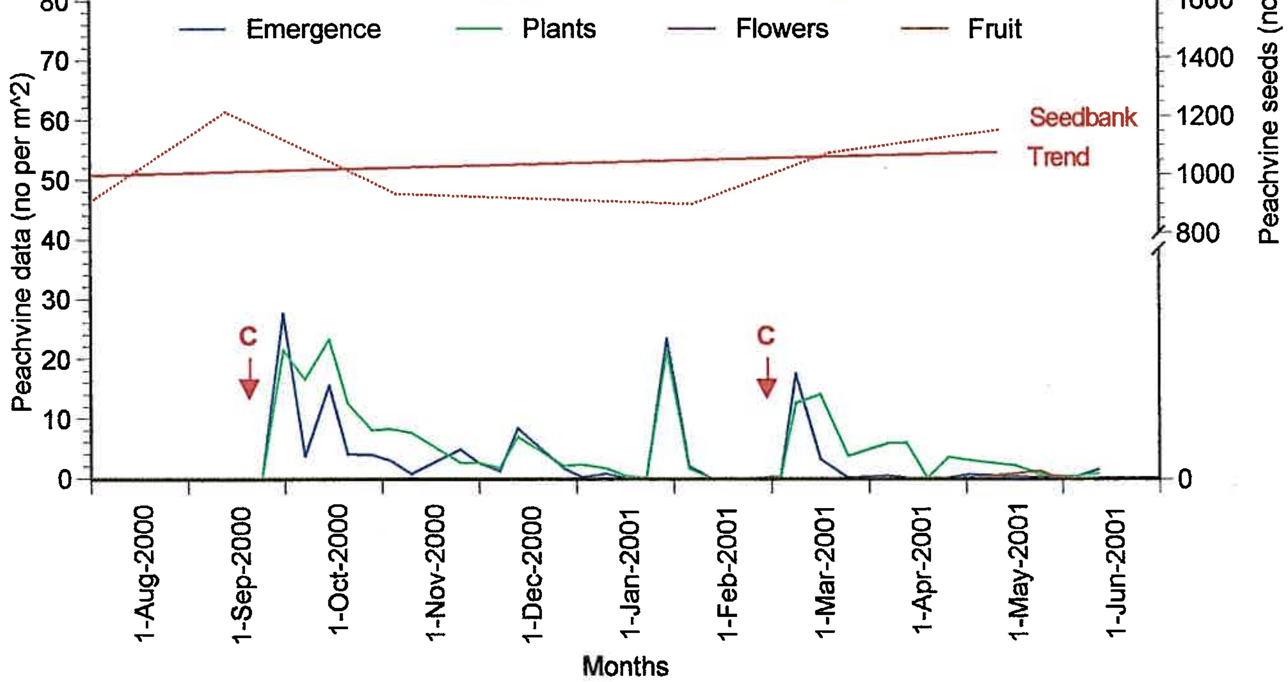


Fig 7. Alternative system - Pre-planting - 2 kg Zoliar
Planting - 2 L Cotogard
Layby - 4.5 L Gesagard

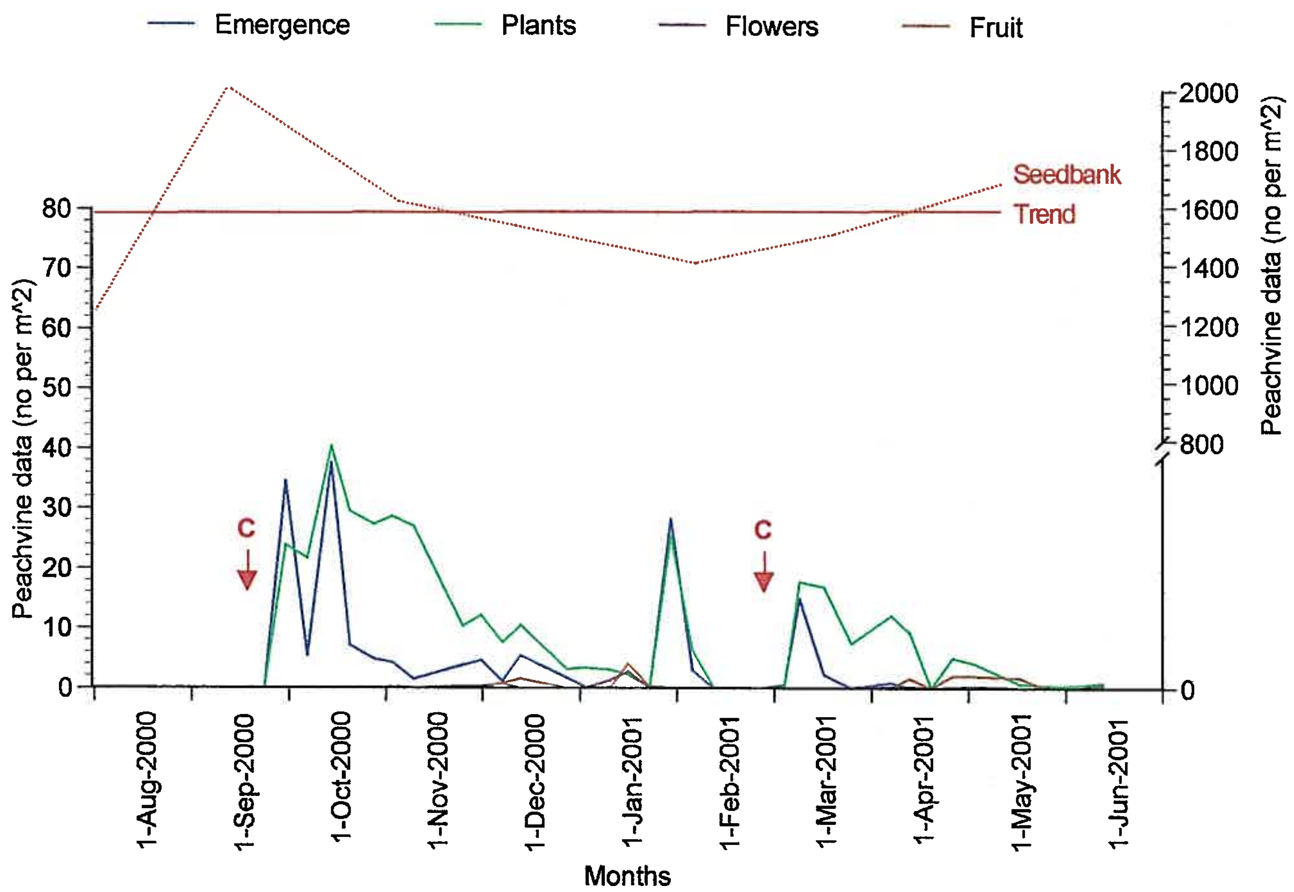
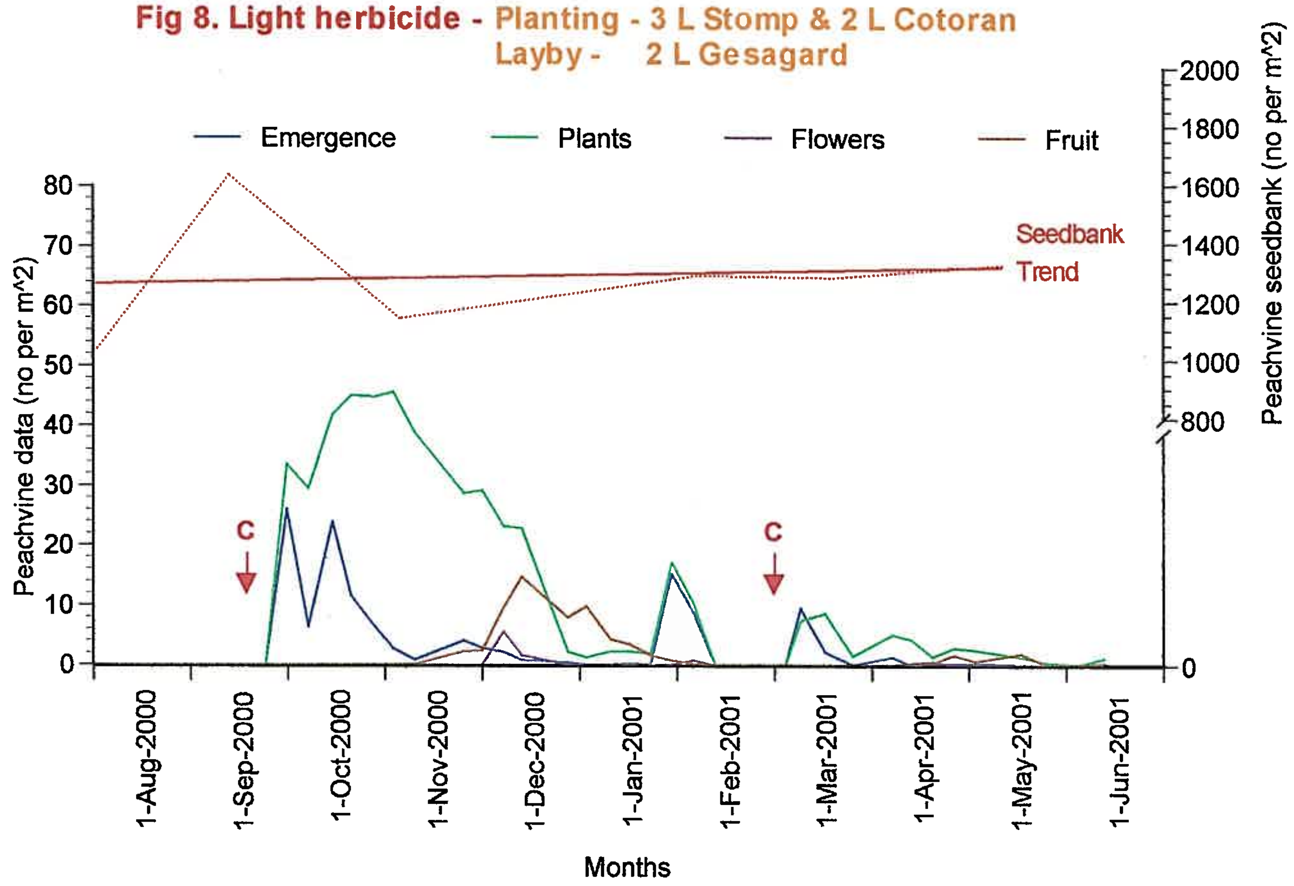
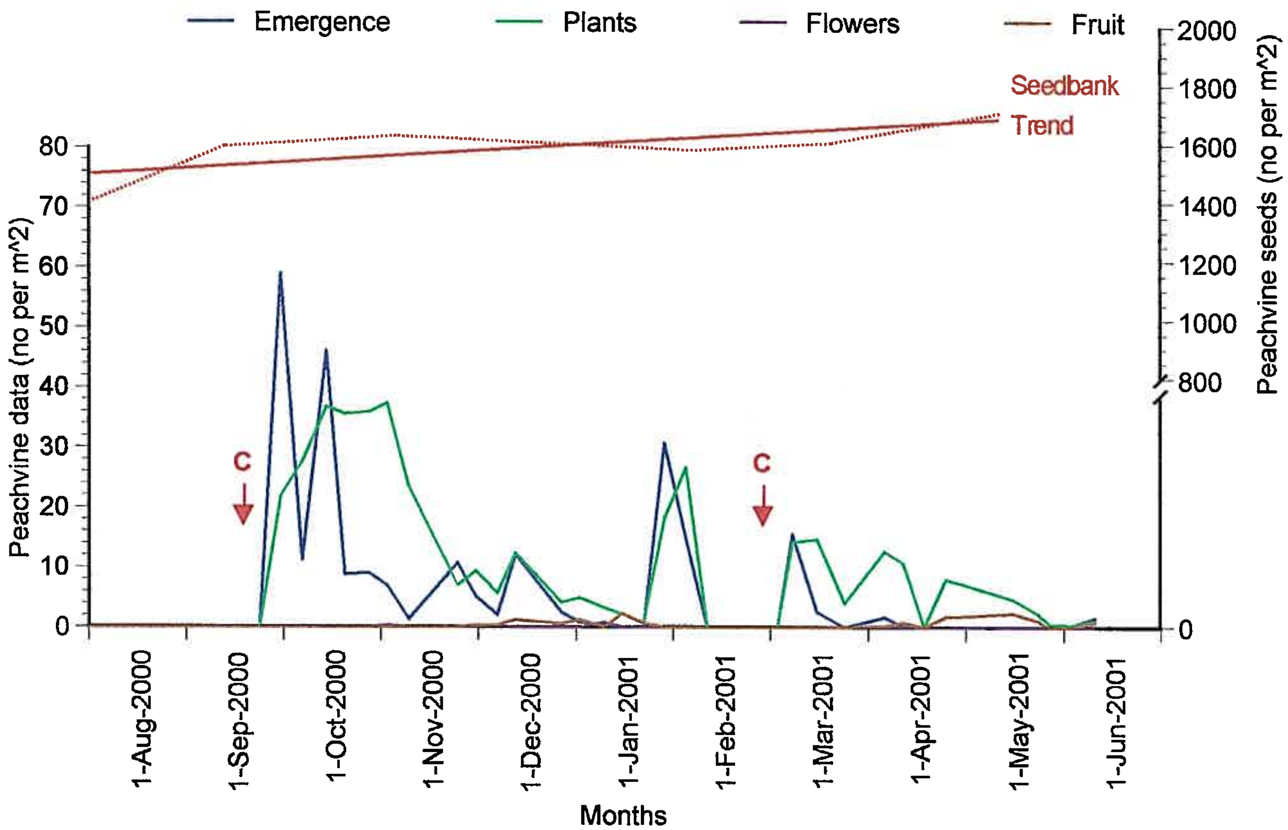



Fig 8. Light herbicide - Planting - 3 L Stomp & 2 L Cotoran
Layby - 2 L Gesagard



## Fig 9. Bi-monthly control - 4 L Basta bi-monthly




## Fig 10. Monthly control - 4 L Basta as required

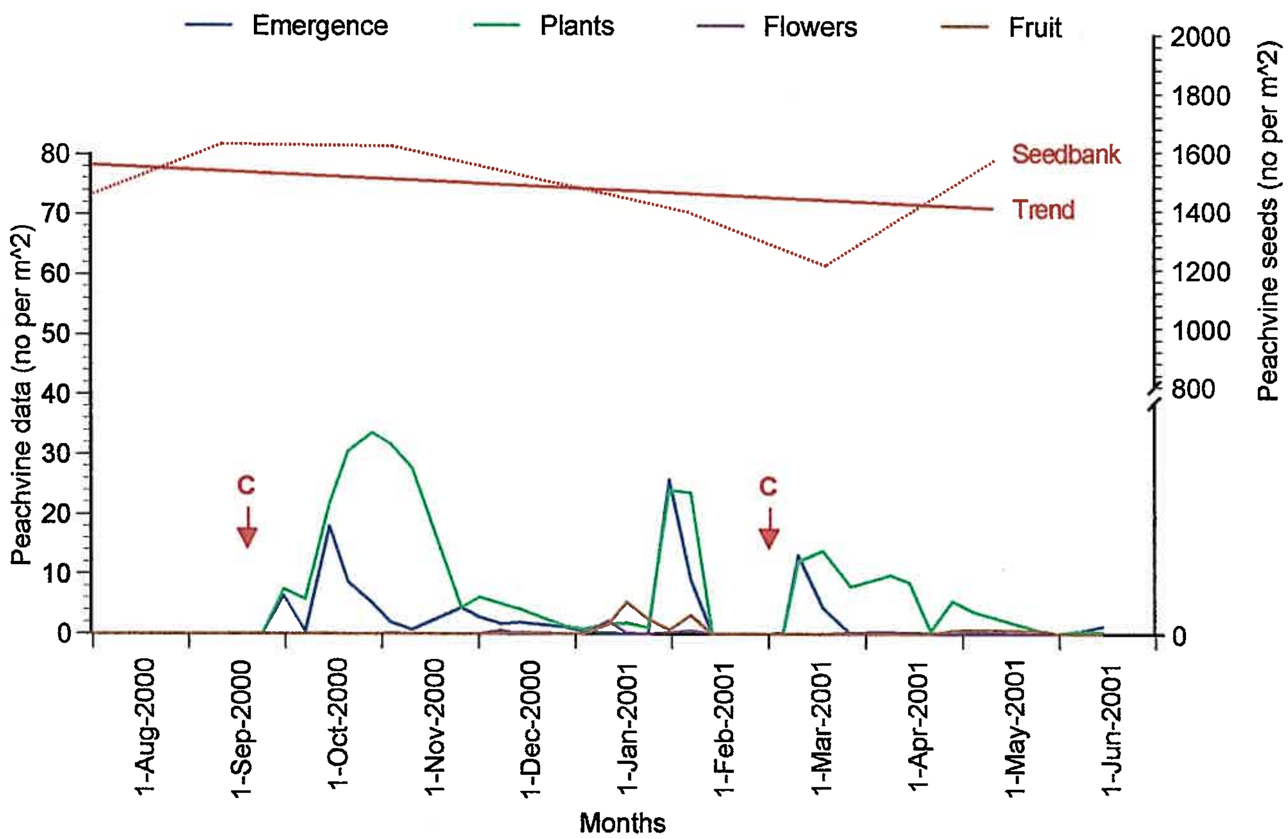


Table 3

| Treatment | Seedbank (seeds per m$^2$) | | Trend in seedbank | |
|---|---|---|---|---|
| | 1 Jul 00 | 24 May 01 | Actual | % of seedbank |
| Standard herbicide | 1039 | 1465 | + 274 | + 23.2 |
| Heavy herbicide | 917 | 1151 | + 77 | + 7.8 |
| Alternate herbicide | 1245 | 1681 | + 11 | + 0.7 |
| Light herbicide | 1039 | 1325 | + 56 | + 4.5 |
| Bimonthly control | 1408 | 1708 | + 187 | + 12.5 |
| Monthly control | 1454 | 1570 | - 146 | - 9.4 |

Table 4

| Treatment | Seedling emergence | | New seeds produced | |
|---|---|---|---|---|
| | actual | % of seedbank | actual | % of seedbank |
| Standard herbicide | 126 | 10.7 | 1 | 0.1 |
| Heavy herbicide | 78 | 7.9 | 10 | 1.0 |
| Alternate herbicide | 163 | 10.4 | 10 | 0.6 |
| Light herbicide | 125 | 9.9 | 21 | 1.7 |
| Bimonthly control | 243 | 16.3 | 7 | 0.5 |
| Monthly control | 108 | 7.0 | 8 | 0.5 |
| Average | 141 | 10 | 10 | 0.7 |

This trial has only been running for 1 season, which is a relatively short period for a seedbank with the apparent longevity of peachvine.

The overall trends in the seedbank data indicate increases in most treatments, with a reduction only on the treatment receiving maximum (monthly) control without residual herbicides. Another season's data should clarify the trends.

Total seedling emergence over the season was much greater than in the previous experiment, with 10% of the seebank emerging in 1 year compared to 7% over 2 years. This occurred even though the area was rain-fed. Germination was least on the treatment receiving the heaviest herbicide load and greatest on a treatment receiving no herbicide, but the trend was not consistent. The importance of cultivation in this needs to be clarified. Shading in-crop may be a major factor reducing peachvine germination.

Seed production was much smaller than in the previous experiment, representing just 0.7% of the seedbank on average.