IPM ONfarm – Protected Cropping

Competency Training in Integrated Pest Management for the Ornamental and Greenhouse Industries

Course Workbook

Stages 1, 2, 3 and 4

Produced by NSW Agriculture in conjunction with Horticulture Australia
IPM ONfarm – Protected Cropping: Course Workbook

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Introduction to IPM

This course does not address any national competencies in the National Training Package in Horticulture: it provides an understanding of the aims and practices of IPM and it is also the introduction to Stages 2 and 3 of the IPM ONfarm training program.

Course structure

- What is IPM?
- The seven sectors of plant health
- Pests and diseases
- Benefits of IPM
- Potential barriers to adoption of IPM
- Chemical availability
- Pest and disease resistance
- Commitment to IPM
- Common questions about IPM

Reference material in the Information Guide

- Section 1: What is IPM?
- Section 2: Common Questions
- Section 9: Directory
- Section 11: Glossary
- Handy Guide 4: Registered Chemicals for Common Pests
- Handy Guide 5: Registered Chemicals for Common Diseases

Purpose

You learn about IPM, including the benefits and possible problems with IPM and its role in plant health.
Activities

- Discussing the principles of IPM and some IPM strategies
- Identifying pests and diseases from your own experiences
- Outlining factors that affect plant health
- Listing the benefits of IPM
- Explaining the limitations to the use of registered chemicals and possible chemical resistance in pests
- Outlining how a computer database of registered chemicals is used to obtain information on pest and disease control products and information about chemical resistance in pests
- Discussing some of the potential barriers to the adoption of IPM.

Tasks

Note: All suggested reading associated with page numbers in this Workbook refers to the Information Guide by Section and then page number, for your industry.

What is IPM?

1. What is integrated pest management (IPM)?
   If you think you know what IPM is, write it down.

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

DEFINITION OF IPM

a) It’s one o’clock in the afternoon
b) I Pray More
c) A system of pest management that plans ahead, considers all options, and aims to minimise the use of toxic pesticides
2. Read the brief description of IPM on page 1–2 and compare it with yours.

3. What is an IPM program? Tick one in the list below that you think best fits the definition on page 1–2.

**AN IPM PROGRAM:**

- a) Uses non-toxic chemicals only
- b) Uses only biological control agents
- c) Seeks to integrate all compatible options

4. List the elements of an IPM program that you feel you are already practising in your crop(s).

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5. Plant health can be affected by a range of factors. Refer to *Plant Health Management* on pages 1–2 and 1–3 and familiarise yourself with all the sectors of plant health. Look at the list below and tick the factors that are harmful to your crops. Make a brief note about why the ones you have selected may be a problem. You could discuss your answer with your mentor or trainer.

- a. environment .............................................................................................................................

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

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

- b. soil/media condition .................................................................................................................

........................................................................................................................................
Pests and diseases

A pest can be defined as any organism that has the capacity or potential to cause economic harm by reducing quality or yield of crops or other products.

6. You have been provided with specimens of pests and diseases. Write down the names of those that you think you recognise.

a. 

b. 

c. 

d. 

e. 

f. 

g. 

7. Which pests and diseases have you seen infesting your crops?

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

..........................................................
8. Which are the major ones, and what type of damage does each cause?

9. Describe the action you would take if you came across an unknown pest or disease.

Benefits of IPM
Refer to pages 1-4 and 1-5 and read about the benefits of IPM.

10. List the benefits in what you see as being the order of importance. Put the most important benefit first in your list.

a. 

b. 

c. 

d. 

e. 

f. 

g. 

h. 

11. Which benefits in Task 10 do you feel best able to achieve?

Potential barriers to adoption of IPM

Many growers are unsure about starting an IPM program for many reasons. Some of these include cost, uncertainty about the time commitment, uncertainty about using biocontrol agents – or they just don’t know much about it.

12. Read through the list of potential problems on pages 1–6 and 1–7. Would any of these be of concern to you, and why?

13. Do you have any concerns with using IPM? If so, what are they?
Chemical availability
In the picture below is one way of looking at pest management.

**IS THIS YOUR ONLY VISION OF PEST MANAGEMENT?**

14. Where can you get information on registered chemicals for your crops? (See pages 9–22 and 9–23 and Handy Guides 4 and 5.)

15. What problems could there be in using chemicals in the future?
16. Have you ever come across problems with pest or disease resistance? If so, briefly describe the pest or disease and the chemical involved.

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17. Explain why you thought the problem was resistance and not some other factor.

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18. List three other factors that might lead to poor control.

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19. Are you aware of what resistance management is?

Yes..............................  No..........................

If you are aware of resistance management, describe some of the key aspects of it.

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Commitment to IPM

Have a look at Challenges on page 1–7.

20. What do you think IPM has to offer you and your farm?

Common questions about IPM

See Section 2 Common Questions in the Information Guide.

21. What are two questions about IPM that you would like to ask? Can you find them in Section 2?
Basic recognition and monitoring EQUIPMENT

National competencies addressed in this training course are from the National Training Package in Horticulture:

- RUHHR202A Treat pests and diseases (element /01 Recognise pests and diseases)

Learners who successfully complete the assessment exercise will receive a Certificate of Attainment for the element of the National Competency listed above.

Course structure

**Topic 1. Introduction to IPM** is dealt with in Stage 1 at the beginning of this Course Workbook

**Topic 2. Basic pest and disease recognition, biocontrol and monitoring equipment**

- Pest recognition
- Disease recognition
- Biocontrol recognition
- Monitoring equipment

Reference material in the Information Guide

**Topic 1 Introduction to IPM**: see Stage 1 at the beginning of this Course Workbook

**Topic 2 Basic pest and disease recognition, biocontrol and monitoring equipment:**

- Section 4: Designing an IPM Program: Monitoring & Decision-making
- Section 5: Know Your Pests
- Section 6: Know Your Diseases
- Section 7: Know Your Biocontrol Agents
- Section 9: Directory
Basic Recognition and Monitoring Equipment

- Section 11: Glossary
- Handy Guide 4: Registered Chemicals for Common Pests
- Handy Guide 5: Registered Chemicals for Common Diseases

Purpose

In this stage you will learn how to recognise pests and diseases in your crops and the symptoms of damage. You will also learn about the biocontrol agents that might be useful to you and how to tell them apart from pest species. You learn about the use of chemicals against pests and diseases. Finally, you will learn about the need for monitoring and the equipment and methods used.

Activities

- Recognising pests, diseases and biocontrol agents
- Examining examples of key pests infesting crop and weed plants
- Examining diseased plant material
- Examining samples of commercially produced biocontrol agents and any naturally occurring predators and parasitoids that are available
- Discussing pest and disease diagnosis with reference to Pests, Diseases, Disorders and Beneficials: Field Identification Guide
- Looking for pests and beneficials in plant samples by using a headband or a hand magnifier
- Looked at a sticky trap that has trapped insects in a crop

Tasks

Note that all suggested reading associated with page numbers in this Workbook refers to the Information Guide by Section and then page number, for your industry.

Pest recognition

22. Look at the directory of pests on pages 5–2 and 5–3 and check Pests, Diseases, Disorders and Beneficials: Field Identification Guide. Have a look at the specimens provided. Can you recognise them?

   a. ........................................ b. ........................................ c. ........................................

   d. ........................................ e. ........................................

23. Which of the specimens provided have you seen in your crops? Tick above
24. Choose three of the most common pests you have seen in your crop(s)

For Pest 1:
Can you describe how you recognised it and which plants you found it on?

What sort of damage did you see?

What were you asked to do about it, if anything?

For Pest 2:
Can you describe how you recognised it and which plants you found it on?

What sort of damage did you see?

What were you asked to do about it, if anything?
For Pest 3:
Can you describe how you recognised it and which plants you found it on?

What sort of damage did you see?

What were you asked to do about it, if anything?

Disease recognition

25 Look at the directory of diseases on page 6-2 and check Pests, Diseases, Disorders and Beneficials: Field Identification Guide. Have a look at the specimens provided. Can you recognise them?

1. ..............................................................

2. ..............................................................

3. ..............................................................

26. Describe each as caused by a fungus, bacteria, virus or nematode

1. ..............................................................

2. ..............................................................

3. ..............................................................
27. Describe the symptoms you've seen caused by each of the diseases shown in Task 25. Refer to Know your Diseases, Section 6 of the Information Guide, and check diagnostic features.

1. ........................................................................................................

2. ........................................................................................................

3. ........................................................................................................

28. Describe what you have been asked to do when you've seen these diseases in your crops.

1. ........................................................................................................

2. ........................................................................................................

3. ........................................................................................................

Biocontrol recognition

29. From the directory of commercially available biocontrol agents on page 7-2, choose the biocontrol agents you could use against the pests you named earlier in Tasks 23 & 24. Check Pests, Diseases, Disorders, Beneficials: Field Identification Guide for colour pictures and some key information.

30. Which biocontrol agents have been used in your crops?

1. ........................................................................................................

2. ........................................................................................................

3. ........................................................................................................

4. ........................................................................................................

31. What pests where they used against?

1. ........................................................................................................

2. ........................................................................................................

3. ........................................................................................................

4. ........................................................................................................
Basic Recognition and Monitoring Equipment

32. How did you tell the biocontrol agent apart from the pest?

1. ..........................................................................................................................

2. ..........................................................................................................................

3. ..........................................................................................................................

4. ..........................................................................................................................

Monitoring equipment

Look at pages 4–3, 4–4 and 4–9 and answer the following questions.

33. Look at the equipment provided. Use it to magnify a pest or disease from the specimens provided. What can you see now?

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34. Look at the sticky trap provided. Explain how it is used in the crop.

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..........................................................................................................................
National competencies addressed in this training course are from the National Training Package in Horticulture:

- RUHHRT317A Control pests and diseases (all elements)
- RUHHRT352A Implement an integrated pest management program (all elements)
- RUHHRT353A Select chemicals and biological agents (element /01, Select appropriate chemical)
- RUHHRT202A Treat pests and diseases (all elements).

Learners who successfully complete the on-farm assessment exercise will receive a Certificate of Attainment for the National Competencies listed above.

**Course structure**

**Topic 1. Introduction to IPM is dealt with in Stage 1 at the beginning of this Course Workbook.**

**Topic 2. Implement an IPM program:**

- Section 1: Preparing for IPM
- Section 2: Pest and disease recognition and biocontrol recognition and use
- Section 3: Monitoring and decision-making

**Section 1: Preparing for IPM**

Subject areas:

- Staff considerations
- Site considerations
- Physical considerations
- Cultural considerations
- Chemical considerations
- Preparing to implement IPM
Reference material in the Information Guide

- Section 3: Preparing for IPM: Property and Staff
- Section 9: Directory
- Handy Guide 4: Registered Chemicals for Common Pests
- Handy Guide 5: Registered Chemicals for Common Diseases
- Handy Guide 6: Chemical Toxicity to Biocontrol Agents

Purpose

In this section you will learn about the steps that can be taken to minimise the risk of pests and diseases in your crops by preparing your property.

Activities

Drawing up a list of improvements to your work site in preparation for the introduction of IPM

Tasks

Note that all suggested reading associated with page numbers in this Workbook refers to the Information Guide by Section and then page number, for your industry.

Staff considerations

As a person with responsibility for implementing an IPM program, you must be properly prepared for, and be committed to, IPM.

Staff need to:
- understand crop hygiene
- identify, monitor and record pests and diseases.

22. Here is a checklist for staff management:
- Is there a training program in IPM for staff in your workplace? Yes/No/Undecided
- Are you committed to implementing IPM? Yes/No/Undecided
- Do you have appropriate reference material available? Yes/No/Undecided
- Do you know and have you documented your responsibilities in your IPM program? Yes/No/Undecided
- Are appropriate staff hygiene measures in place? Yes/No/Undecided
Site considerations

A poorly managed and badly structured site can attract pests and diseases and hinder any attempts to control them. Part of IPM is the preparation of the production sites so that they prevent pests from occurring.

23. Prepare a mud map of your site on the page provided. Include each of the following
   a. orientation (N/S/E/W)
   b. climate and micro-climate (winds/shelter/aspect)
   c. growing areas
   d. buildings
   e. roads
   f. public access areas
   g. rubbish tips
   h. soil, pot and media storage areas
   i. propagation and production areas.

24. See the site considerations listed on pages 3–4 and 3–5. Do any of these problems relate to your site? If so, list them.

25. Write a list of possible site improvements you could make on your property.

Physical considerations

Greenhouses are important to propagation and production of crops. Growers who have greenhouses need to take special steps to ensure that the environmental conditions in their greenhouses do not favour pests and diseases, but do favour beneficials and healthy crop growth.

Refer to pages 3–6 to 3–10 (Ornamentals), or 3–5 to 3–9 (Greenhouse Vegetables), and then complete the following tasks. You might like to discuss your responses with others in your group.

26. Heat. How do you manage high or low temperatures?
27. Relative humidity. How do you prevent condensation?


28. Water. What type of water management do you use?


Now refer to pages 3-10 to 3-17 and continue with the following tasks:

29. Do you use screening?

Yes ...................................................... No ..................................................

If not, why not? ..................................................

If yes, what do you use and how effective is it? ..................................................

30. What are the benefits of ventilation in greenhouses and how do you ventilate your greenhouse?


31. Ignoring costs, are there any site or structural modifications that you would like to make to your greenhouse? List them.


32. Look at these examples of insect screening.

**TO SCREEN OR NOT TO SCREEN?**

Cultural considerations

Now refer to the paragraphs on nutrient and irrigation management on page 3-18 (Ornamentals), or 3-17 (Greenhouse Vegetables), and continue with the following tasks.

33. What are some of the problems associated with excess nutrients?

34. What sort of irrigation system do you use, and why? How do you prevent waterlogging or plants drying out?

35. What sort of pests and diseases are associated with waterlogging and poor drainage?
Refer to Sanitation Management pages 3–18 to 3–20 (Ornamentals), or 3–17 to 3–19 (Greenhouse Vegetables).

36. Make a list of three things that you do and three things that are new to you.

**Things I do**


**New ideas**


37. The following task relates to the weeds box below. Tick the statements that you think are true.

### WEEDS AND YOUR PLACE

**WEEDS ARE GOOD FOR:**

a) Checking for pests
b) Harbouring TSWV
c) Making the place look neglected
d) Showing you can grow something well
e) Nothing
f) All of the above
Examples of poor weed management

**WEED NO-NO's!**

Top left: Crop trash left in greenhouse. Top right: Dumping old crop near your greenhouse is asking for reinvasion by pests and diseases. Bottom left: Weeds and house plants in a greenhouse make a good refuge for pests and diseases. Bottom right: Open greenhouses with broad-leaved weeds growing right up to the edge.

Do you have any of these situations on your property?

**Chemical considerations**

Chemical use will remain an important tool in an IPM program. Effective results will be determined by which ones you choose and the way they are used.

On pages 3–20 to 3–23 (Ornamentals), or 3–19 to 3–22 (Greenhouse Vegetables), you will find details of what you need to consider before you use chemicals. You’ll also find some of the problems you can have with using chemicals.

38. What happens when you over-use chemicals?

Now refer to pages 3–28 and 3–29 (Ornamentals), or page 3–27 (Greenhouse Vegetables), for some recommendations about using pesticides.

Check Handy Guides 4 and 5 for details of chemicals registered for pests and diseases in your crops. Note the different activity groups for insecticides and fungicides.

**What is an activity group?**

Start the Infopest® CD ROM. Click on the information tab at the top of the opening page. Click on the line Pesticide resistance group information from AvCare® and have a look at the details on activity groups and resistance management strategies.
Now continue with the following tasks.

39. Select two insecticides/miticides and write down the chemical group and activity group for each.

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

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

40. Select two fungicides and write down the chemical group and activity group for each.

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

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

41. What is a common pest or disease on your property?

With reference to your answer to Task 39, see page 3-21 (Ornamentals), or 3-20 (Greenhouse Vegetables), and the paragraph Rotate between pesticide chemical groups to delay resistance, and check Handy Guides 4 and 5. Note the different activity groups that are effective against the pest you nominated, and then write a Resistance Management Plan using chemicals from different activity groups.

42. Make a list of things to consider before you use chemicals on your crop and in your greenhouse.

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

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

43. What are two major problems you might face in using chemicals at your site?

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

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

44. On what basis do you decide which chemicals to use in your crops?

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

.................................................................
45. What can you do if there isn't an effective chemical registered in your crop for the pest you wish to spray? See Permits on page 3-29.

Now refer to What you need to know about sprayers and spraying on pages 3–23 to 3–28 (Ornamentals), or 3–23 to 3–26 (Greenhouse Vegetables).

46. What equipment do you use for applying pesticides?

47. List the advantages and the disadvantages you have found in using this equipment.

48. When did you last check nozzle output or change your nozzles?

49. How could you improve the way you apply chemicals?

50. Have you completed a Chemical Users' Course (SMARTtrain, ChemCert, Chemsmart, Farm Care or Farm Chemical Users Course)?

Yes........................................ No ..................................
Implementation of IPM

For more information see pages 3–30 and 3–31 (Ornamentals), or 3–28 and 3–29 (Greenhouse Vegetables), and 9–22 and 9–23.

Preparing to implement IPM

Refer to Maximising the success of IPM on pages 3–31 and 3–32 (Ornamentals), or page 3–30 (Greenhouse Vegetables).

51. Prepare a list of practices you would like to introduce to your workplace.

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Now refer back to the points listed on pages 3–31 and 3–32 (Ornamentals), or page 3–30 (Greenhouse Vegetables). Did you miss anything? Why? Discuss with your trainer.
Section 2: Pest and disease recognition and biocontrol recognition and use

Subject areas:
- Pest recognition
- Biocontrol recognition and use
- Use of chemicals with biocontrol agents
- Disease recognition

Reference material in the Information Guide

- Section 5: Know Your Pests
- Section 6: Know Your Diseases
- Section 7: Know Your Biocontrol Agents
- Section 9: Directory
- Section 11: Glossary
- Handy Guide 4: Registered Chemicals for Common Pests
- Handy Guide 5: Registered Chemicals for Common Diseases
- Handy Guide 6: Chemical Toxicity to Biocontrol Agents
- Plus Pests, Diseases, Disorders and Beneficials: Field Identification Guide for your crop

Purpose

In this Section you will learn how to recognise pests and diseases in your crops and the symptoms of damage. You will also learn to recognise and use biocontrol agents and learn about their use with chemicals.

Activities

- Recognising pests, diseases and biocontrol agents
- Examining examples of key pests infesting crop and weed plants (obtained from suppliers for the course and brought in from farms by participants)
- Examining diseased plant material
- Examining samples of commercially produced biocontrol agents (obtained from producers)
- Examining any naturally occurring predators and parasitoids that are available
Implementation of IPM

Tasks

**Pest recognition**

52. Look at the directory of pests on pages 5–2 and 5–3 (Ornamentals), or page 5–2 (Greenhouse Vegetables).

   Have a look at the specimens provided. Can you recognise them?

   a. .................................... b. .............................. c. ..............................

   d. .............................. e. ..............................

53. Which of the specimens provided have you seen in your crops? Tick above.

54. Choose three of the most common pests you have seen in your crop(s).

For Pest 1:

Describe the pest and state the plants where you found it.

Describe its life cycle. (See Section 5 and go to the appropriate pest group for an example of a life cycle.)
What sort of damage did you see?

What did you do to prevent it from occurring or to reduce its presence?

Refer to the notes related to this pest in Section 5 of the Information Guide.

Would you do something different now?

For Pest 2:
Describe the pest and state the plants where you found it.
Describe its life cycle. (See Section 5 and go to the appropriate pest group for an example of a life cycle.)

What sort of damage did you see?

What did you do to prevent it from occurring or to reduce its presence?

See the notes related to this pest in Section 5 of the Information Guide.

Would you do something different now?
Implementation of IPM

For Pest 3:
Describe the pest and state the plants where you found it.

Describe its life cycle (see Section 5 and go to the appropriate pest group for an example of a life cycle).

What sort of damage did you see?

What did you do to prevent it from occurring or to reduce its presence?
Implementation of IPM

See the notes related to this pest in Section 5 in the Information Guide.

Would you do something different now?

55. Look at the directory of Pest and Disease Diagnostic Services on pages 9-9 to 9-13 (Ornamentals), or 9-8 to 9-12 (Greenhouse Vegetables).

Which pest diagnostic service is nearest to you? Have you used its services?

Biocontrol recognition and use

For Tasks 56 to 60 have a look at pages 7-3 to 7-7, Know your Biocontrol Agents.

Find Handy Guide 6 with the chemical toxicity table.

56. Have a look at the specimens provided. Can you recognise them?

a) .................................................................

b) .................................................................

c) .................................................................

d) .................................................................

e) .................................................................
57. Name these biocontrol agents (BCAs). The target pest for each is in brackets.

WHICH BIOCONTROL AGENT IS THIS?

a. .................................................. (spider mite)
b. .................................................. (aphids)
c. .................................................. (fungus gnats)
d. .................................................. (whitefly)
e. .................................................. (thrips)
f. .................................................. (aphids)

58. Which biocontrol agents, if any, have you used in your crops?

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

What pests where they used against? Name the pests and their biocontrol agents.

..................................................
..................................................
..................................................
59. When would you choose to use a biocontrol agent?


60. When would you choose not to use a biocontrol agent?

BIOCONTROL IS NOT POSSIBLE IN WHICH OF THESE CROPS?
Cucumber
Tomato
Pot plant, cut flowers

61. From the directory of commercially available biocontrol agents on page 7–2, and the notes on pages 7–8 to 7–23 (Ornamentals), or 7–8 to 7–20 (Greenhouse Vegetables), choose one agent you could use and answer the following:

- Name the biocontrol agent: .................................................................
- Name the key pest you would use it against: ...........................................
- Name a supplier: ..........................................................................
- Describe how you would use it: .........................................................


Use of chemicals with biocontrol agents

**WHICH CHEMICALS ARE SAFE TO USE?**

- Lannate
- Maldison
- Eco-oil
- Natrasoap
- Pirimor
- Vertimec
- Success
- Benlate
- Sulfur
- Bravo

62. With reference to the biocontrol agent you selected for Task 61, consult Handy Guide 6: Chemical toxicity to biocontrol agents. List three chemicals you could use with your selected biocontrol agent in an IPM program.

63. Look at the directory of diseases in Know your Diseases on page 6-2.

   Have a look at the specimens provided. Can you recognise them?
   
   a. .................................................................
   
   b. .................................................................
   
   c. .................................................................

   d. .................................................................
   
   e. .................................................................

   Which of the specimens provided have you seen in your crops? Tick above.

64. Choose three of the most damaging diseases (in terms of $ loss) you have experienced in your crops.

   1. .................................................................
   
   2. .................................................................
   
   3. .................................................................
Is it a fungus, bacterium, virus or nematode?

1. 

2. 

3. 

Describe the symptoms you've seen.

1. 

2. 

3. 

How do you think it originally got on to the property?

1. 

2. 

3. 

How do you think it spread through the crop?

1. 

2. 

3. 


Implementation of IPM

How did you (or others) control it or prevent a reoccurrence?

1. ........................................................................................................................................

2. ........................................................................................................................................

3. ........................................................................................................................................

See the notes related to these diseases in Section 6 of the Information Guide.

Would you do something different now?

1. ........................................................................................................................................

2. ........................................................................................................................................

3. ........................................................................................................................................

65. Have a look at the directory of Pest and Disease Diagnostic Services on pages 9–8 to 9–12.

Which disease diagnostic service is nearest to you? Have you used it and if not, why not?

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

Practise your skills in the Pest Sense Card Game.
Section 3: Monitoring and decision-making

Subject areas:
- Monitoring equipment
- Monitoring
- Sticky traps
- Record keeping
- Monitoring plan
- Case study exercise
- Action thresholds
- Indicator plants (ornamentals only)
- Final preparation for IPM
- On-farm course assignment

Reference material in the Information Guide
- Section 4: Designing an IPM Program: monitoring and decision-making
- Section 9: Directory
- Section 11: Glossary
- Handy Guide 1: IPM Checklist
- Handy Guide 2: Crop Management
- Handy Guide 3: Sample Monitoring Record Sheets

Purpose
In this Section you will learn how to monitor pests and diseases in your crops and the symptoms of damage. You also learn about the need for thresholds and how to use them in decision-making.

Activities
- Monitoring pests and diseases in crops
- Discussing crop inspection techniques
- Keeping monitoring records
- Using and modifying sample record sheets in Handy Guide 3, and going through a monitoring case study to interpret the information provided.
- Interpreting the information provided in a monitoring case study
66. Look at the equipment provided or listed on pages 4–3 and 4–4 and decide what you need to purchase for an IPM program on your property.

Monitoring equipment – what do you have now?

What would you like to have ($ no barrier!!)

See Suppliers of monitoring tools on pages 9–6 and 9–7. Where could you purchase the monitoring equipment you would like to have?

67. Use each of the magnification aids to view one of the pest or disease specimens provided.

What do you notice?

Discuss your diagnosis with the presenter.
Monitoring

Refer to pages 4–2 to 4–8.

68. What does monitoring achieve?

69. Page 4–2 suggests reasons for monitoring. Select the five that are most important.

70. See page 4–3 (Ornamentals), or pages 4–2 and 4–3 (Greenhouse Vegetables), and the sections Who does the monitoring? and What level of service do you want? What approach would be suitable for your farm?

71. Now see pages 4–5 to 4–7. What is a scout, and what is a scout’s responsibility? Look at Handy Guide 3: Record Sheet: Crop Inspection Data, Pest & Disease Control Treatments and Pest & Disease Summary Reports.
Sticky traps

See pages 4–9 to 4–12 (Ornamentals), or 4–7 to 4–11 (Greenhouse Vegetables), and look at Handy Guide 3: Record Sheet: Sticky Trap Data.

**STICKY TRAP PLACEMENT WHICH IS CORRECT?**

- Top left: hung well above the crop
- Bottom left: positioned just above crop height
- Top right: lying in the pathway
- Bottom right: blue and yellow traps with a numbered station positioned just above crop height

72. Prepare a set of simple steps for installing, monitoring and recording sticky traps in a greenhouse. This should identify:

- where to place the traps (Hint, you may like to draw a map)
- when to place them
- the number of traps to use
- how to display the sticky trap counts.

...................................................................................................................
...................................................................................................................
...................................................................................................................
...................................................................................................................
...................................................................................................................
73. Practising with sticky traps

Count and record the numbers of pests on the sticky trap provided. Test your skill by comparing with the actual number previously counted. If you are having difficulty, get another trap and repeat the exercise. Talk to your presenter about any problems, especially if the insects are hard to identify.

74. Pick up the sticky trap you brought in after having it hang in your crop for a week. Count and record the numbers of insect pests.

75. Inspect the Pest Sticky Trap Poster. Ask the presenter to clarify the diagnostic characters of insect pests on the poster or the sticky traps, as you require.

Which insect pests are on these sticky traps?

a. .................................................................

b. .................................................................

c. .................................................................

d. .................................................................
76. Consider any difficulties you may have with using sticky traps.

Record keeping

77. What points should you keep a weekly note of on your property?

Have a look at pages 4–14 and 4–15 (Ornamentals) or page 4–13 (Greenhouse Vegetables), for some tips.

Monitoring plan

78. Prepare a simple monitoring plan that includes:

- how you will measure the number and type of pests
- who will do this on a regular basis
- what crops you want to monitor
- when you will monitor (daily, weekly, monthly, morning, afternoon or evening).

You might find it helpful to consult pages 4–5 to 4–7.

Case study exercise

79. Case study exercise

The following tables are monitoring summary sheets for two crops, one chrysanthemum, the other a hydroponically grown cucumber crop. A graph of each table has been prepared.
Select the crop type appropriate to you and complete the tasks.

**Cucumber crop data**

**Table of sticky trap counts: cucumber**

<table>
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<tr>
<th>Date Collected</th>
<th>Fungus gnat</th>
<th>Thrips</th>
<th>Whitefly</th>
<th>Shore fly</th>
<th>Aphid</th>
</tr>
</thead>
<tbody>
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<td>0.09</td>
<td>0.00</td>
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<td>0.09</td>
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<td>0.36</td>
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</table>

**Graph of sticky trap counts: cucumber**

![Graph of sticky trap counts: cucumber](image-url)
## Table of crop inspection data: cucumber

<table>
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<tr>
<th>Date inspected</th>
<th>Total number of plants inspected</th>
<th>Percent (%) of plants infested with pest</th>
<th>Two-spotted mite</th>
<th>Greenhouse whitefly (adult)</th>
<th>Greenhouse whitefly (immature)</th>
<th>Thrips</th>
<th>Aphid</th>
<th>No. of weeks crop in ground</th>
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## Graph of crop inspection percentages: cucumber

![Crop Inspection Graph](image)

**Crop Inspection Graph**
- Soldier Mite
- Greenhouse whitefly (adult)
- Greenhouse whitefly (immature)
- Thrips
- Aphid

**Average number per trip per 7 days**
- 0.0
- 20.0
- 40.0
- 60.0
- 80.0
- 100.0
- 120.0

**Data**
- 1/1/1990
- 2/1/1990
- 3/1/1990
- 4/1/1990
- 5/1/1990
- 6/1/1990
- 7/1/1990
- 8/1/1990
- 9/1/1990
- 10/1/1990
- 11/1/1990
- 12/1/1990
- 1/1/1991
- 2/1/1991
- 3/1/1991
- 4/1/1991
- 5/1/1991
- 6/1/1991
- 7/1/1991
- 8/1/1991
- 9/1/1991
- 10/1/1991
- 11/1/1991
- 12/1/1991

IPM ONfarm – Protected Cropping: Course Workbook
### Implementation of IPM

**Ornamental crop data**

#### Table of sticky trap counts: ornamentals

<table>
<thead>
<tr>
<th>Date Collected</th>
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<th>Aphids</th>
<th>Fungus Gnat</th>
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#### Graph of sticky trap counts: ornamentals

![Sticky Trap Graph](image)
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**Graph showing percentage of plants infested: ornamentals**

![Crop Inspection Graph](image)
On the basis of these data, what action if any, would you take?

What factors influenced your decision?

**Action thresholds**

Refer to pages 4–12 to 4–14 (Ornamentals), or 4–11 and 4–12 (Greenhouse Vegetables).

80. Describe the difference between an action threshold and an economic damage threshold.

81. What is an example of an action threshold for a given pest in your crop?
82. Refer to your response to Task 81. What actions are available to you and which would you implement at this stage?

83. Refer to your response to Task 81. What could you have done to prevent the pest from reaching this stage?

**Indicator plants (ornamentals only)**

Indicator plants could play an important role in your IPM plan. See page 4-14 (for ornamentals only).

84. Select a key pest for your crop(s) from the list provided and a plant that might be used to provide an early indication of its presence.

Where would you locate the indicator plants? (Hint, you may like to use your map.)

**Final preparation for IPM**

85. Do you feel you are properly prepared to implement an IPM program? If not, what extra information or training do you need?
On-farm course assignment

86. This exercise is designed to allow you to demonstrate your competency in implementing IPM and will be used to assess you for your Certificate of Attainment in the National Competencies in Horticulture, as outlined in this Course Workbook.

Task: Develop and implement an IPM program for your property

Time allowed to complete the exercise: Two months in winter, or one month at any other time of the year.

You may discuss this exercise with your group and the course presenter.

Here is what you need to do:

• Develop a physical plan of the property with buildings and any other features.
• Identify key pests and diseases in your crops.
• List steps that you could take on your property to minimise the risk of pests and diseases occurring in your crops.
• Compile a list of biocontrol agents available for the pests and diseases you have identified.
• Having in mind your biocontrol agents, compile a list of chemicals registered for use in your crops that would be suitable for your enterprise.
• Develop a management strategy for the pests and diseases that you might anticipate in your crops during this time; use biocontrol agents where possible.
• Prepare a monitoring plan. Follow the guidelines in this course.
• Monitor the crops and count sticky traps weekly, or fortnightly in winter.
• Keep a record of the monitoring data and graph your summary data either on an EXCEL spreadsheet, if you have a computer with Microsoft EXCEL, or by hand on graph paper.
• When you have completed this assignment, notify your course supervisor and arrange for an on-site appointment. Hand your completed assignment to the course supervisor and discuss the details.
Developing an IPM PROGRAM

• National competencies addressed in this training course are from the National Training Package in Horticulture:
  • RUHHRT412A Develop an integrated pest management program (all elements)
  • RUHHRT431A/01 Promote plant health (point 6 in element/01, Monitor factors that influence plant health; element/02, Diagnose plant health problems; points 1 & 3 in element 03, Remedy plant health problems; element 04/ Evaluate treatment programs)

Learners who successfully complete the on-farm assessment exercise will receive a Certificate of Attainment for the National Competencies listed above.

Course structure

• Designing an IPM Program
• Crop notes
• Access to information and advice
• On-farm course assignment

Reference material in the Information Guide

• Section 3 Preparing for IPM: property and staff
• Section 4 Designing an IPM Program: monitoring and decision making
• Sections 8 Crop Notes
• Sections 9 Directory
• Sections 10 Further Reading
• Section 11 Glossary
• Handy Guide 1 IPM Checklist
• Handy Guide 2 Crop Management
Implementation of IPM

Purpose

You learn:

- how to identify the most appropriate approach to IPM for your enterprise
- to identify your staff training needs and where to obtain training in IPM for them
- to make an objective evaluation of the advantages of IPM to your enterprise
- how to use the IPM checklist (Handy Guide 1) before, during and after designing an IPM program
- how to use the Crop Management Guide, Handy Guide 2.
- how to apply your IPM knowledge into real practice on a property
- how you can contribute your knowledge towards an industry database of pests and diseases
- where to find more information on IPM and related issues.

Activities

- a visit to a production enterprise, critically evaluating the farm operation with regards to pest and disease management and making recommendations about improvements to pest and disease management
- evaluating your present pest and disease management program
- developing an IPM program for your own property

Tasks

Note that all suggested reading associated with page numbers in this Workbook refers to the Information Guide by Section and then page number, for your industry.

Designing an IPM program

See Section 4 Designing an IPM Program in the Information Guide. Refer to pages 4–15 to 4–18 (Ornamentals), 4–13 to 4–16 (Greenhouse Vegetables) Putting it all together.

87. Discuss the relevance of the three-phase approach to your enterprise. Tick off any of the elements in Phases I–III that you feel you have already put in place. Remember that there are no time-lines on adopting any particular phase.

89. How and to whom would you delegate responsibility for ensuring that the property was IPM-ready?

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90. Refer to Handy Guide 2 Crop Management for Ornamentals. You might find it useful to refer to this Guide through each crop cycle. Are there any other points you can add? Discuss this Section.

**Crop notes**

For tasks 89–90 see Section 8 Crop notes.

91. Test your familiarity with pests and diseases that occur on your own property by listing them and noting when you would be on the lookout for them. Name the crops affected.

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92. Describe your management program for dealing with the pests and diseases above.

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Access to information and advice

For tasks 93–95 have a look at Section 9 Directory and Section 10 Further Reading.

93. If a computer with Internet access is available, access one or more of the IPM websites and comment on their relevance to your operation.

94. Where do you currently access information on pest and disease management issues? List your sources and discuss them with the group. Have you come across any other businesses or reading material that you would like to add to the list?

95. Have you ever contacted a consultant, and did you feel that this was helpful? Discuss where you feel you particularly need outside help, and whether the Directory is appropriate to your needs.

On-farm course assignment

96. Task: Prepare an outline for an IPM program for your workplace

Time allowed to complete the exercise: One month.

Submit documentary evidence for completion of attainment.

Use information in Section 3 Preparing for IPM and Section 4 Designing an IPM Program to outline your present pest and disease management practices.

Assign an estimate of annual costs to this program: separate the costs for time, labour and materials.

Prepare an outline of a new IPM program for your operation, using the phased approach. See page 4–15 to 4–18 (Ornamentals), 4–13 to 4–16 (Greenhouse Vegetables) and use Handy Guide 1 as a reference.

Indicate:

- site considerations
- crop(s)
- known key pests and diseases
- staff involvement and training needs
- equipment required
- external assistance and level of service needed
- recording methods
- monitoring schedules
- timetable for commencement and target dates for key steps
Implementation of IPM

- likely costs of the new program (time, labour, materials) and any other pieces of information you feel would be necessary at your workplace or are unique to your workplace.

- your course supervisor and arrange for an on-site appointment. Hand your completed assignment to the course supervisor and discuss the details.
Integrated Pest Management

IPM ONfarm
Competency-based training for industry

PROTECTED CROPPING

Trainers’ Guide

NSW Agriculture

NATIONAL CENTRE FOR GREENHOUSE HORTICULTURE
IPM ONfarm – Protected Cropping
Competency Training in Integrated Pest Management for the Ornamental and Greenhouse Industries

Trainer’s Guide
Stages 1, 2, 3 and 4

Produced by NSW Agriculture in conjunction with Horticulture Australia
IPM ONfarm – Protected Cropping:
Trainer’s Guide

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NSW Agriculture 2002

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Disclaimer

The information contained in this publication is based on knowledge and understanding at the time of writing (1 September 2002). However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up to date and to check currency of the information with the appropriate officer of New South Wales Department of Agriculture or the user’s independent adviser.

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Paterson NSW 2421
Phone: 1800 025 520

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Stage 4. Developing an IPM Program

Designing an IPM program
Crop notes
Access to information and advice
On-farm course assessment
Introduction

Welcome to the Trainers’ Guide for the four courses in IPM ONfarm, which is all about integrated pest management (IPM) for greenhouse producers and people working in the greenhouse and ornamentals industries.

In addition to this Trainers’ Guide, check that you have the following essential printed materials:

- Integrated Pest Management Information Guide, which contains the six Handy Guides and the Pest Sticky Trap Poster
- Pests, Diseases, Disorders and Beneficials: Field Identification Guide
- A course workbook for each participant. You will notice that in this Trainers’ Guide, the trainer’s instructions are given on the left-hand page and the corresponding section in the workbook is on the right-hand page.

The four courses are referred to as Stages.

Stage 1. Introduction to IPM is a half-day course that provides a basic overview of IPM. It can be a stand alone course and it also serves as the first topic for the later Stages. In other words, all participants start with this Stage.

Stage 2. Basic recognition and monitoring equipment is a two-day course for unskilled workers who probably work under supervision. It addresses National Horticulture competencies at AQF (Australian Qualifications Framework) Level 2 (Certificate 2).

Stage 3. Implementation of IPM is a four-day course for skilled workers who mainly have some qualifications and work with little supervision. It addresses National Horticulture competencies at AQF Level 3 (Certificate 3).

Stage 4. Developing an IPM program is a one-day course for managers. Completion of Stage 3 is a pre-requisite for this Stage. This course addresses National Horticulture competencies at AQF Level 4 (Certificate 4).

The Course Workbook contains the four Stages. Stages 2 to 4 are designed to ensure that participants receive adequate training in the practical aspects of IPM.

Assessment

If they wish, participants may gain nationally recognised qualifications by successfully completing the assessment tasks for Stage 2, 3 or 4. Details of the required assessment tasks are provided in the relevant sections of the Course Workbook.
Advice for trainers delivering the course

Recommended delivery schedule

The following proposed schedule ensures that course participants receive sufficient practice at the tasks to provide them with adequate skills.

Stage 1

No special instructions necessary.

Stage 2

Day 1

Topic 1. Introduction to IPM – half day
Topic 2. Undertake all tasks on remainder of day 1

Day 2

Repeat Topic 2

Stage 3

Day 1

Topic 1. Introduction to IPM – half day
Topic 2. Section 1. Preparing for IPM (Tasks 22 to 51)
Topic 2. Section 2. Undertake tasks in pest and biocontrol recognition; biocontrol agents and chemical use; biocontrol agent use in crops (52 to 62).

End with questions and answers (Q&A) on the day’s topics. Hand out a fresh sticky trap to each participant. Get them to hang them in their own crops and bring them in the following week.

Day 2

Repeat pest and biocontrol recognition tasks from Day 1 (52 to 62).
Topic 2. Section 2. Undertake tasks in disease recognition (63 to 65); monitoring equipment (66 to 67); monitoring practices (68 to 71); using sticky traps (72 to 76).

End with Q&A on the day’s topics. Hand out a fresh sticky trap to each participant. Get them to set them up in their own crops and bring them in the following week.

Day 3

Repeat disease recognition tasks; monitoring practices (68 to 71); using sticky traps (72 to 76).
Topic 2. Section 3. Undertake tasks on record keeping (77); developing a monitoring plan (78 to 79); action thresholds (80 to 83); indicator plants (ornamental crops only, 84 to 85); monitoring exercise (86); property visit to demonstrate all facets of preparing and implementing an IPM program (preparing, monitoring, sticky traps, record keeping, decision-making, actions).

End with Q&A on the day's topics. Hand out a fresh sticky trap to each participant. Get them to set them up in their own crops and bring them in the following week.

Day 4

Repeat sticky trap tasks.
Repeat any aspects of pest, disease and biocontrol agent recognition and biocontrol agent use as required.
Hold group discussion on how IPM principles apply to the participants' crops.
Prepare for on-farm external assignment in IPM.

Stage 4

No special instructions necessary.

Managing the group

The course offers activities in different-sized groups and as take-home activities.

Small group activities

This symbol indicates small group activities. Participants can work in groups of 2 to 5 to discuss or list issues of interest. This helps those who are returning to study, or who are shy about joining larger discussions with more experienced growers. It is often useful to use pre-printed overhead transparencies to guide the groups in their discussions.

Whole group activities

This symbol indicates whole group activities, which involve everyone in discussions. Where you can, record the key issues that come out of the discussions on a whiteboard, butchers' paper or overhead transparency.

Take-home activities

Take-home activities are valuable because a great deal of participants' learning will come from applying IPM techniques in their own workplaces. Participants are involved in valuable enterprises, and they need to be able to relate all that they learn to their own properties.

External assignments for Stages 3 and 4

The external assignments are to be completed at the end of the course and when participants are back in the workplace. They are used for assessment.
Course resource information

The Integrated Pest Management Information Guide is the resource document for these courses, and participants should be aware not only of its structure and content, but also of its practical value after the conclusion of the course for producing a better crop through the successful implementation of IPM. We usually refer to this document as the Information Guide.

The page numbers referred to in the Course Workbook refer to the Information Guide. For example, a reference to page 1-2 refers to SECTION 1 page 2 in the Information Guide. The companion Field Identification Guide should be referred to throughout the course as a useful tool for pest and disease recognition.

Before the course starts, let the participants know that they must each have a set of the following companion publications appropriate to their crop:

- Integrated Pest Management Information Guide
- Pests, Diseases, Disorders and Beneficials: Field Identification Guide.

You will need to let the participants know where they can obtain these materials and how much they will cost. Both publications can be obtained from the NSW Agriculture Bookshop. There is a wholesale rate for a bulk order of 10 or more copies. The bookshop can be contacted on phone 1800 028 374; fax 1800 642 065; email bookshop@agric.nsw.gov.au.

When you start the course, take a moment to go through these documents with the participants so that they become familiar with them. The note ‘How to use this Information Guide’ on page (ii) of the Information Guide may help with this process.
Stage 1. Introduction to IPM

This Stage does not involve any formal assessment and is a half-day introductory session.

Small or large groups?

Trainers may find that some participants undertaking this Stage have no prior experience, whereas others are more experienced with the ideas of IPM. We suggest that you use small groups in a step-by-step approach for the inexperienced. A large group or consensus discussion is likely to be suitable for a more experienced group. If a group has members with mixed experience, a small group approach will enable those with more experience to assist the beginners.

Resources

Trainers need to provide:

- a computer with a pesticide database such as *InfoPest* (available from Infopest, Animal and Plant Health Service, Department of Primary Industries, GPO Box 46, Brisbane QLD 4001; phone (07) 3239 3967; fax (07) 3211 3239; email infopest@dpi.qld.gov.au/infopest) to demonstrate how participants can obtain information on appropriate chemical registrations for their crops. This is for Tasks 14 and 15 in *Chemical availability*.

- seven specimens or slides of some common pests and diseases of crops familiar to the participants.
Introduction to IPM

This course does not address any national competencies in the National Training Package in Horticulture: it provides an understanding of the aims and practices of IPM and it is also the introduction to Stages 2 and 3 of the IPM ONfarm training program.

Course structure

- What is IPM?
- The seven sectors of plant health
- Pests and diseases
- Benefits of IPM
- Potential barriers to adoption of IPM
- Chemical availability
- Pest and disease resistance
- Commitment to IPM
- Common questions about IPM

Reference material in the Information Guide

- Section 1: What is IPM?
- Section 2: Common Questions
- Section 9: Directory
- Section 11: Glossary
- Handy Guide 4: Registered Chemicals for Common Pests
- Handy Guide 5: Registered Chemicals for Common Diseases

Purpose

You learn about IPM, including the benefits and possible problems with IPM and its role in plant health.
Tasks

What is IPM?

Give participants a few minutes to look at Tasks 1 to 3 and write down their answers before moving into small groups to compare notes. Then allow the small groups to discuss Task 4. List definitions of IPM on whiteboard or butchers’ paper, or you can use overhead transparencies.

Discuss the importance of aspects of IPM, such as:

- the fact that all pests and diseases are now referred to as ‘pests’.
  (See definition on page 1-3.)
- correct identification of pests and diseases
- monitoring techniques
- record keeping
- crop hygiene
- appropriate management strategies
- minimal use of chemicals.

Hold a whole-group discussion on IPM strategies, including those that involve consultants and trained staff. Discuss how IPM strategies can vary to accommodate the size of the enterprise.
Introduction to IPM

Activities

• Discussing the principles of IPM and some IPM strategies
• Identifying pests and diseases from your own experiences
• Outlining factors that affect plant health
• Listing the benefits of IPM
• Explaining the limitations to the use of registered chemicals and possible chemical resistance in pests
• Outlining how a computer database of registered chemicals is used to obtain information on pest and disease control products and information about chemical resistance in pests
• Discussing some of the potential barriers to the adoption of IPM.

Tasks

Note: All suggested reading associated with page numbers in this Workbook refers to the Information Guide by Section and then page number, for your industry.

What is IPM?

1. What is integrated pest management (IPM)?
   If you think you know what IPM is, write it down.

DEFINITION OF IPM

a) It's one o'clock in the afternoon
b) I Pray More
c) A system of pest management that plans ahead, considers all options, and aims to minimise the use of toxic pesticides
Before directing the participants to look at the appropriate section in the *Information Guide*, allow time to complete Task 5.

Discuss the responses with the whole group. List them on whiteboard or butchers’ paper and choose those that the participants feel are the most important. Then refer participants to The Seven Sectors of Plant Health on pages 1-2 and 1-3 of ‘What is IPM’ in the *Information Guide*. Participants should compare their ranked lists with this information. Make adjustments to the ranking by popular consent.

Introduce the idea of *genetics* as a factor that can influence plant health. Point out that this is an internal factor, whereas others are external to the plant.

Provide a final list of factors on butchers’ paper or whiteboard. Ask participants to make a note of the final prioritised list. Indicate that these factors can be interactive, and give some examples.
2. Read the brief description of IPM on page 1–2 and compare it with yours.

3. What is an IPM program? Tick one in the list below that you think best fits the definition on page 1–2.

AN IPM PROGRAM:

a) Uses non-toxic chemicals only
b) Uses only biological control agents
c) Seeks to integrate all compatible options

4. List the elements of an IPM program that you feel you are already practising in your crop(s).

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The seven sectors of plant health

5. Plant health can be affected by a range of factors. Refer to Plant Health Management on pages 1–2 and 1–3 and familiarise yourself with all the sectors of plant health. Look at the list below and tick the factors that are harmful to your crops. Make a brief note about why the ones you have selected may be a problem. You could discuss your answer with your mentor or trainer.

a. environment .................................................................

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

b. soil/media condition .................................................................

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

This is an interactive session.

- Display the materials (pests, damaged plants, diseased plants) on tables and allow the participants to complete Task 6. Then, in small groups, they can compare notes and report back to the whole group. Encourage them to refer to the Pest Sticky Trap Poster, Field Identification Guide and other references.

- Complete Tasks 7 to 9.

- When you discuss the responses to Task 9, emphasise the importance of correct diagnosis. If the diagnosis is not correct, the grower can waste money on chemicals and see no benefit.
Introduction to IPM

c. weeds

d. pesticides

e. nutrition

f. pests

g. diseases

Pests and diseases

A pest can be defined as any organism that has the capacity or potential to cause economic harm by reducing quality or yield of crops or other products.

6. You have been provided with specimens of pests and diseases. Write down the names of those that you think you recognise.

a. 

b. 

c. 

d. 

e. 

f. 

g. 

7. Which pests and diseases have you seen infesting your crops?
Benefits of IPM

- Run through the list of benefits on pages 1-4 and 1-5 with the group. Allow participants time to fill in the workbook. Complete Tasks 10 and 11.

- Get participants to tell their stories: people learn best from stories. Have one ready that you can start with, for example:

  Two farmers in Tasmania had attended an IPM workshop. They had signed a promise to try spraying only when they had identified pests. They had previously sprayed every two weeks. The two told us about standing on the property and agonising over whether to spray or not – they hadn’t seen enough pests to be over the threshold. They spent hours discussing would they or wouldn’t they. They didn’t. Nothing bad happened. But they said they both got grey hairs!
8. Which are the major ones, and what type of damage does each cause?

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9. Describe the action you would take if you came across an unknown pest or disease.

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Benefits of IPM

Refer to pages 1–4 and 1–5 and read about the benefits of IPM.

10. List the benefits in what you see as being the order of importance. Put the most important benefit first in your list.

a. ...................................................................................................................

b. ...................................................................................................................

c. ...................................................................................................................

d. ...................................................................................................................

e. ...................................................................................................................

f. ...................................................................................................................

g. ...................................................................................................................

h. ...................................................................................................................
Potential barriers to adoption of IPM

- Complete Tasks 12 and 13.
- Hold a whole group discussion about the barriers and possible solutions to IPM, for example, what participants know, what they think, what they have observed, and what solutions they might choose.
11. Which benefits in Task 10 do you feel best able to achieve?

Potential barriers to adoption of IPM

Many growers are unsure about starting an IPM program for many reasons. Some of these include cost, uncertainty about the time commitment, uncertainty about using biocontrol agents – or they just don’t know much about it.

12. Read through the list of potential problems on pages 1–6 and 1–7. Would any of these be of concern to you, and why?

13. Do you have any concerns with using IPM? If so, what are they?
Chemical availability

- Refer to the Handy Guides on chemical registrations in the Information Guide. Refer to pesticide databases of registered chemicals on pages 9-22 and 9-23. Discuss State legislation differences and the role of the National Registration Authority (NRA). Demonstrate a chemical registration database such as InfoPest®.

- Allow participants time to complete Tasks 14 and 15. Discuss Task 15 with the whole group.

- Note that deregistration is an important issue, because if a chemical loses registration it is illegal to use it. Give examples of chemicals that are no longer allowed, and explain why these registrations have been withdrawn: usually the reasons are associated with occupational health and safety or potential damage to the environment. Ask participants to describe any experiences they may have had with WorkCover inspections.

- Ask participants to describe any discussions that they may have had with local councils or with the Environment Protection Authority (EPA) with regard to the use and disposal of chemicals.

- Ask participants to describe arrangements for collecting unused chemicals for disposal. Note that you need special qualifications to buy some chemicals, for example Endosulfan®.
Chemical availability

In the picture below is one way of looking at pest management.

IS THIS YOUR ONLY VISION OF PEST MANAGEMENT?

14. Where can you get information on registered chemicals for your crops? (See pages 9–22 and 9–23 and Handy Guides 4 and 5.)

15. What problems could there be in using chemicals in the future?
Pest and disease resistance

- Begin by giving a small example of pest resistance. Allow participants time to complete Tasks 16 to 18 in the workbook.

- Hold a small group exercise to discuss ideas and also draw on their experiences about factors that can contribute to poor chemical control, such as:
  - poor spray coverage
  - wrong equipment
  - wrong time of day to spray
  - wrong choice of chemical
  - poor mixing of chemicals
  - pest resistance.

- Each group records its ideas on butchers' paper or a whiteboard. The trainer then processes trends and reports to the whole group.

- Complete Task 19 and discuss with group. List some key aspects of resistance management on the whiteboard. Consult the InfoPest database, under Information, for these aspects.
Pest and disease resistance

Refer to Pest Resistance on page 1–5.

16. Have you ever come across problems with pest or disease resistance? If so, briefly describe the pest or disease and the chemical involved.

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__________________________________________________________________________

__________________________________________________________________________

17. Explain why you thought the problem was resistance and not some other factor.

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__________________________________________________________________________

18. List three other factors that might lead to poor control.

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__________________________________________________________________________

19. Are you aware of what resistance management is?

Yes................................. No.............................................

If you are aware of resistance management, describe some of the key aspects of it.

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__________________________________________________________________________
Commitment to IPM

- Get participants to refer to page 1-7, complete Task 20, then discuss the responses with the whole group.

Common questions about IPM

- Refer to Section 2. Complete Task 21, then with the whole group discuss reasons for asking questions and answers.
Commitment to IPM

Have a look at Challenges on page 1–7.

20. What do you think IPM has to offer you and your farm?

Common questions about IPM

See Section 2 Common Questions in the Information Guide.

21. What are two questions about IPM that you would like to ask? Can you find them in Section 2?
Stage 2. Basic recognition and monitoring equipment

Assessment

The assessment task for this Stage does not appear in the course workbook. The trainer needs to prepare a basic task in recognition and monitoring for those who wish to be assessed for the relevant element of the National Competency. See the Course Workbook for details.

This is a two-day course.

Course structure

Two topics:

Topic 1 Introduction to IPM is dealt with in Stage 1 at the beginning of the Trainers' Guide

Topic 2 Basic pest and disease recognition, biocontrol and monitoring equipment

Purpose of this stage

The important overall message for the trainer to deliver in this course is that every bit of help in the early recognition of pest and disease problems is important.

This is a course in basic recognition only. At the end of the course the participants should be aware of the key pests and diseases that can cause problems in crops. They should be able to recognise some of these, and they should be confident to know when something is wrong in the crop and when they need to report it to their supervisor.

Participants have an opportunity to learn how to recognise pests and diseases in their crops and the symptoms of damage. They also learn about the biocontrol agents that might be useful and how to tell them apart from pest species. They learn about the need for monitoring and about some equipment used for monitoring, such as magnifiers and sticky traps.

Resources

Trainers need to provide:

- samples of pests (at least five)
- samples of diseased plants
- samples of biocontrol agents
- microscopes
- hand lenses and head band magnifiers
- Pests, Diseases, Disorders and Beneficials: Field Identification Guide
- sticky traps
- Pest Sense card game.
Basic recognition and monitoring

EQUIPMENT

National competencies addressed in this training course are from the National Training Package in Horticulture:

- RUHRT202A Treat pests and diseases (element /01 Recognise pests and diseases)

Learners who successfully complete the assessment exercise will receive a Certificate of Attainment for the element of the National Competency listed above.

Course structure

Topic 1. Introduction to IPM is dealt with in Stage 1 at the beginning of this Course Workbook

Topic 2. Basic pest and disease recognition, biocontrol and monitoring equipment

- Pest recognition
- Disease recognition
- Biocontrol recognition
- Monitoring equipment

Reference material in the Information Guide

Topic 1 Introduction to IPM: see Stage 1 at the beginning of this Course Workbook

Topic 2 Basic pest and disease recognition, biocontrol and monitoring equipment:

- Section 4: Designing an IPM Program: Monitoring & Decision-making
- Section 5: Know Your Pests
- Section 6: Know Your Diseases
- Section 7: Know Your Biocontrol Agents
- Section 9: Directory

IPM ONfarm – Protected Cropping Trainer’s Manual
Tasks

Pest recognition

- Discuss the two reference sources mentioned in Task 22 and explain how they can help participants to recognise the specimens provided.
- Complete Task 22.
- Discuss Task 23 with the whole group.
- Complete Task 24 and discuss with the whole group.
Basic Recognition and Monitoring Equipment

- Section 11: Glossary
- Handy Guide 4: Registered Chemicals for Common Pests
- Handy Guide 5: Registered Chemicals for Common Diseases

**Purpose**

In this stage you will learn how to recognise pests and diseases in your crops and the symptoms of damage. You will also learn about the biocontrol agents that might be useful to you and how to tell them apart from pest species. You learn about the use of chemicals against pests and diseases. Finally, you will learn about the need for monitoring and the equipment and methods used.

**Activities**

- Recognising pests, diseases and biocontrol agents
- Examining examples of key pests infesting crop and weed plants
- Examining diseased plant material
- Examining samples of commercially produced biocontrol agents and any naturally occurring predators and parasitoids that are available
- Discussing pest and disease diagnosis with reference to Pests, Diseases, Disorders and Beneficials: Field Identification Guide
- Looking for pests and beneficials in plant samples by using a headband or a hand magnifier
- Looked at a sticky trap that has trapped insects in a crop

**Tasks**

Note that all suggested reading associated with page numbers in this Workbook refers to the Information Guide by Section and then page number, for your industry.

**Pest recognition**

22. Look at the directory of pests on pages 5-2 and 5-3 and check Pests, Diseases, Disorders and Beneficials: Field Identification Guide. Have a look at the specimens provided. Can you recognise them?

    a. ................................ b. ................................ c. ................................
    d. ................................ e. ................................

23. Which of the specimens provided have you seen in your crops? Tick above
24. Choose three of the most common pests you have seen in your crop(s)

For Pest 1:
Can you describe how you recognised it and which plants you found it on?

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What sort of damage did you see?

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What were you asked to do about it, if anything?

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For Pest 2:
Can you describe how you recognised it and which plants you found it on?

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What sort of damage did you see?

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What were you asked to do about it, if anything?

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Disease recognition

- Discuss the two reference sources mentioned in Task 25 and explain how they can assist the participants to recognise the specimens provided. Complete Tasks 25 to 27.
- Discuss Task 28 with the whole group.
Basic Recognition and Monitoring Equipment

For Pest 3:
Can you describe how you recognised it and which plants you found it on?

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__________________________________________________________________________

What sort of damage did you see?

__________________________________________________________________________

__________________________________________________________________________

What were you asked to do about it, if anything?

__________________________________________________________________________

__________________________________________________________________________

Disease recognition

25 Look at the directory of diseases on page 6–2 and check Pests, Diseases, Disorders and
Beneficials: Field Identification Guide. Have a look at the specimens provided. Can you
recognise them?

1. ..............................................................................................................

2. ..............................................................................................................

3. ..............................................................................................................

26. Describe each as caused by a fungus, bacteria, virus or nematode

1. ..............................................................................................................

2. ..............................................................................................................

3. ..............................................................................................................
Biocontrol recognition

- Complete Task 29. Discuss with the whole group.
- Complete Tasks 30 to 32. Discuss with the whole group. Be prepared to clarify the answer, because some given by participants may be incorrect.
27. Describe the symptoms you've seen caused by each of the diseases shown in Task 25. Refer to *Know your Diseases*, Section 6 of the Information Guide, and check diagnostic features.

1. .................................................................

2. .................................................................

3. .................................................................

28. Describe what you have been asked to do when you've seen these diseases in your crops.

1. .................................................................

2. .................................................................

3. .................................................................

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**Biocontrol recognition**

29. From the directory of commercially available biocontrol agents on page 7-2, choose the biocontrol agents you could use against the pests you named earlier in Tasks 23 & 24. *Check Pests, Diseases, Disorders, Beneficials: Field Identification Guide* for colour pictures and some key information.

30. Which biocontrol agents have been used in your crops?

1. .................................................................

2. .................................................................

3. .................................................................

4. .................................................................

31. What pests were they used against?

1. .................................................................

2. .................................................................

3. .................................................................

4. .................................................................
Monitoring equipment

- Complete Task 33. Practise using the equipment.
- Complete Task 34. Discuss what a sticky trap is used for, and the different colours and types.
- Discuss how familiar participants are with the use of sticky traps on their farms.

Chemical use

- It is appropriate to discuss the use of chemicals at the end of this Stage. Although there isn’t a session on chemical use in the Course Workbook, discuss which chemicals can be used for specific pests and diseases.
- Refer to Handy Guides 4 and 5, and 3-20.
- Include these points in your discussion:
  - within fungicides there are specifics and protectives (broad spectrum)
  - many specific fungicides are also systemic.

Pest Sense card game

Play for 15–20 minutes.
32. How did you tell the biocontrol agent apart from the pest?

1. 

2. 

3. 

4. 

Monitoring equipment

Look at pages 4-3, 4-4 and 4-9 and answer the following questions.

33. Look at the equipment provided. Use it to magnify a pest or disease from the specimens provided. What can you see now?

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

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

34. Look at the sticky trap provided. Explain how it is used in the crop.

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

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

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

   ........................................................................
Stage 3. Implementation of IPM

Assessment

For those who wish to be assessed for the relevant national competencies, the assessment task for this Stage is Task 86 in the Course Workbook. See the Course Workbook for details.

This is a four-day course.

Course structure

Topic 1. Introduction to IPM is dealt with in Stage 1 at the beginning of the Trainers’ Guide.

Topic 2. Implement an IPM program

Topic 2. is in three sections:

• Section 1: Preparing for IPM
• Section 2: Pest and disease recognition and biocontrol recognition and use
• Section 3: Monitoring and decision-making

Section 1: Preparing for IPM

Purpose of this section

Participants learn about what can be done to minimise the risk of pests and diseases in crops. These preventive measures include:

• knowing what to do before considering monitoring and control
• training staff and providing them with information about chemicals
• using physical barriers to prevent pest entry
• managing the environment to minimise the risk of diseases and to assist the work of biocontrol agents.

Participants need to be aware of the factors presented in Section 3 of the Information Guide:

• staff considerations
• site considerations
• physical considerations
• cultural considerations
• chemical considerations.

A note on the activities

When you get to this part of the course, discuss Task 51 with the participants before they begin to work on it. This task asks participants to draw up a list of improvements to their
Implementation of IPM

National competencies addressed in this training course are from the National Training Package in Horticulture:

- RUHHRT317A Control pests and diseases (all elements)
- RUHHRT352A Implement an integrated pest management program (all elements)
- RUHHRT353A Select chemicals and biological agents (element /01, Select appropriate chemical)
- RUHHRT202A Treat pests and diseases (all elements).

Learners who successfully complete the on-farm assessment exercise will receive a Certificate of Attainment for the National Competencies listed above.

Course structure

Topic 1. Introduction to IPM is dealt with in Stage 1 at the beginning of this Course Workbook.

Topic 2. Implement an IPM program:

- Section 1: Preparing for IPM
- Section 2: Pest and disease recognition and biocontrol recognition and use
- Section 3: Monitoring and decision-making

Section 1: Preparing for IPM

Subject areas:

- Staff considerations
- Site considerations
- Physical considerations
- Cultural considerations
- Chemical considerations
- Preparing to implement IPM
own sites and to list practices they would like to introduce into their workplaces to improve staff training, hygiene, and the physical protection of plants against pests and diseases. All of these improvements are part of preparing for the introduction of IPM. The reference section in the Information Guide is in Maximising your chances of success page 3-31 (Ornamentals), or 3-30 (Greenhouse Vegetables).

Guest speakers

Suitable guest speakers would be:

- a speaker who can provide information and examples of chemical resistance in pests. This should include practical examples of what can be done about chemical resistance. You could invite a suitable technical representative from a chemical company, or a scientist with an appropriate research background.
- a producer who is using IPM
- a person who is an expert on physical issues in a greenhouse. This person should include samples of insect screening.

Resources

- a supply of paper for Task 23

Tasks

Staff considerations

- If you can find a local property manager or grower who has implemented IPM on their property, ask them to tell of their experience.
- Ask participants if they have any doubts about the implementation of IPM on their properties. Discuss any worries they might have, and suggest solutions.
- Complete Task 22 and discuss with the whole group. Expect that most participants will not have training courses established in their workplaces. Emphasise the importance of commitment to IPM and the importance of remaining committed even through busy times such as Christmas, Easter and Mothers’ Day. This applies to ornamental and greenhouse vegetable enterprises. For example, it is important to continue monitoring, even when the enterprise is very busy. Provide examples to emphasise the importance of staff hygiene, and stress that monocultures are particularly vulnerable to breaches of hygiene.
Reference material in the Information Guide

- Section 3: Preparing for IPM: Property and Staff
- Section 9: Directory
- Handy Guide 4: Registered Chemicals for Common Pests
- Handy Guide 5: Registered Chemicals for Common Diseases
- Handy Guide 6: Chemical Toxicity to Biocontrol Agents

Purpose

In this section you will learn about the steps that can be taken to minimise the risk of pests and diseases in your crops by preparing your property.

Activities

Drawing up a list of improvements to your work site in preparation for the introduction of IPM

Tasks

Note that all suggested reading associated with page numbers in this Workbook refers to the Information Guide by Section and then page number, for your industry.

Staff considerations

As a person with responsibility for implementing an IPM program, you must be properly prepared for, and be committed to, IPM.

Staff need to:

- understand crop hygiene
- identify, monitor and record pests and diseases.

22. Here is a checklist for staff management:

- Is there a training program in IPM for staff in your workplace? Yes/No/Undecided
- Are you committed to implementing IPM? Yes/No/Undecided
- Do you have appropriate reference material available? Yes/No/Undecided
- Do you know and have you documented your responsibilities in your IPM program? Yes/No/Undecided
- Are appropriate staff hygiene measures in place? Yes/No/Undecided
Site considerations

- Ensure that participants have suitable pieces of paper for Task 23.
- Ask participants to complete Task 23 and draw up their own site plans.
- Complete Tasks 24 and 25.
- Select two or three from the group and discuss the problems and solutions they identified.

Physical considerations

- Allow participants time to read through the appropriate sections in the Information Guide, and complete Tasks 26 to 28.
- Encourage small groups to discuss the management of heat, humidity and water in their greenhouses, and possible improvements.
- Explain that Tasks 26 to 28 are relevant to both outdoor and greenhouse environments.
- If available, ask a local expert (e.g. greenhouse manufacturer, agent, reseller, IPM consultant) to speak to the group.
- Have examples of different types of screening available for the group to examine and discuss. You might like to invite a manufacturer to give a presentation. You may like to invite both the local expert and the screening expert together, if appropriate.
- Complete Tasks 29 to 32 and discuss them with the whole group.

Note that insect screens should be set up in a way that increases the surface area for best ventilation (Task 32).
Implementation of IPM

Site considerations

A poorly managed and badly structured site can attract pests and diseases and hinder any attempts to control them. Part of IPM is the preparation of the production sites so that they prevent pests from occurring.

23. Prepare a mud map of your site on the page provided. Include each of the following
   a. orientation (N/S/E/W)
   b. climate and micro-climate (winds/shelter/aspect)
   c. growing areas
   d. buildings
   e. roads
   f. public access areas
   g. rubbish tips
   h. soil, pot and media storage areas
   i. propagation and production areas.

24. See the site considerations listed on pages 3-4 and 3-5. Do any of these problems relate to your site? If so, list them.

__________________________________________________________________________________

__________________________________________________________________________________

25. Write a list of possible site improvements you could make on your property.

Physical considerations

Greenhouses are important to propagation and production of crops. Growers who have greenhouses need to take special steps to ensure that the environmental conditions in their greenhouses do not favour pests and diseases, but do favour beneficials and healthy crop growth.

Refer to pages 3-6 to 3-10 (Ornamentals), or 3-5 to 3-9 (Greenhouse Vegetables), and then complete the following tasks. You might like to discuss your responses with others in your group.

26. Heat. How do you manage high or low temperatures?

__________________________________________________________________________________

__________________________________________________________________________________
27. Relative humidity. How do you prevent condensation?

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28. Water. What type of water management do you use?

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Now refer to pages 3-10 to 3-17 and continue with the following tasks:

29. Do you use screening?

Yes ............................................. No ....................................................

If not, why not? ...................................................................................................................
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If yes, what do you use and how effective is it? .................................................................
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30. What are the benefits of ventilation in greenhouses and how do you ventilate your greenhouse?

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31. Ignoring costs, are there any site or structural modifications that you would like to make to your greenhouse? List them.

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IPM ONfarm – Protected Cropping: Trainer’s Manual
Cultural considerations

- Refer participants to the Information Guide on nutrition and irrigation management, and get them to complete Tasks 33 to 36.
- Ask participants why nutrition, irrigation and sanitation are so important to IPM. List the answers on the whiteboard.
- Allow 10 minutes for participants to consider their answer to Task 36, and then list examples of good sanitation from the Information Guide on whiteboard or butchers' paper and discuss. Give a case study of a bad example. See pages 3-18 to 3-20 (optional before completing Task 36).
- Complete Task 37. Briefly discuss with the whole group. The answers are yes for a and b, and no for c, d, e and f.
32. Look at these examples of insect screening.

TO SCREEN OR NOT TO SCREEN?

Cultural considerations
Now refer to the paragraphs on nutrient and irrigation management on page 3–18 (Ornamentals), or 3–17 (Greenhouse Vegetables), and continue with the following tasks.

33. What are some of the problems associated with excess nutrients?

34. What sort of irrigation system do you use, and why? How do you prevent waterlogging or plants drying out?

35. What sort of pests and diseases are associated with waterlogging and poor drainage?
Refer to Sanitation Management pages 3-18 to 3-20 (Ornamentals), or 3-17 to 3-19 (Greenhouse Vegetables).

36. Make a list of three things that you do and three things that are new to you.

Things I do ...........................................................................................................................................................................
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New ideas ...........................................................................................................................................................................
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37. The following task relates to the weeds box below. Tick the statements that you think are true.

**WEEDS AND YOUR PLACE**

WEEDS ARE GOOD FOR:

a) Checking for pests
b) Harbouring TSWV
c) Making the place look neglected
d) Showing you can grow something well
e) Nothing
f) All of the above
Chemical considerations

- Note the activity groups in Handy Guide 4. If possible, ask a local chemical expert (e.g. a technical specialist or researcher for a chemical company or your State Department of Agriculture or Primary Industries) to talk to the group about national and State legislation requirements. Introduce chemical databases such as InfoPest. Emphasise the importance of having the most appropriate spray equipment for the crop situation, and discuss spray application.

- Allow participants time to complete Task 38 in the Course Workbook. Refer to the following instructions in the workbook, and use this information in a discussion of pesticide resistance and activity groups.

- Discuss with the participants what to do when there is no effective chemical registered in their crop for the pest they wish to spray.

- Complete Tasks 39 to 41. Discuss the responses with the whole group.

- Complete Tasks 42 to 45, and then form small groups and discuss the responses. Get a representative from each group to report. Prepare a list on the whiteboard or on butchers' paper. Provide a copy to each participant.

- Complete Tasks 46 to 50. Discuss them with the whole group. Ask participants to name the spray equipment they use and to tell other participants the advantages and disadvantages of this equipment. Note the points on the whiteboard.

- Discuss chemical-user training with the group. Ask for a show of hands as to who has been trained. For those who have, remind them of the renewal requirements.
Examples of poor weed management

WEED NO-NO's!

Top left: Crop trash left in greenhouse. Top right: Dumping old crop near your greenhouse is asking for reinvasion by pests and diseases. Bottom left: Weeds and house plants in a greenhouse make a good refuge for pests and diseases. Bottom right: Open greenhouses with broad-leaved weeds growing right up to the edge.

Do you have any of these situations on your property?

Chemical considerations

Chemical use will remain an important tool in an IPM program. Effective results will be determined by which ones you choose and the way they are used.

On pages 3-20 to 3-23 (Ornamentals), or 3-19 to 3-22 (Greenhouse Vegetables), you will find details of what you need to consider before you use chemicals. You'll also find some of the problems you can have with using chemicals.

38. What happens when you over-use chemicals?

Now refer to pages 3-28 and 3-29 (Ornamentals), or page 3-27 (Greenhouse Vegetables), for some recommendations about using pesticides.

Check Handy Guides 4 and 5 for details of chemicals registered for pests and diseases in your crops. Note the different activity groups for insecticides and fungicides.

What is an activity group?

Start the Infopest® CD ROM. Click on the information tab at the top of the opening page. Click on the line "Pesticide resistance group information from AvCarèd" and have a look at the details on activity groups and resistance management strategies.
Now continue with the following tasks.

39. Select two insecticides/miticides and write down the chemical group and activity group for each.

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40. Select two fungicides and write down the chemical group and activity group for each.

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41. What is a common pest or disease on your property?

With reference to your answer to Task 39, see page 3-21 (Ornamentals), or 3-20 (Greenhouse Vegetables), and the paragraph Rotate between pesticide chemical groups to delay resistance, and check Handy Guides 4 and 5. Note the different activity groups that are effective against the pest you nominated, and then write a Resistance Management Plan using chemicals from different activity groups.

42. Make a list of things to consider before you use chemicals on your crop and in your greenhouse.

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43. What are two major problems you might face in using chemicals at your site?

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44. On what basis do you decide which chemicals to use in your crops?

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45. What can you do if there isn't an effective chemical registered in your crop for the pest you wish to spray? See Permits on page 3-29.

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Now refer to What you need to know about sprayers and spraying on pages 3–23 to 3–28 (Ornamentals), or 3–23 to 3–26 (Greenhouse Vegetables).

46. What equipment do you use for applying pesticides?

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47. List the advantages and the disadvantages you have found in using this equipment.

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48. When did you last check nozzle output or change your nozzles?

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49. How could you improve the way you apply chemicals?

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50. Have you completed a Chemical Users' Course (SMARTtrain, ChemCert, Cheemsmart, Farm Care or Farm Chemical Users Course)?

Yes........................................... No .........................................................
Preparing to implement IPM

Get participants to refer to ‘Maximising the Success of IPM’ on pages 3-31 and 3-32 (Ornamentals), or page 3-30 (Greenhouse Vegetables). Complete Task 51, and discuss with the whole group why this Task was important to them. Go back to the list in the Information Guide and discuss any points left out.
Implementation of IPM

For more information see pages 3-30 and 3-31 (Ornamentals), or 3-28 and 3-29 (Greenhouse Vegetables), and 9-22 and 9-23.

Preparing to implement IPM

Refer to Maximising the success of IPM on pages 3-31 and 3-32 (Ornamentals), or page 3-30 (Greenhouse Vegetables).

51. Prepare a list of practices you would like to introduce to your workplace.

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Now refer back to the points listed on pages 3-31 and 3-32 (Ornamentals), or page 3-30 (Greenhouse Vegetables). Did you miss anything? Why? Discuss with your trainer.
Section 2: Pest and disease recognition and biocontrol recognition and use

Purpose of this section

Participants will become aware of the biocontrol agents that might be useful to them, how to tell them apart from pest species, and how to use them, particularly with chemicals. Alert participants to the fact that it is harder to identify diseases than to identify insect and mite pests. Direct them to expert diagnostic services, such as the plant health diagnostic services indicated in Section 9 Directory in the Information Guide. Participants should also be directed to consultants and to the suppliers of biocontrol agents indicated in the same section. Trainers should look closely at the consultant list on page 9–19 and should delete or add to it as required for a group of participants.

A note about the activities

The activities involve a whole group exercise. Participants examine examples of key pests infesting crop and weed plants (obtained from suppliers for the course and brought in from farms by participants); diseased plant material; samples of commercially produced biocontrol agents (obtained from producers); and any naturally occurring predators and parasitoids (brought in from farms by participants) that are available. They also discuss the pest and disease diagnosis in the Field Identification Guide.

Resources

- *Pests, Diseases, Disorders and Beneficials: Field Identification Guide* (for the appropriate crop)
- stereo microscopes
- hand lenses for each participant
- headband magnifiers
- live pests on crop plants and/or weeds
- samples and slides of pest damage symptoms
- samples and slides of diseased crop plants
- samples of biocontrol agents in their commercial packaging, just as they would be obtained from a commercial supplier
- Pest Sense card game to play at the end of the section
Section 2: Pest and disease recognition and biocontrol recognition and use

Subject areas:
- Pest recognition
- Biocontrol recognition and use
- Use of chemicals with biocontrol agents
- Disease recognition

Reference material in the Information Guide
- Section 5: Know Your Pests
- Section 6: Know Your Diseases
- Section 7: Know Your Biocontrol Agents
- Section 9: Directory
- Section 11: Glossary
- Handy Guide 4: Registered Chemicals for Common Pests
- Handy Guide 5: Registered Chemicals for Common Diseases
- Handy Guide 6: Chemical Toxicity to Biocontrol Agents
- Plus Pests, Diseases, Disorders and Beneficials: Field Identification Guide for your crop

Purpose
In this Section you will learn how to recognise pests and diseases in your crops and the symptoms of damage. You will also learn to recognise and use biocontrol agents and learn about their use with chemicals.

Activities
- Recognising pests, diseases and biocontrol agents
- Examining examples of key pests infesting crop and weed plants (obtained from suppliers for the course and brought in from farms by participants)
- Examining diseased plant material
- Examining samples of commercially produced biocontrol agents (obtained from producers)
- Examining any naturally occurring predators and parasitoids that are available
Tasks

Pest recognition

- Explain the diagnostic differences between species.
- Give a worked example for Pest 1 in Task 54. Participants can then continue with Pest 2 and Pest 3.
- Give participants time to complete Tasks 52 to 54. Discuss the responses with the whole group.
- Explain how to use the information in the Information Guide and the Field Guide to recognise pests, and how knowledge of their life cycles and habits can help in controlling them.
- Practise recognising pests and their symptoms. Describe the diagnostic features, and refer to both of the books above.
- In preparation for Task 55, check whether any of the diagnostic and analytical services listed are now defunct; check whether new ones should be added. Ask participants if they are aware of any new services. Discuss Task 55 with the whole group.
Implementation of IPM

Tasks

Pest recognition

52. Look at the directory of pests on pages 5–2 and 5–3 (Ornamentals), or page 5–2 (Greenhouse Vegetables).

Have a look at the specimens provided. Can you recognise them?

a. ........................................ b. ........................................ c. ........................................

d. ........................................ e. ........................................

53. Which of the specimens provided have you seen in your crops? Tick above.

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54. Choose three of the most common pests you have seen in your crop(s).

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For Pest 1:
Describe the pest and state the plants where you found it.

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Describe its life cycle. (See Section 5 and go to the appropriate pest group for an example of a life cycle.)

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Implementation of IPM

What sort of damage did you see?

What did you do to prevent it from occurring or to reduce its presence?

Refer to the notes related to this pest in Section 5 of the Information Guide.

Would you do something different now?

For Pest 2:
Describe the pest and state the plants where you found it.
Implementation of IPM

Describe its life cycle. (See Section 5 and go to the appropriate pest group for an example of a life cycle.)

What sort of damage did you see?

What did you do to prevent it from occurring or to reduce its presence?

See the notes related to this pest in Section 5 of the Information Guide.

Would you do something different now?
For Pest 3: 
Describe the pest and state the plants where you found it.

Describe its life cycle (see Section 5 and go to the appropriate pest group for an example of a life cycle).

What sort of damage did you see?

What did you do to prevent it from occurring or to reduce its presence?
Biocontrol recognition and use

- Explain how to use the information in the Information Guide and the Field Guide to recognise beneficials, and how knowledge of their life cycles and habits can help in encouraging them.
- Show participants how to recognise biocontrol agents and to distinguish them from pests.
- Show them how biocontrol agents are packaged, and how they are released. Ask a biocontrol agent producer to talk about production and cost.
- Complete Tasks 56 to 60, and give the answers and discuss the responses with the whole group.
- For Task 59 give an example of a specific time in a pest life cycle when a biocontrol agent could be used.
- Complete Task 61.
See the notes related to this pest in Section 5 in the Information Guide.

Would you do something different now?

55. Look at the directory of Pest and Disease Diagnostic Services on pages 9–9 to 9–13 (Ornamentals), or 9–8 to 9–12 (Greenhouse Vegetables).

Which pest diagnostic service is nearest to you? Have you used its services?

Biocontrol recognition and use

For Tasks 56 to 60 have a look at pages 7–3 to 7–7, Know your Biocontrol Agents.

Find Handy Guide 6 with the chemical toxicity table.

56. Have a look at the specimens provided. Can you recognise them?

a) ........................................................................

b) ........................................................................

c) ........................................................................

d) ........................................................................

e) ........................................................................
57. Name these biocontrol agents (BCAs). The target pest for each is in brackets.

**WHICH BIOCONTROL AGENT IS THIS?**

| a. | ............................................. (spider mite) |
| b. | ............................................. (aphids) |
| c. | ............................................. (fungus gnats) |
| d. | ............................................. (whitefly) |
| e. | ............................................. (thrips) |
| f. | ............................................. (aphids) |

58. Which biocontrol agents, if any, have you used in your crops?

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

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

What pests where they used against? Name the pests and their biocontrol agents.

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

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

.............................................
59. When would you choose to use a biocontrol agent?

60. When would you choose not to use a biocontrol agent?

61. From the directory of commercially available biocontrol agents on page 7–2, and the notes on pages 7–8 to 7–23 (Ornamentals), or 7–8 to 7–20 (Greenhouse Vegetables), choose one agent you could use and answer the following:

- Name the biocontrol agent:
- Name the key pest you would use it against:
- Name a supplier:
- Describe how you would use it:
Use of chemicals with biocontrol agents

- Give the answers to Task 62. Work in small groups. Discuss reasons for the choice of chemicals.

Disease recognition

- Explain how to use the information in the Information Guide and the Field Guide to recognise diseases, and how knowledge of their life cycles and habits can help in controlling them.

- Practise recognising disease symptoms. Emphasise the difficulty of this task, and tell participants where they can get accurate disease diagnosis. Refer to Section 8: Directory in the Information Guide for details on diagnostic laboratories in their State.

- Complete Tasks 63 to 65. Discuss recognition and the use of the hand lens and the microscope.

- At the end of this section discuss all of the information and the answers and clear up any misconceptions.

- Play the Pest Sense card game.
Use of chemicals with biocontrol agents

**WHICH CHEMICALS ARE SAFE TO USE?**

- Lannate
- Maldison
- Eco-oil
- Natrasoap
- Pirimor
- Vertimec
- Success
- Benlate
- Sulfur
- Bravo

62. With reference to the biocontrol agent you selected for Task 61, consult Handy Guide 6: *Chemical toxicity to biocontrol agents*. List three chemicals you could use with your selected biocontrol agent in an IPM program.

Disease recognition

63. Look at the directory of diseases in *Know your Diseases* on page 6-2.

Have a look at the specimens provided. Can you recognise them?

a. ........................................
b. ........................................
c. ........................................

d. ........................................
e. ........................................

Which of the specimens provided have you seen in your crops? Tick above.

64. Choose three of the most damaging diseases (in terms of $ loss) you have experienced in your crops.

1. ........................................
2. ........................................
3. ........................................
Implementation of IPM

Is it a fungus, bacterium, virus or nematode?

1. ........................................................................................................

2. ........................................................................................................

3. ........................................................................................................

Describe the symptoms you've seen.

1. ........................................................................................................

2. ........................................................................................................

3. ........................................................................................................

How do you think it originally got on to the property?

1. ........................................................................................................

2. ........................................................................................................

3. ........................................................................................................

How do you think it spread through the crop?

1. ........................................................................................................

2. ........................................................................................................

3. ........................................................................................................
Implementation of IPM

How did you (or others) control it or prevent a reoccurrence?

1. ........................................................................................................................................
   ........................................................................................................................................

2. ........................................................................................................................................
   ........................................................................................................................................

3. ........................................................................................................................................
   ........................................................................................................................................

See the notes related to these diseases in Section 6 of the Information Guide.

Would you do something different now?

1. ........................................................................................................................................
   ........................................................................................................................................

2. ........................................................................................................................................
   ........................................................................................................................................

3. ........................................................................................................................................
   ........................................................................................................................................

65. Have a look at the directory of Pest and Disease Diagnostic Services on pages 9–8 to 9–12.

Which disease diagnostic service is nearest to you? Have you used it and if not, why not?

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

Practise your skills in the Pest Sense Card Game.
Section 3: Monitoring and decision-making

Purpose of this section

In this section participants learn about the need for monitoring, how to monitor their crops, how to use sticky traps, how to keep records, how to develop action thresholds for themselves, and how to take a phased approach to implementing an IPM program.

A note about the activities

In this Section you:

• demonstrate how to monitor for pests and diseases, give participants practice in monitoring, and introduce the Pest Sticky Trap Poster in the Information Guide

• give participants practice in identifying pests on sticky traps using a numbered set of pre-counted sticky traps. Show the difference between pest species and non-pest species and the diagnostic characteristics for each pest species. Ask participants to count pest numbers on a trap that you give to them in the exercise. Ask them to record their counts and report to the group. As the trainer, you will need to count the numbers in each pest group on these demonstration traps before you give them out. Then you can compare trainer and participant counts. Identify any blind spots in each participant’s pest recognition and get them to repeat the exercise with a different trap where appropriate.

• give a fresh sticky trap to each participant to hang in his or her own crops for a week on each of the first three days of the course. Ask them to bring the traps along on each of the following training days: this provides further practice at identifying and counting pests on sticky traps and also demonstrates which insects are in their crops. Discuss the results with the whole group.

• discuss the case study appropriate to the industry that is provided in the Course Workbook with the whole group, so that participants become familiar with monitoring data and how to interpret and act upon it

• discuss the on-farm exercise in crop inspection technique: discuss practical approaches to this task, how to keep records, and the use of a whiteboard and magnetic coloured buttons for pest location

• discuss Handy Guides 1 and 2 as practical guides to IPM and crop production

• discuss the sample record sheets in Handy Guide 3 and how participants may use or modify them.

Guest speakers

You could invite:

• a scout or consultant who does commercial monitoring for growers, or alternatively someone who regularly monitors their own crops, to discuss their approach to monitoring

• a consultant to talk about setting up an IPM program, the services they offer to growers, and their costs and benefits.
Section 3: Monitoring and decision-making

Subject areas:
- Monitoring equipment
- Monitoring
- Sticky traps
- Record keeping
- Monitoring plan
- Case study exercise
- Action thresholds
- Indicator plants (ornamentals only)
- Final preparation for IPM
- On-farm course assignment

Reference material in the Information Guide
- Section 4: Designing an IPM Program: monitoring and decision-making
- Section 9: Directory
- Section 11: Glossary
- Handy Guide 1: IPM Checklist
- Handy Guide 2: Crop Management
- Handy Guide 3: Sample Monitoring Record Sheets

Purpose
In this Section you will learn how to monitor pests and diseases in your crops and the symptoms of damage. You also learn about the need for thresholds and how to use them in decision-making.

Activities
- Monitoring pests and diseases in crops
- Discussing crop inspection techniques
- Keeping monitoring records
- Using and modifying sample record sheets in Handy Guide 3, and going through a monitoring case study to interpret the information provided.
- Interpreting the information provided in a monitoring case study
Resources

- a numbered set of demonstration sticky traps containing a range of common pests that have been pre-counted by the trainer
- a variety of sticky traps to show the range on the market
- the Pest Sticky Trap Poster (copy in each Information Guide) to assist participants to distinguish pest species
- sticky traps hung in each participant's crop during the previous week, for classroom practice. Differentiate pest species from non-pest species to show participants what they currently have in their crops.
- The sample record sheets in Handy Guide 3
- a fresh sticky trap provided to each participant on each of the first three training days to hang in his or her crop for a week and to bring back for refresher training
- pro formas to distribute to participants for record keeping
- calculators to work out averages for a summary table in record keeping
- examples to show how to use the pro forma sheets
- graph paper to give to participants so that they can plot weekly averages in record keeping
- indicator plants for Task 84 (ornamentals industry only)
- an example of the contents of a monitoring kit.

Tasks

Monitoring equipment

- For Task 66 have a display of equipment. Complete Task 66 and discuss with the whole group.
- Complete Task 67.
Implementation of IPM

Tasks

Monitoring equipment

66. Look at the equipment provided or listed on pages 4–3 and 4–4 and decide what you need to purchase for an IPM program on your property.

Monitoring equipment – what do you have now?

What would you like to have ($ no barrier!!)

See Suppliers of monitoring tools on pages 9–6 and 9–7. Where could you purchase the monitoring equipment you would like to have?

67. Use each of the magnification aids to view one of the pest or disease specimens provided.

What do you notice?

Discuss your diagnosis with the presenter.
Monitoring

- Crop inspection or scouting. Discuss the need to monitor, who does the monitoring or scouting, the level of service required, and equipment needed to monitor, as described in What is Monitoring on pages 4-2 to 4-4 in the Information Guide.
- Complete Tasks 68 to 70 and discuss.
- If possible, ask a local IPM consultant or scout to talk to the group about their approaches to practical crop monitoring and scouting, the costs, and the different kinds of services offered.
- Discuss the preferred ways to monitor pests and diseases and how to go about monitoring by crop inspection. Refer to pages 4-5 to 4-7. Some Handy Tips to monitoring crops are provided on these pages.
- Complete Task 71.
- Discuss where to look on a plant for pests and the damage symptoms to look out for. See page 4-8, Table 1 Some common symptoms of pests and where to look for them.
- Discuss the key issues for monitoring, as listed on pages 4-4 to 4-7.
Implementation of IPM

Monitoring
Refer to pages 4-2 to 4-8.

68. What does monitoring achieve?

69. Page 4-2 suggests reasons for monitoring. Select the five that are most important.

70. See page 4-3 (Ornamentals), or pages 4-2 and 4-3 (Greenhouse Vegetables), and the sections Who does the monitoring? and What level of service do you want? What approach would be suitable for your farm?

71. Now see pages 4-5 to 4-7. What is a scout, and what is a scout’s responsibility? Look at Handy Guide 3: Record Sheet: Crop Inspection Data, Pest & Disease Control Treatments and Pest & Disease Summary Reports.
Sticky traps

- Use the Sticky Trap Poster.
- Give the answer to the graphic about sticky trap placement. Explain why (d) is the best option. Mention that blue is used for some species, for example female western flower thrips, but that yellow is of more general use. Mention that yellow, however, also attracts biocontrol agents (but only if they fly or are wind blown).
- Show Handy Guide 3 and how it is used.
- Show the range of sticky traps on the market.
- Go over Using sticky traps on pages 4-9 to 4-12 (Ornamentals), or 4-7 to 4-11 (Greenhouse Vegetables), in the Information Guide.
- Show participants how to use a sticky trap properly, and show them what not to do.
- Complete Task 72 in small groups. Write up each group’s response, then compare the responses and discuss them with the whole group.
- Complete Task 73. Discuss the results with each participant and show them what to look for. Repeat this discussion (as many times as is necessary) with any participant experiencing difficulties with any particular pest species.
- Complete Task 74. Discuss the findings and any surprises. The answers to task 75 are (a) aphid, (b) shore fly, (c) white fly, (d) fungus gnat, (e) parasitic wasp, (f) thrips.
- Discuss Tasks 75 and 76. The answers to task 75 are (a) aphid, (b) shore fly, (c) white fly, (d) fungus gnat, (e) parasitic wasp, (f) thrips. Give the answer to Task 76.
Sticky traps

See pages 4–9 to 4–12 (Ornamentals), or 4–7 to 4–11 (Greenhouse Vegetables), and look at Handy Guide 3: Record Sheet: Sticky Trap Data

STICKY TRAP PLACEMENT
WHICH IS CORRECT?

Top left: hung well above the crop
Bottom left: positioned just above crop height
Top right: lying in the pathway
Bottom right: blue and yellow traps with a numbered station positioned just above crop height

72. Prepare a set of simple steps for installing, monitoring and recording sticky traps in a greenhouse. This should identify:

- where to place the traps (Hint, you may like to draw a map)
- when to place them
- the number of traps to use
- how to display the sticky trap counts.
73. Practising with sticky traps

Count and record the numbers of pests on the sticky trap provided. Test your skill by comparing with the actual number previously counted. If you are having difficulty, get another trap and repeat the exercise. Talk to your presenter about any problems, especially if the insects are hard to identify.

74. Pick up the sticky trap you brought in after having it hang in your crop for a week. Count and record the numbers of insect pests.

75. Inspect the Pest Sticky Trap Poster. Ask the presenter to clarify the diagnostic characters of insect pests on the poster or the sticky traps, as you require.

Which insect pests are on these sticky traps?

a. ................................................

b. ................................................

c. ................................................

d. ................................................
Record keeping

- Provide pro formas for participants to take home and trial. Handy Guide 3 in the Information Guide is useful for this. Go over each record sheet and demonstrate how to fill them in.

- Go through an example on the board. You may need to provide calculators for working out averages for the summary table. Provide graph paper to show how to plot weekly averages of each major pest and disease.

- Ask participants to run through the case study data in the Course Workbook.

- Give the answer to Task 77.

Monitoring plan

- Note that monitoring present or absent is different to counting.

- Provide any examples or case studies you have for discussion and comment. Ask an IPM consultant or scout to describe a typical monitoring plan for a nursery.

- Complete Task 78 for participants’ crops in small groups. Participants should add this to their workbook notes.

Case study exercise

- Show participants the case study exercises. Explain the tables and graphs for the crop appropriate to their interests. Show how the raw data are first summarised and then a graph made of the summarised data. Get them to complete Task 79.

- Discuss the implications of counts and graphs.

- Highlight those places where the data give an early indication of problems.

- Emphasise that the graph is a summary, not a table of raw data.
Implementation of IPM

76. Consider any difficulties you may have with using sticky traps.

Record Keeping

77. What points should you keep a weekly note of on your property?

Have a look at pages 4–14 and 4–15 (Ornamentals) or page 4–13 (Greenhouse Vegetables), for some tips.

Monitoring Plan

78. Prepare a simple monitoring plan that includes:

- how you will measure the number and type of pests
- who will do this on a regular basis
- what crops you want to monitor
- when you will monitor (daily, weekly, monthly, morning, afternoon or evening).

You might find it helpful to consult pages 4–5 to 4–7.

Case Study Exercise

79. Case Study exercise

The following tables are monitoring summary sheets for two crops, one chrysanthemum, the other a hydroponically grown cucumber crop. A graph of each table has been prepared.
Implementation of IPM – Trainer’s Guide
Select the crop type appropriate to you and complete the tasks.

Cucumber crop data

Table of sticky trap counts: cucumber

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<th>Fungus gnat</th>
<th>Thrips</th>
<th>Whitefly</th>
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<th>Aphid</th>
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Graph of sticky trap counts: cucumber

Sticky Trap Counts

- F.Gnats
- Thrips
- Whitefly
- Shore Fly
- Aphids
### Implementation of IPM

#### Table of crop inspection data: cucumber

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<th>Aphid</th>
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#### Graph of crop inspection percentages: cucumber

![Crop Inspection Graph](image)

- Spider Mite
- Greenhouse whitefly (adult)
- Greenhouse whitefly (immature)
- Thrips
- Aphid

*IPM ONfarm – Protected Cropping: Trainer’s Manual*
Ornamental crop data

Table of sticky trap counts: ornamentals

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Graph of sticky trap counts: ornamentals
Implementation of IPM

Table of crop inspection data: ornamentals

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Graph showing percentage of plants infested: ornamentals
Action thresholds

- Note that there is no single action threshold for any one pest for all situations: it is up to the manager to make his or her own decision.

- Emphasise that managers need to have a clear view of their action threshold for each crop.

- Discuss how participants can develop their own action thresholds through experience with the pest and its damage to their crops. See ‘Action thresholds’ on pages 4-12 to 4-14 (Ornamentals), or 4-11 and 4-12 (Greenhouse Vegetables).

- In small groups get participants to complete Tasks 80 to 83. Discuss the responses with the whole group.

- Give the answer to Task 80. Give examples of when biocontrol was successful and what the grower gained by not spraying.
On the basis of these data, what action if any, would you take?

What factors influenced your decision?

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**Action thresholds**

Refer to pages 4–12 to 4–14 (Ornamentals), or 4–11 and 4–12 (Greenhouse Vegetables).

80. Describe the difference between an action threshold and an economic damage threshold.

81. What is an example of an action threshold for a given pest in your crop?
Indicator plants

Task 84 is for the Ornamentals industry only.

- Have some examples of indicator plants in the classroom. Preferably include some showing symptoms of damage by viruses or bacteria and some that are healthy and intact.
- In small groups, complete Task 84. Discuss with the whole group.

Final preparation for IPM

- Discuss Task 85 and provide any repeat exercises that individual participants might identify and wish to undertake. Give them a few minutes to look back over their notes and workbooks before the discussion.
82. Refer to your response to Task 81. What actions are available to you and which would you implement at this stage?

83. Refer to your response to Task 81. What could you have done to prevent the pest from reaching this stage?

**Indicator plants (ornamentals only)**

Indicator plants could play an important role in your IPM plan. See page 4-14 (for ornamentals only).

84. Select a key pest for your crop(s) from the list provided and a plant that might be used to provide an early indication of its presence.

Where would you locate the indicator plants? (Hint, you may like to use your map.)

**Final preparation for IPM**

85. Do you feel you are properly prepared to implement an IPM program? If not, what extra information or training do you need?
On-farm course assignment

- Go over Task 86 with the whole group. Discuss each requirement and set a deadline for completion. Provide participants with your contact details, and undertake to go to their workplaces and discuss each assignment on site wherever logistically possible. Conduct a practice crop walk, perhaps in a greenhouse or in the gardens surrounding the classroom. You will need to have enough hand lenses, magnifying headbands and sticky traps for everyone. Demonstrate crop inspection and where to look for different pests.
On-farm course assignment

86. This exercise is designed to allow you to demonstrate your competency in implementing IPM and will be used to assess you for your Certificate of Attainment in the National Competencies in Horticulture, as outlined in this Course Workbook.

Task: Develop and implement an IPM program for your property

Time allowed to complete the exercise: Two months in winter, or one month at any other time of the year.

You may discuss this exercise with your group and the course presenter.

Here is what you need to do:

- Develop a physical plan of the property with buildings and any other features.
- Identify key pests and diseases in your crops.
- List steps that you could take on your property to minimise the risk of pests and diseases occurring in your crops.
- Compile a list of biocontrol agents available for the pests and diseases you have identified.
- Having in mind your biocontrol agents, compile a list of chemicals registered for use in your crops that would be suitable for your enterprise.
- Develop a management strategy for the pests and diseases that you might anticipate in your crops during this time; use biocontrol agents where possible.
- Prepare a monitoring plan. Follow the guidelines in this course.
- Monitor the crops and count sticky traps weekly, or fortnightly in winter.
- Keep a record of the monitoring data and graph your summary data either on an EXCEL spreadsheet, if you have a computer with Microsoft EXCEL, or by hand on graph paper.
- When you have completed this assignment, notify your course supervisor and arrange for an on-site appointment. Hand your completed assignment to the course supervisor and discuss the details.
Stage 4. Developing an IPM program

Assessment

For those who wish to be assessed for the relevant national competencies, the assessment task for this Stage is Task 95 in the Course Workbook. See the workbook for details.

This is a one-day course. Stage 3 is a pre-requisite for Stage 4.

Purpose of this stage

This is the most advanced Stage in the course. It is designed so that participants can confidently implement and manage an IPM program for their enterprises.

A note about the activities

In addition to providing an opportunity for a visit to an appropriate farm, this Stage also gives participants an opportunity to develop an IPM plan for their own enterprises.

Guest speakers

- Invite an IPM consultant to discuss his or her role in assisting growers to successfully practise IPM in a practical and affordable manner.

Resources

- access to an appropriate farm to run through the external on-farm assignment
- access to computers and the Internet for Task 93
Developing an IPM PROGRAM

- National competencies addressed in this training course are from the National Training Package in Horticulture:
  - RUHHRT412A Develop an integrated pest management program (all elements)
  - RUHHRT431A/01 Promote plant health (point 6 in element/01, Monitor factors that influence plant health; element/02, Diagnose plant health problems; points 1 & 3 in element 03, Remedy plant health problems; element 04/ Evaluate treatment programs)

Learners who successfully complete the on-farm assessment exercise will receive a Certificate of Attainment for the National Competencies listed above.

Course structure

- Designing an IPM Program
- Crop notes
- Access to information and advice
- On-farm course assignment

Reference material in the Information Guide

- Section 3 Preparing for IPM: property and staff
- Section 4 Designing an IPM Program: monitoring and decision making
- Sections 8 Crop Notes
- Sections 9 Directory
- Sections 10 Further Reading
- Section 11 Glossary
- Handy Guide 1 IPM Checklist
- Handy Guide 2 Crop Management
Tasks

Designing an IPM program

- Discuss the three-phase approach to designing and implementing IPM on a property. See pages 4-15 to 4-18 (Ornamentals), or 4-13 to 4-16 (Greenhouse Vegetables). Discuss the use of consultants. Run through the various steps that participants can take to improve property and crop hygiene and to prevent pests and diseases from occurring in the first place. Consider who needs to undertake training in IPM, who will have responsibility for the monitoring and decision-making, and the role of other staff. Discuss the development of an action plan for economic pests and diseases, including the use of biocontrol agents and biorational chemicals and emphasising their strategic usage. See page 3-28 (Ornamentals), or 3-27 (Greenhouse Vegetables), for a note on biorational chemicals.

- Complete Task 87.
- Complete Task 88. Discuss it with the whole group.
- Complete Task 89.
- In small groups complete Task 90. Discuss it with the whole group.
Purpose

You learn:

- how to identify the most appropriate approach to IPM for your enterprise
- to identify your staff training needs and where to obtain training in IPM for them
- to make an objective evaluation of the advantages of IPM to your enterprise
- how to use the IPM checklist (Handy Guide 1) before, during and after designing an IPM program
- how to use the Crop Management Guide, Handy Guide 2.
- how to apply your IPM knowledge into real practice on a property
- how you can contribute your knowledge towards an industry database of pests and diseases
- where to find more information on IPM and related issues.

Activities

- a visit to a production enterprise, critically evaluating the farm operation with regards to pest and disease management and making recommendations about improvements to pest and disease management
- evaluating your present pest and disease management program
- developing an IPM program for your own property

Tasks

Note that all suggested reading associated with page numbers in this Workbook refers to the Information Guide by Section and then page number, for your industry.

Designing an IPM program

See Section 4 Designing an IPM Program in the Information Guide. Refer to pages 4–15 to 4–18 (Ornamentals), 4–13 to 4–16 (Greenhouse Vegetables) Putting it all together.

87. Discuss the relevance of the three-phase approach to your enterprise. Tick off any of the elements in Phases I–III that you feel you have already put in place. Remember that there are no time-lines on adopting any particular phase.

Crop notes

- Complete Task 91. Discuss it with the whole group.
- Discuss Task 92 with the whole group.
89. How and to whom would you delegate responsibility for ensuring that the property was IPM-ready?

90. Refer to Handy Guide 2 Crop Management for Ornamentals. You might find it useful to refer to this Guide through each crop cycle. Are there any other points you can add? Discuss this Section.

Crop notes

For tasks 89–90 see Section 8 Crop notes.

91. Test your familiarity with pests and diseases that occur on your own property by listing them and noting when you would be on the lookout for them. Name the crops affected.

92. Describe your management program for dealing with the pests and diseases above.
Access to information and advice

- Complete Task 93 if access to the Internet is available.
- Complete Task 94. The trainer should have some examples to contribute to the discussion. Discuss the task with the whole group, and list responses on whiteboard or butchers’ paper.
- In small groups discuss Task 95 and then report back to the whole group.

On-farm course assignment

- Ask participants to design an IPM program for their enterprises and to implement it for four weeks. They should submit documentary evidence, including the steps discussed in ‘Designing an IPM program’ above, as final evidence of their competency.
- Draw up an outline of a plan for the group. Get participants to record it and take it home for modification so that it suits their own situations. This method will make it theirs rather than yours.
- Visit an appropriate farm and demonstrate what is required in the assignment.
Access to information and advice

For tasks 91–92 have a look at Section 9 Directory and Section 10 Further Reading.

93. If a computer with Internet access is available, access one or more of the IPM websites and comment on their relevance to your operation.

94. Where do you currently access information on pest and disease management issues? List your sources and discuss them with the group. Have you come across any other businesses or reading material that you would like to add to the list?

95. Have you ever contacted a consultant, and did you feel that this was helpful? Discuss where you feel you particularly need outside help, and whether the Directory is appropriate to your needs.

On-farm course assignment

96. Task: Prepare an outline for an IPM program for your workplace

Time allowed to complete the exercise: One month.

Submit documentary evidence for completion of attainment.

Use information in Section 3 Preparing for IPM and Section 4 Designing an IPM Program to outline your present pest and disease management practices.

Assign an estimate of annual costs to this program: separate the costs for time, labour and materials.

Prepare an outline of a new IPM program for your operation, using the phased approach. See page 4–15 to 4–18 (Ornamentals), 4–13 to 4–16 (Greenhouse Vegetables) and use Handy Guide 1 as a reference.

Indicate:

- site considerations
- crop(s)
- known key pests and diseases
- staff involvement and training needs
- equipment required
- external assistance and level of service needed
- recording methods
- monitoring schedules
- timetable for commencement and target dates for key steps
Developing an IPM Program

- likely costs of the new program (time, labour, materials) and any other pieces of information you feel would be necessary at your workplace or are unique to your workplace.

- your course supervisor and arrange for an on-site appointment. Hand your completed assignment to the course supervisor and discuss the details.