



NSW DEPARTMENT OF
PRIMARY INDUSTRIES

Readers' Note

This document is part of a larger publication. The remaining parts and full version of the publication can be found at:

<http://www.dpi.nsw.gov.au/agriculture/horticulture/stone-fruit/summerfruit-ipdm>

Updated versions of this document can also be found at the above web address.

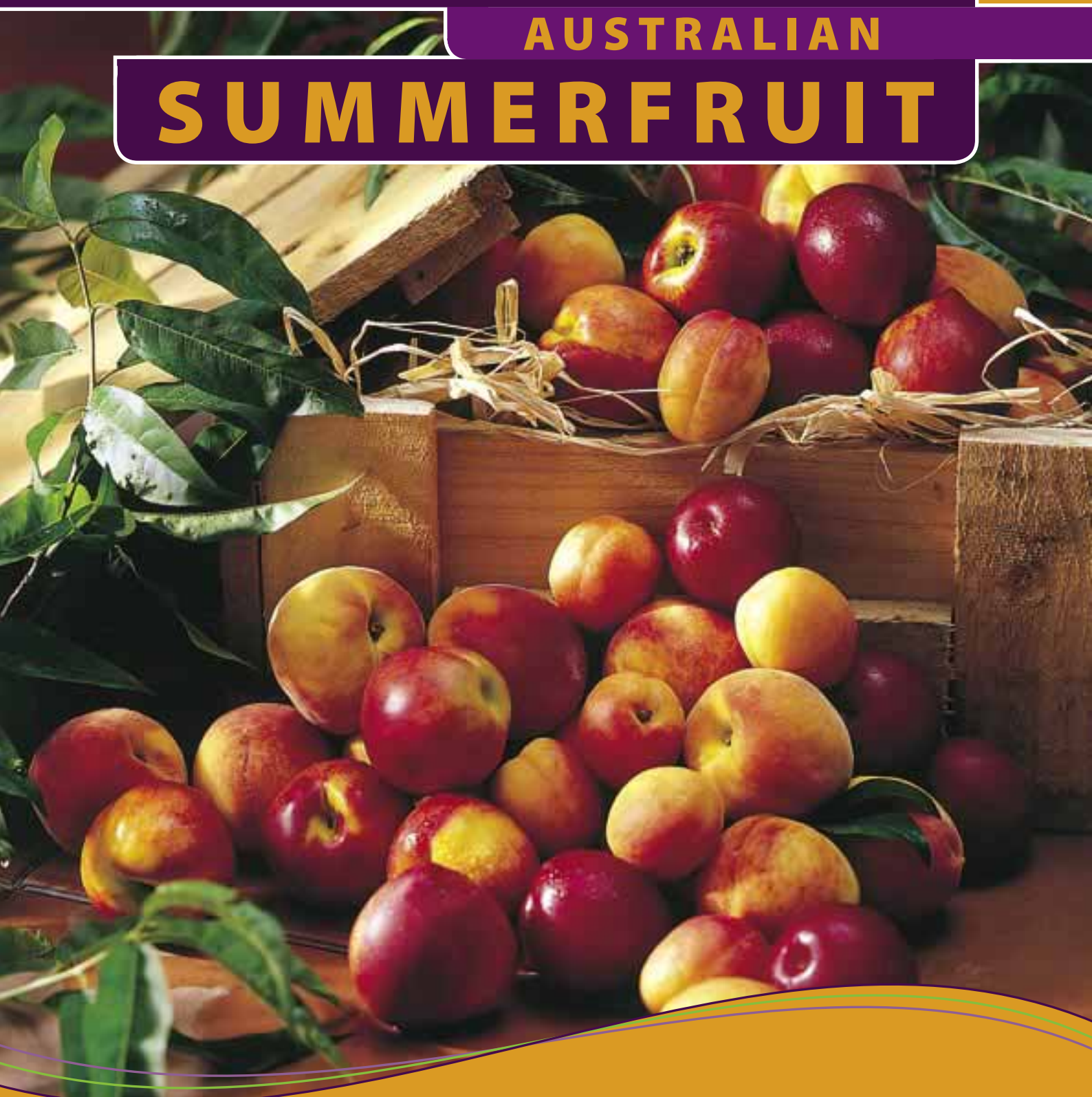
This document is subject to the disclaimers and copyright of the full version from which it is extracted. These disclaimers and copyright statements are available in the appropriate document at the above web address.



INTEGRATED PEST AND DISEASE MANAGEMENT FOR

AUSTRALIAN

SUMMERFRUIT



Disclaimer

This document has been prepared by the authors for Summerfruit Australia Inc. in good faith on the basis of available information.

While the information contained in the document has been formulated with all due care, the users of the document must obtain their own advice and conduct their own investigations and assessments of any proposals they are considering, in the light of their own individual circumstances.

The document is made available on the understanding that Summerfruit Australia Inc., the authors and the publisher, their respective servants and agents accept no responsibility for any person acting on, or relying on, or upon any opinion, advice, representation, statement or information whether expressed or implied in the document, and disclaim all liability for any loss, damage, cost or expense incurred or arising by reason of any person using or relying on the information contained in the document or by reason of any error, omission, defect or misstatement (whether such error, omission or misstatement is caused by or arises from negligence, lack of care or otherwise).

While the information is considered true and correct as at December 2005, changes in circumstances after the time of publication may impact on the accuracy of the information. The information may change without notice, and Summerfruit Australia Inc., the authors and the publisher and their respective servants and agents are not in any way liable for the accuracy of any information contained in this document.

The product trade names in this publication are supplied on the understanding that no preference between equivalent products is intended and that the inclusion of a product name does not imply endorsement by Summerfruit Australia Inc. over any equivalent product from another manufacturer.

Recognising that some of the information in this document is provided by third parties, Summerfruit Australia Inc., the authors and the publisher take no responsibility for the accuracy, currency, reliability and correctness of any information included in the document provided by third parties.

Always read the label

Users of agricultural or veterinary chemical products must always read the label and any permit, before using the product, and strictly comply with the directions on the label and the

conditions of any permit. Users are not absolved from compliance with the directions on the label or the conditions of the permit by reason of any statement made or not made in this publication.

© The State of New South Wales, NSW Department of Primary Industries
Summerfruit Australia Inc. 2005

ISBN 0 7347 1675 3

Prepared by Shane Hetherington

Edited by Ann Munroe

Designed by Gecko Photographics, Orange NSW 2800
Orange, December 2005

Acknowledgments and contributors

Coordinating author

Shane Hetherington

Contributing authors

Staff from several State Government departments of agriculture and primary industries wrote and provided expert advice on most chapters in this manual. Specific contributions were made by Mofakhar Hossain and David Williams of the Department of Primary Industries Victoria; they wrote most of the text for the oriental fruit moth and *Carpophilus* beetle chapters. Penny Domeney (Department of Primary Industries, Water and Environment, Tasmania) and Christine Horlock (Queensland Department of Primary Industries and Fisheries) provided technical feedback on various aspects of this manual, particularly on the bacterial spot and earwig chapters.

In formulating strategies for individual pests and diseases, valuable technical input was made by many people, including the following:

The project team

Ms Penny Domeney, Department of Primary Industries, Water and Environment, Tasmania

Ms Sandra Hardy, NSW Department of Primary Industries

Dr Mofakhar Hossain, Department of Primary Industries Victoria

Dr Peter Nimmo, Queensland Department of Primary Industries and Fisheries

Mr Graham Thwaite NSW Department of Primary Industries (retired)

Mr Bruce Valentine, Valentine Horticultural Services

Fruit fly

Dr Andrew Jessup, NSW Department of Primary Industries Gosford Horticultural Institute

Bernie Dominiak, NSW Department of Primary Industries

Mr Peter Gillespie, NSW DPI, Orange Agricultural Institute

Western flower thrips

Ms Sandra Hardy, NSW Department of Primary Industries Gosford Horticultural Institute

Dr Marilyn Steiner, NSW Department of Primary Industries Gosford Horticultural Institute

Mr Graham Thwaite, NSW Department of Primary Industries (retired)

Bacterial spot

Ms Christine Horlock, Queensland Department of Primary Industries and Fisheries Applethorpe Research Station

Dr Bruce Topp, Queensland Department of Primary Industries and Fisheries Maroochy Centre for Subtropical Fruit

European earwigs

Dr Adrian Nicholas, Tamworth Agricultural Institute

Two-spotted mites

Dr Andy Ryland, Beneficial Bugs

Pest and disease susceptibility of cultivars

Dr Roy Menzies, NSW Department of Primary Industries, Bathurst Agricultural Research and Advisory Station

Birds as pests of summerfruit

Mr John Tracey, NSW Department of Primary Industries, Orange Agricultural Institute

Viral diseases of summerfruit

Dr Michael Barkley, NSW Department of Primary Industries, Elizabeth Macarthur Agricultural Institute

Carpophilus beetles and oriental fruit moth

Mr David Williams, Department of Primary Industries Victoria Tatura Centre

Photography

All images supplied by photographers other than the author are acknowledged, but particular thanks to:

Dr DPF De Lima, Department of Agriculture
Western Australia

Scott Bauer, United States Department of
Agriculture Agricultural Research Service

Mr David Pickering, NSW Department of
Primary Industries

Clemson University: United States Department
of Agriculture Cooperative Extension Slide
Series, University of Georgia

Thanks also to the extension staff from various
State Government departments of primary
industries and agriculture who helped run the
grower meetings that provided the focus for this
manual.

Particular thanks to the industry-minded
orchardists who contributed their valuable
time to attend the project meetings that gave a
practical focus to this manual.

Funding

This manual was funded through Horticulture
Australia Limited from the National
Summerfruit Levy, with a matching financial
contribution from the Commonwealth

Government. Summerfruit Australia Limited
approved funding for this project to help the
Australian summerfruit industry in its transition
to integrated pest and disease management.

Dr Shane Hetherington
Deciduous Fruits Pathologist
NSW Department of Primary Industries

Contents

ACKNOWLEDGMENTS AND CONTRIBUTORS	iii
ABOUT THIS MANUAL	viii
WHAT IS IPDM?	ix
MAKING THE DECISION TO USE IPDM: PERSONAL CHOICES	ix
SOME IPDM TERMS DEFINED	x

SIX STEPS TO CONTROLLING SUMMERFRUIT PESTS AND DISEASES 1

STEP 1: SET UP AND MAINTAIN YOUR ORCHARD TO MINIMISE PESTS AND DISEASES	3
STEP 2: START THE SEASON WITH A PLAN	4
STEP 3: MONITOR	7
STEP 4: TAKE ACTION ONLY IF YOU NEED TO	8
STEP 5: WHEN THE LAST OF THE FRUIT IS SOLD, EVALUATE YOUR SEASON	8
STEP 6: PLAN FOR NEXT SEASON	9

PEST AND DISEASE FACT SHEETS 11

SUMMARY OF PEST AND DISEASE MONITORING TIMES	12
BACTERIAL CANKER	14
BACTERIAL SPOT	18
BLACK AND GREEN PEACH APHIDS	23
BLOSSOM BLIGHT AND BROWN ROT	27
CARPOPHILUS BEETLE	32
EUROPEAN EARWIG	37
FRECKLE	40
FRUIT FLY (QUEENSLAND AND MEDITERRANEAN)	43
LEAF CURL	50
LIGHTBROWN APPLE MOTH	53
ORIENTAL FRUIT MOTH	57
PEACH WHITE SCALE	63
PLAGUE THRIPS AND WESTERN FLOWER THRIPS	65
RUST	70
SAN JOSÉ SCALE	74
SHOT-HOLE	77
SILVER LEAF	80
TWO-SPOTTED MITE	84

OTHER PESTS AND DISEASES OF AUSTRALIAN SUMMERFRUIT 89

ARMILLARIA	90
CROWN GALL	91
FRUIT-SUCKING INSECTS	91
FRUIT TREE MOTH BORER	92
FUNGAL GUMMOSIS	93
HELIOTHIS	94
MEALYBUG	94
MITES	95
MONOLEPTA	95
NEMATODES	96
PAINTED APPLE MOTH	96
PEAR AND CHERRY SLUG	97
PHYTOPHTHORA ROOT AND COLLAR ROTS	97
POSTHARVEST DISEASES	99
POWDERY MILDEW	99
RUTHERGLEN BUG	100
VIRAL DISEASES	101
WEEVILS	102
WINGLESS GRASSHOPPER	102

BIOLOGICAL CONTROL 105

NATURAL ENEMIES	107
COMMERCIAL BIOLOGICAL CONTROL AGENTS	109
BIOLOGICAL CONTROL AGENTS AND PESTICIDES	112
SUPPLIERS OF BIOLOGICAL CONTROL AGENTS AND MORE INFORMATION	119

REDUCING THE IMPACTS OF BIRDS IN HORTICULTURE 121

INTRODUCTION	122
MANAGEMENT OPTIONS	124

FORMS, SCHEDULES AND RESOURCES	129
MITE MONITORING FORM FOR AUSTRALIAN SUMMERFRUIT	130
MONITORING FORM FOR DISEASES OF AUSTRALIAN SUMMERFRUIT	131
MONITORING FORM FOR INSECT PESTS OF AUSTRALIAN SUMMERFRUIT	132
USEFUL CONTACTS	133
USEFUL READING	135
SPRAY SCHEDULES	137
PLUMS	138
PEACHES AND NECTARINES	143
APRICOTS	152
LOW- AND MEDIUM-CHILL SUMMERFRUIT (NECTARINES, PEACHES, PLUMS)	156
INDEX	165

About this manual

Introduction

This manual outlines the Australian summerfruit IPDM strategy.

From its initiation, this strategy has involved collaboration between Australian summerfruit orchardists, researchers and extension specialists. The objective was to create a strategy that gave practical pest and disease management options instead of 'warm fuzzy' philosophy.

The information-gathering phase of the strategy involved 66 peach orchardists, 65 nectarine orchardists, 50 plum orchardists and 31 apricot orchardists in 13 Australian Summerfruit regions in six Australian states. The objective was to identify the problems that were most important to industry. Orchardists were asked what their major pest and disease problems were. This series of interviews took place before and after the 2003–04 fruit season. Many of Australia's orchard regions were in the grip of a long-running drought. The interviewees were asked to compensate for the possible reduction in pest and disease problems due to the drought by recalling their problems from up to 10 years ago.

Australian summerfruit is grown in a range of climatic zones from the sub-tropical low-chill enterprises of the northern states to the cold temperate zones of Tasmania. Naturally, the pest and disease problems experienced by orchardists in our regions are diverse. The creation of a national strategy was therefore challenging. This manual deals with this diversity by providing information on which regions have had problems with specific pests and diseases over the past 10

years. Where the information provided is region-specific, this is highlighted in the manual.

This manual provides a framework for setting up IPDM in your orchard. Many orchardists will want to be personally responsible for monitoring and decision-making. Others may not have the confidence or time to do this. Consultants are available for this work in most regions. In any case, a successful IPDM program will save money and improve your orchard and personal health.

As we moved about the country asking questions, we realised that some of the issues being raised weren't quite what we expected. Bird damage was an issue that came up at almost all of the meetings. Initially we wanted to limit the manual to insect pests and diseases, but birds were such an issue that we invited a guest author to write a section on bird control. John Tracey works for the NSW Department of Primary Industries and is a respected authority on control of pest birds in horticulture. His article can be found on page 122.

Many orchardists were interested in the life cycles of their pests and diseases and wanted this included in the manual. This was difficult, because life cycles vary from region to region, usually in line with temperatures. The manual therefore presents a representative life cycle for each pest and disease. In most cases (except where noted) this life cycle is typical for the Goulburn Valley or the NSW Central West. Orchardists should make their own modifications to this to suit their region.

What is IPDM?

IPDM is 'Intelligent Pesticide Decision Making'. Alternatively (and more conventionally) IPDM is integrated pest and disease management. More simply, IPDM involves evaluating your pest and disease problems and then applying the most appropriate solution. The complication is that, when choosing this option, you must consider its impact on the entire block. For example, applying bifenthrin for a small *Carpophilus* beetle infestation may kill the natural enemies of mites. This, in turn, may create larger problems (and lose you more money) by creating a two-spotted mite problem.

Fewer pesticides are used in well-run IPDM programs. Although this isn't the overall objective of IPDM, it is a natural consequence of considering the entire range of control options available. When an orchardist using IPDM chooses a management option, it is because

it is the most effective at controlling the pest or disease, without any bias toward or against chemical pesticides or other management options.

Prevention of pests and diseases is also an important component of IPDM. Many problems can be avoided by making your orchard an inhospitable place for pests and diseases. Some general strategies for doing this are outlined in this manual (page 1), and specific prevention strategies for each pest and disease are given throughout.

The key to IPDM success is to keep good records. Records should be used to think about what you're currently doing and honestly evaluate whether you're choosing the best options. This allows you to constantly refine your management strategy and cope with new threats.

Making the decision to use IPDM: personal choices

Australian summer fruit orchardists are understandably conservative. Bad and damaged fruit costs money. Our survey of Australian orchardists showed that an average pack-out of 96.2% of picked fruit is acceptable. To move toward IPDM, orchardists are willing to accept a slight reduction in pack-out, to 95%. Of course, these figures are averages and vary widely among individual orchardists, regions, types of pest and disease damage and crops. Some orchardists are willing to accept up to a 10% reduction in pack-out.

IPDM involves making personal choices about what you think is acceptable and what level of risk you're willing to accept. There are no firm rules and regulations.

A well run IPDM program involves no reduction in pack out. However, during the first few seasons inexperience means that mistakes will happen. The strategy in this manual provides a way of minimising that risk:

- **Start small:** Orchardists with limited experience in IPDM should never convert an entire enterprise or a large, high-value block during the first seasons of transition. Start with a small, low-value block until you build up confidence.
- **Take it step by step:** Change one aspect of your pest management and evaluate the impact of the change over several seasons. At the end of each season modify the strategy until you're happy with the result. Gradually introduce changes to other management practices.

Some IPDM terms defined

IPDM comes with its own jargon. The terminology is quite simple and will help you to understand this manual. It's important that you understand the following four terms and the relationship between them.

1. Monitoring

Monitoring is a structured system for quantifying the likelihood of pests and disease becoming a problem in the orchard. It involves either:

- carefully monitoring certain trees in the orchard, paying particular attention to trees prone to problems (i.e. hot spots), or
- carefully monitoring the weather for conditions likely to favour pests or diseases.

2. Sample unit

This is the precise item that is monitored. For example:

- if two-spotted mite is being monitored, the sample unit is a leaf
- if bacterial canker is being monitored, the sample unit is a limb
- if rust is being monitored, the sample units are the temperature and rainfall.

3. Action threshold

This is the point in time when monitoring indicates that damage to the crop will be unacceptable unless the pest or disease is managed. The action threshold can be the time at which:

- a certain number of pests is seen while monitoring
- a certain amount of damage is seen while monitoring
- the weather is so favourable to a pest or disease that it is almost certain that damage will follow.

4. Appropriate action

When the action threshold has been reached appropriate action must be taken. Appropriate action must:

- be effective over a relatively long period
- not cause secondary problems.