Rubus Integrated Pest Management Poster Calendar 2012

Michele Buntain
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Rubus IPM Poster Calendar 2012

Penny Domeney and Michele Buntain

Perennial Horticulture Centre

Tasmanian Institute of Agriculture

RB12000

Michele Buntain
Perennial Horticulture Centre
Tasmanian Institute of Agriculture
New Town Research Laboratories
St Johns Ave New Town TAS 7008
Phone: +61 3 6233 6814
Mobile: +61 429 957 975
Email: michele.buntain@utas.edu.au

Penny Domeney
Email: penny.domeney@yahoo.com.au
Mobile: +61 429 194 612

The purpose of this report is to inform readers about the development, adoption and impact of the Rubus IPM poster calendar. It provides recommendations for future extension of integrated pest and disease management information to the rubus industry in Australia.

Acknowledgements

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19 June 2013

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Media Summary

Integrated pest and disease management or IPDM uses a range of management strategies to achieve economic pest and disease management. IPDM relies on understanding the lifecycles of pests, diseases and beneficial organisms and monitoring their numbers in the crop. This allows the most appropriate management strategy to be used at the right time. A natural consequence of well-run IPDM is less reliance on and use of pesticides.

The Rubus industry in Australia has employed IPDM strategies for many years. However the information was not easily accessible in one place. The Rubus industry identified the need for a quick-reference poster that presents the information in a pictorial format that can be displayed in the farm office or packing shed. The aim of this project was to produce a relevant and useful IPDM poster for the Australian Rubus industry.

In December 2012, the IPDM poster for Raspberries and Blackberries was distributed to 150 rubus growers throughout Australia. The calendar displays photos and information on plant growth stages matched to corresponding insect/disease life stages. This is linked to the four management strategies of monitoring, cultural control, biological control and chemical control to give growers the information they need to make informed pest and disease management decisions.

A phone survey of rubus growers was conducted to evaluate the usefulness and relevance of the calendar to their business. The major recommendations from this survey included:

1. Develop alternative IPDM resources for the rubus industry including:
    - A pocket or glove box IPDM guide
    - IPDM Smart Phone app.
    - An updated RABA website pages with IPDM information
2. Produce a simplified calendar focusing on photos, lifecycles and monitoring whilst maintaining links to crop growth stages

Introduction

The Rubus industry in Australia has employed IPDM strategies for many years. However, critical control strategies have not been collated into one readily accessible document. The Rubus industry identified the need for a quick-reference poster that presents the information in a pictorial format that can be displayed in the farm office or packing shed. The aim of this project was to produce a relevant and useful IPDM poster for the Australian Rubus industry.

Integrated pest and disease management (IPDM) calendar posters for perennial horticulture industries have proved popular and effective. They serve to raise awareness about integrated pest and disease management strategies, highlight the importance of monitoring and timing of management activities, and act as a quick visual reference for identification of pests and beneficial organisms. Their main attraction is easy accessibility of information in one place. Industries that have adopted a calendar approach to the extension of IPDM information include the National cherry industry, the Tasmanian wine grape industry and the Tasmanian apple industry with conventional and organic versions. Distinct from a conventional ordinal calendar, the IPDM calendar poster is arranged so that plant growth-stages rather than dates correspond to insect and disease life stages. This links these environment driven biological processes and provides a logical connection between the two. The calendar design aims to visually integrate plant and pest life cycles with management strategies.

The desired short term outcome of an IPDM calendar poster for the rubus industry is to increase grower awareness of IPDM strategies. In the longer term, the IPDM calendar represents an additional tool supporting industry wide adoption of IPDM. This can lead to better environmental outcomes, improved business outcomes related to more sustainable production practices and OH&S improvements for staff from reduced chemical inputs on the farm. Improved biodiversity at the micro-level associated with successful IPDM enhances biodiversity at the farm level with flow on effects for the surrounding human and natural communities. The benefits of sustainable production practices are shared by the wider community.

Technology transfer

Poster content

Grower survey

A survey of raspberry and blackberry producers was conducted to determine the priority pests and diseases to be included on the IPDM poster. Selected survey participants included raspberry and /or blackberry producers representing all production regions of Australia and a diversity of production systems, from organic to intensive protected cropping. Producers were provided with a list of known pests and diseases of rubus crops in Australia. They were asked to indicate how frequently economic damage occurred or how frequently they needed to take action to prevent economic damage. The 4 choice options included:

- **Option 1:** (3 points) Economic Damage occurs **every year** or protectant activities for their control are required **every year**
- **Option 2:** (2 points) Economic Damage occurs **every 2nd year** or protectant activities are required **every 2nd year** for their control
- **Option 3**: (1 point) Economic Damage or protectant activities for their control have been used **but less than 1 in every 2 years**
- **Option 4**: (0 points) No economic damage has occurred and /or no crop protection has been used

The results of this survey are presented in Table 1.

The priority list of rubus pests and diseases are detailed in Table 2.

Table 2: Priority rubus pests and diseases

Common Name	**Scientific name**
Pests	
Bugs (green vegetable bug, stink bug)	*Nezara viridula, Plautia affinis*
Dried Fruit Beetle	*Carpophilus spp.*
Queensland Fruit Fly	*Bactrocera tryoni*
Heliothis	*Helicoverpa puncitgera*
Light Brown Apple Moth	*Epiphyas postvittana*
Loopers	*Chrysodeixis argentifera*, *Ectropis excursaria* (native twig looper)
Thrips (plague thrips, onion thrips)	Thrips imaginis (Plague) Thrips tabaci (Onion)
Two-spotted mite	*Tetranychus urticae*
Diseases	
Grey mould	*Botrytis cinerea*
Downy mildew	*Peronospora* sparsa
Powdery mildew	*Podosphaera aphanis*
Phytophthora	*Phytophthora spp.*
Yellow rust	*Phragmidium rubi-idaei*

Table 1: Survey of the economic importance of pests and diseases of raspberries in Australia

	1	2	3	4	scientific name	Score	Rank
Pest	every year	2 out of 3 yrs	1 in 3 yrs or less	Not seen			
dock sawfly		1	2	3	*Ametastegia glabrata*	4	
looper	5			1	*Chrysodeixis argentifera*	15	**3**
heliothis	5		1		*Helicoverpa puncitgera*	16	**2**
light brown apple moth	6				*Epiphyas postvittana*	18	**1**
earwigs	1		2	3	*Forficula auricularia*	5	
beetles and bugs	4		1	1		13	
harlequin bug	1	2	2	1	*Dindymus versicolor*	9	
Rutherglen bug		5	1		*Nysius vinitor*	11	
green stink bug	4	1		1	*Plautia affinis*	14	**4**
green vegie bug	4		1	1	*Nezara viridula*	13	**5**
mealy bug			1	5	*Pseudococcus spp.*	1	
dried fruit beetle	4			2	*Carpophilus spp.*	12	**6**
weevils		2	3	1	*Otiorhynchus sulcatus*	7	
snails/slugs	2	1	2	1	*Gastropoda, Helix aspersa*	10	
grasshoppers	2	1	1	2	*Orthoptera*	9	
aphids	2	2	1	1	*Myzus spp.*	11	
thrips	3	1	1	1	*Thrips imaginis*	12	**6**
whitefly		2	2	2	*Trialeurodes vaporariorum*	6	
passion vine hopper			2	4	*Scolypopa australis*	2	
Qld Fruit fly	2			4	*Bactrocera tryoni*	6	
Mediterranean fruit fly			1	5	*Ceratitis capitata*	1	
two spotted mite	3	3			*Tetranychus urticae*	15	**3**
European red mite		2	1	3	*Panonychus ulmi*	5	
broad mite	2	2		2	*Polyphagotarsonemus latus*	10	
bean spider mite	2	2		2	*Tetranychus ludeni*	10	
Disease							
anthracnose	1	2	1	2	*Elsinoe veneta*	8	
grey mould	5	1			*Botrytis cinerea*	17	**1**
cane botrytis	1	3	1	1	*Botrytis cinerea*	10	**5**
Rusts	4	1	1		*Phragmidium rubi-idaei*	15	**2**
Phytophthora	4	1		1	*Phytophthora spp.*	14	**3**
verticillium	1	1	2	2	*Verticillium*	7	
crown gall		1	4	1	*Rhizobium radiobacter*	6	
leaf spot	2	3		1	*Septoria rubi*	12	**4**
downy mildew	4		2		*Peronospora sparsa*	14	**3**
powdery mildew	1	1	2	2	*Podosphaera aphanis*	7	
Raspberry Bushy Dwarf Virus		2	3	1	*RBDV*	7	

Literature review and photo collection

A review of the biology and current management practices for each priority pest and disease was conducted. The information on the poster summarises this literature. Photos were sourced from growers, researchers, IPM specialists and from trusted internet sources.

Poster design

The format of the poster was initially based on the Cherry Integrated Pest Management calendar developed by TIA for use by the Australian cherry industry. An initial hurdle to poster design was the geographic spread of production of rubus in Australia. Rubus production extends from Queensland in the north to Tasmania in the south and as far west as Western Australia. The pests and diseases have a lot of commonality but the production timing is vastly different with Northern Australia harvesting in the winter months whilst Southern Australia harvests in the summer months. The cost prohibited the production of two different posters. The decision was made to focus on crop growth stages to link with pest and disease critical life-cycle stages.

For each pest or disease, the poster was divided into five bands including 4 management options where applicable. They included

1. Life cycle – stages of development
2. Monitoring activities
3. Cultural management activities
4. Biological management activities
5. Chemical management activities

This design was selected with the understanding that growers use a wide variety of management strategies and to highlight the range of activities that can be undertaken in an integrated program. The listing order was deliberate to highlight the importance of understanding the life cycle and monitoring in any pest and disease management program. Colour coding was used to differentiate each management strategy.

Photos were an essential element of the poster design, aimed to be a quick ready reference for identification.

Poster review

To ensure accuracy and relevance of the poster information, a draft poster was reviewed by industry specialist (Cindy Edward), RABA Industry Development Manager (Alison Brinson) and HAL (Jodie Pedrana).

Promotion

The Fruit Growers Tasmania Berry night seminar in 2012 was an opportunity we took for pre-release promotion of the IPDM poster to both RABA members and non-members. This was combined with an IPDM berry presentation and quiz conducted by TIA staff at the berry night seminar. The poster was promoted through the E-newsletters ‘Berrylink’ (TIA) and RABA news.

Poster Dissemination

The printed poster (Appendix 1) was mailed to 120 businesses, including RABA members and allied support businesses in December 2012. The businesses represented all rubus production regions of Australia.

Evaluation and measurement of outcomes

A detailed phone survey of rubus growers was conducted to evaluate the impact and adoption of the IPDM poster for raspberries and blackberries. The survey was also used to gather information on how the poster could be improved and what other resources or activities would assist growers with the practice of integrated pest and disease management.

Survey participants were selected by RABA Industry Development manager, Alison Brinson, to represent a wide spread of geography, production systems, management expertise and size of enterprise.

The procedure for conducting the survey was reviewed and approved by the UTAS human ethics committee. An information sheet that described who was conducting the survey, the purpose of the survey and what it would entail was emailed to survey participants (Appendix 2). Each grower was given a unique code to ensure confidentiality of responses. The survey questions are detailed in Appendix 3.

Survey results

Demographics:
All survey participants received a copy of the poster but only 50% referred to it during the growing season. Most participants were experienced rubus growers with over 10 years' experience growing rubus crops (Figure 1).

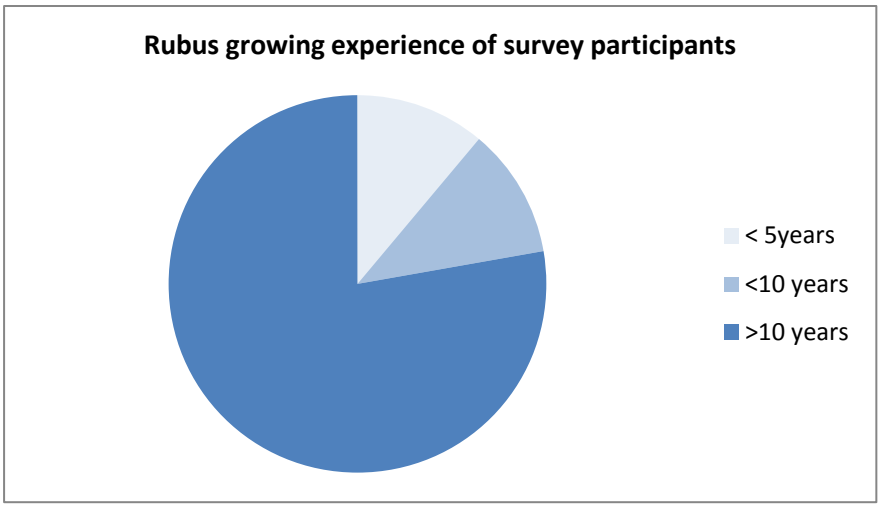


Figure 1: Survey participant's experience growing rubus crops

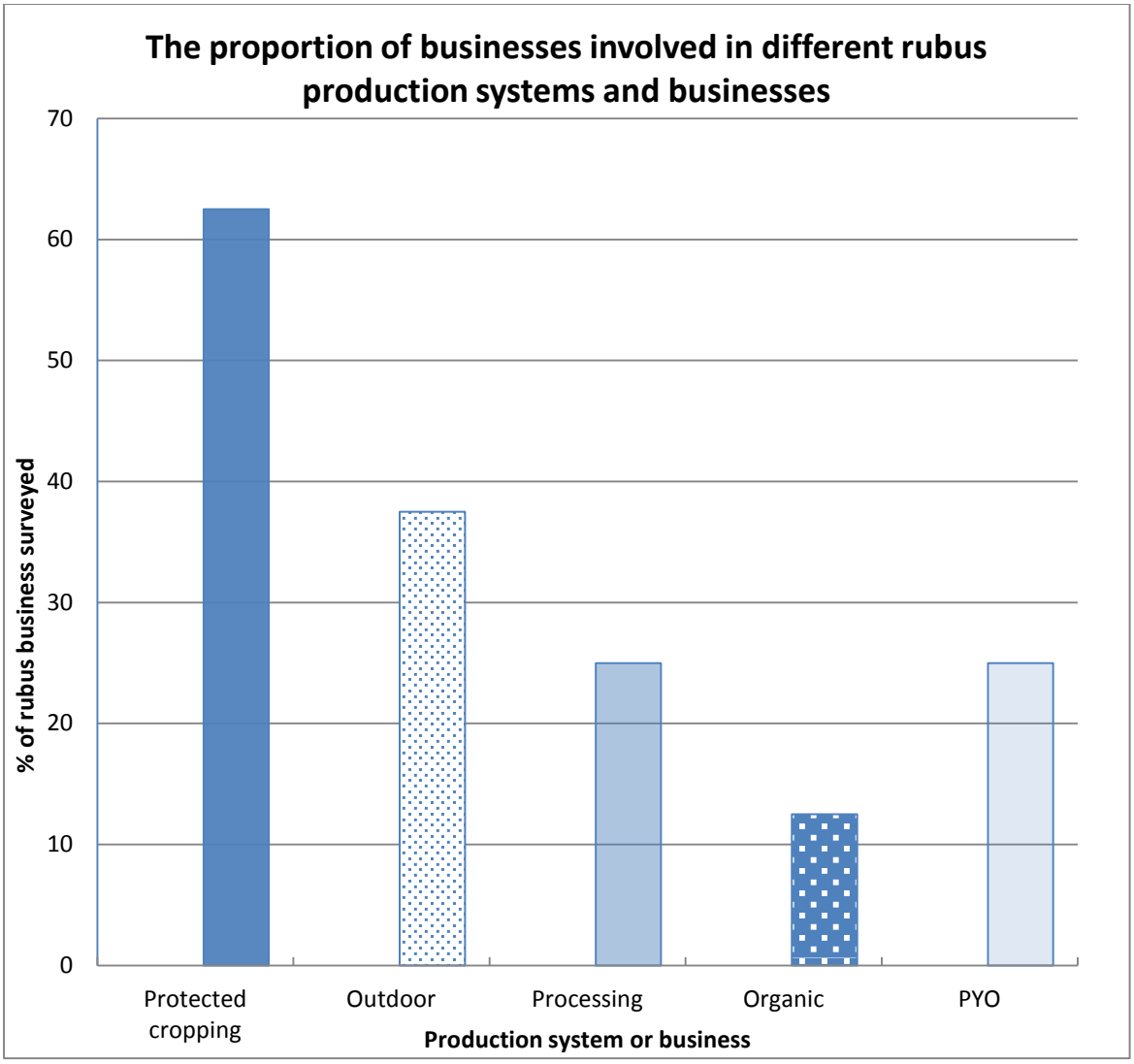


Figure 2: The production systems and business categories of survey participants

All survey participants produced fruit for fresh punnet sales. Over half survey participants grew rubus in a protected cropping system (tunnel production). Some business used fruit from their production for a variety of purposes including fresh punnet fruit, processing and organic production.

Poster use and location:
50% of growers had referred to the poster during the growing season with frequency of referral to the poster ranging from daily to infrequently. Responses on where they would keep the poster included:

- Still in tube – but to go on office wall (22%)
- On wall in managers office (33%)
- Lunch room – shared room for staff (22%)
- Packing shed (22%)

Several growers commented that a laminated poster would be ideal and that they were planning to laminate their poster.

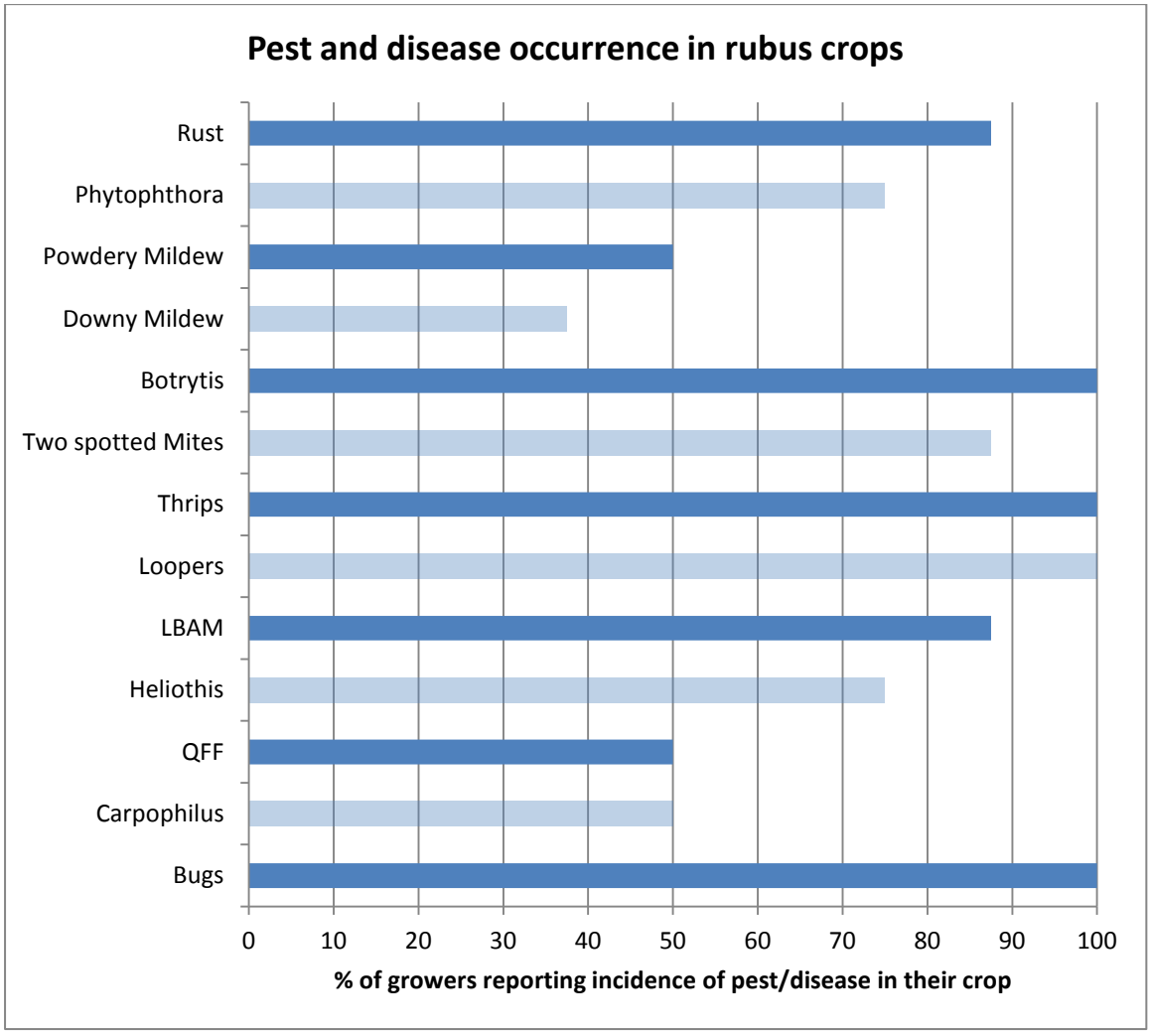
Poster layout

Growers were asked to rate the poster ranging from ***confusing*** (0) to ***clear and easy to find information*** (10). The overall rating was 5.6/10. Comments included:

- Too much information – want less on a poster, simplify
- Too busy – have to look too hard to interpret it and to find what you are looking for
- Would prefer calendar dates rather than growth stages for farm workers
- Landscape orientation may be better
- The poster replaced a large document so found the format useful but can't be read from a distance, a bit daunting the amount of detail
- Liked the layout in relation timing of activities being linked to crop growth stages that covered the whole season
- Bigger pictures would be better, lots of information was both excellent but took some effort to get what you needed.

Relevance/Usefulness of the poster

As a double check against the original survey of pest and disease occurrence in rubus crops, growers were asked if they had encountered any of the pests and diseases on the poster.



Growers commented on whether there were any pests or diseases not represented on the poster and if they had any specific comments about the pests and diseases represented:

Not represented on poster:

- Monolepta beetles (*Monolepta australis*) in millions from surrounding pasture and can strip raspberry leaves in half an hour (northern protected)
- Broad mite, mirids, white fly (northern protected)
- Harlequin and soldier beetles (southern outdoor)
- Aphids (southern protected)

Other comments on pests and diseases included

Northern (protected):

- Big issue is heliothis in October;
- Bugs are the biggest issue – stink bug, green vegetable bug, Rutherglen bug from October to January
- Rust – no effective chemical

Southern outdoor:

- Phytophthora is my biggest issue
- Garden weevil – not sure of importance, but present
- Mites and thrips are my biggest issue

Growers rated the usefulness of sections of the poster from ***not useful*** (0) to ***very useful*** (10).

1. Usefulness of photos

	Range	Score
Pest and disease photos	6-10	7.9
Beneficial photos	3-10	6.7

Comments on photos included:

- Size of photos is an issue, would be better if they were bigger (3 respondents)
- Prefer to use reference books or internet if looking to identify pests/beneficials
- Beneficial bug supplier sends out a calendar each season which has larger photos of pests and beneficials

2. Usefulness of monitoring information

	Range	Score
Monitoring information	5-10	7.6

The majority of growers indicated that they monitored frequently (87%) with the remainder monitoring sometimes (13%). Comments regarding monitoring included:

- Grower trains pickers to monitor (look)
- Most respondents said they monitor but as part of their daily operations rather than formalised monitoring with counts
- One employed someone specifically to monitor
- Erratic monitoring, no set strategy or formula
- Would like critical times highlighted for priority pests and diseases

3. Usefulness of cultural activity information:

	Range	Score
Cultural activity information	0-8	5.1

One grower commented that the cultural activity information was 'very relevant to my system of production'.

4. Usefulness of biological activity information

	Range	Score
Biological activity information	0- 5	4.1

Every grower surveyed used some form of biological agent in their crop every season with the majority releasing introduced biological control agents. Others used production systems that encouraged biodiversity, used resistant varieties and the establishment of natural predator populations. *Phytoseiulus persimilis* was the most common biological agent introduced. The use of ViVus virus and dipel for caterpillars was also noted. One grower commented that trichogramma wasps were hard to maintain for any length of time in the crop.

5. Usefulness of chemical activity information

	Range	Score
Chemical activity information	0- 5	2.8

The majority of growers used some form of chemical management every season (62%) with 12% only in some seasons. The remaining growers (12%) used only organic control agents. One grower commented that a list of registered chemicals and what they can be used for in raspberries would be useful addition to the calendar.

6. Management changes

Growers were asked if they were likely to change any aspect of their management based on information from the calendar poster. Only one respondent indicated that management practices would be changed. Positive comments from other respondents included:

- Heliothis management will be better particularly the timing of management, but a lifecycle graphic would be useful to enhance this
- The poster calls attention to IPDM, so that keeps it current in your management thinking
- The poster will help me schedule monitoring activities and be more proactive on timing of activities
- Unlikely, use own scientists to develop IPDM management strategies

7. **Most** useful features of the calendar poster:
    - Monitoring information
    - Photos for identification (50%)
    - Alignment of management practices with crop growth or activity stage

One grower gave the example of a packing lady asking what the bug was she had been finding in some fruit. He was quickly and easily able to show her the photo on the calendar.

8. **Least** useful features of the calendar poster

Two growers commented that the chemical management section was the least useful part of the poster.

9. Grower suggestions for improvement
    - Simplify threshold so that can categorise these as mild, moderate, severe OR Green, Yellow Red alert
    - Simplify
    - Less detail – photos are good
    - More diagrams of lifecycles
    - Multiple copies for multi farm organisations
    - Really good poster, a pocket guide would be more useful, more mobile
    - Time of year when pests occur rather than growth stages
    - List of registered chemicals including withholding periods for rubus
    - Need to put blue tack in with poster, it keeps falling off the wall!
    - Laminate the poster

Many growers surveyed commented that the poster was 'excellent' and 'having all the information in one location was useful'.

Other IPDM resources or activities for rubus growers
Growers were asked to select up to 3 resources or activities that they would find useful to their future IPDM.

Resource/activity	**Score**
IPM Record keeping resources (monitoring, spraying, etc.)	0
Pocket guide/Glove box guide	8
Fact sheets	6
Group training	1
Farm walks	1
Phone app.	8
Website links to IPDM information	8

The 3 equal top ranked activities or resources that growers selected were:

- A pocket or glove box IPDM guide
- IPDM Phone app.
- Website with IPDM information (preferably RABA website) or links from poster to IPDM website information

Discussion

The grower survey provides an insight into the usefulness of the Rubus IPDM poster calendar to industry and its immediate impact.

The majority of survey participants would be regarded as experienced growers with most having over 10 year's rubus production experience. Over half those surveyed grew rubus in a protected cropping production system, indicating a high level of management intensity and expertise. Potentially these growers would have a good level of self-education regarding IPDM and a motivation to actively acquire skill and information due to the intensive nature of the production system. This demographic has a bearing on the uptake and use of the poster.

A high level of participation in some form of IPDM prior to the release of the calendar poster was indicated by the high rate of crop monitoring and use of biological agents. However, the sophistication of an applied IPDM program was less apparent with many considering monitoring as 'observation' rather than having a formalised monitoring program where thresholds are used to make management decisions. One grower did employ a specialist to monitor pest and disease.

The usefulness of the IPDM poster calendar was rated more highly by those with less rubus production experience or new to Australia, but also indirectly by managers as an awareness tool for the many staff they employ.

The modest rate of reference to the calendar poster during the growing season by survey participants (50%) may reflect the demographic of those surveyed but also the timing of release and distribution of the calendar. The calendar was sent to growers in late December 2012 which would have coincided with the peak harvest period for southern production regions. This was not the ideal time for release and is reflected by the proportion of southern growers contacted who had not referred to the calendar at all. A few growers also commented that they were delaying displaying the calendar until it was laminated to protect it from the elements and extend its life. This, in itself, is an indication that growers value the poster. It was also noted that corporate growers with multiple farms would benefit from multiple copies of the poster.

The relevance of the pest and disease content of the poster was confirmed by the survey with only downy mildew occurring in less than 50% of crops. Downy mildew predominantly affects blackberries and very rarely raspberries. Blackberries are less commonly cultivated than raspberries which would explain the lower incidence of downy mildew. Specific pests not included on the calendar poster of concern to individual growers included

- Monolepta beetles (*Monolepta australis*); Broad mite; mirids; white fly (northern protected)
- Harlequin and soldier beetles (southern outdoor)
- Aphids (southern protected)

The overwhelming response from survey participants was that the content and layout of the poster calendar needed simplifying to be more user friendly in the poster format. Although the amount of detailed information was appreciated by many, it was also considered daunting and took effort to interpret and read.

The most useful and highest rated sections of the poster were the photos, monitoring information and alignment of management practices with crop growth stages. A better format for a future calendar poster could be a focus on photos, life cycles and monitoring information with an easy to interpret alert system.

Indirectly, many survey participants indicated that a useful function of the calendar was in raising awareness amongst the staff they employ during both the growing season and harvest. These are the people who are often the first to notice pest and disease in their day to day contact with the crop.

Even though the majority of growers indicated they were unlikely to change management practices based on the information from the calendar poster, the positive comments indicated that the poster had an ongoing impact on their awareness of IPDM practices and in particular the scheduling and timing of management operations. The changes to management practices may be more subtle due to the level of rubus growing experience of the survey participants.

The rubus IPDM calendar poster may have attempted to be all things to all growers and included an impressive level of detail. Possible alternatives for future poster development include:

- Posters developed for specific production systems or geographical locations: protected cropping and outdoor production posters; northern and southern Australian posters
- A simplified poster with photos and monitoring being the focus with links to more detailed information delivered as either hard copy or web/smart phone applications.

The development of future IPDM resources favoured by growers included:

1. A pocket or glove box IPDM guide
2. IPDM Smart Phone app.
3. Website with IPDM information (preferably RABA website) or links from poster to IPDM website information

The phone survey conducted provided a small window on the short term impact of the rubus IPDM poster calendar. Its value is seen by the many positive comments, suggestions for improvement and ideas for the development of alternative IPDM resources.

Recommendations

The recommendations are based on feedback received from the phone survey of rubus growers. This survey captured the views of a small proportion of industry participants who represent the wide diversity of rubus growers from all production regions of Australia.

1. Investigate the feasibility of developing additional IPDM resources highlighted by the grower survey:
   - A pocket or glove box IPDM guide
   - IPDM Smart Phone app.
   - Website with IPDM information (preferably RABA website) or links from poster to IPDM website information

   In particular, RABA has the potential to increase the value of its website by including IPDM information specific to Australia.

2. For future IPDM poster calendar development, consider a simplified version which focuses on photos, lifecycles and monitoring whilst maintaining the links to crop growth stages. Linking this resource to more detailed information would be valuable. Developing alternative calendars for southern and northern production regions or protected and outdoor production could also be considered in recognition of the differences in crop development and pest occurrence.

3. Distribution of extension information such as a poster would ideally be timed to coincide for maximum uptake, being pre-season. Distributing extra copies to RABA members with multiple farms would be an advantage. Lamination of future posters could be considered.

4. RABA has the opportunity to liaise with growers who identified specific pests that were not represented on the calendar poster. These pests may be emerging new pests of significance associated with new production regions or production systems.

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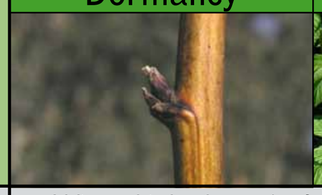
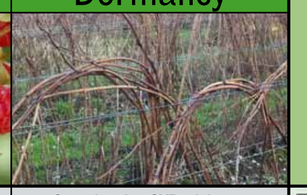
INTEGRATED PEST&DISEASE MANAGEMENT for Raspberries and Blackberries

raba Raspberries & Blackberries Australia

Raspberries and Blackberries Australia
PO Box 145, WANDIN NORTH VIC 3139
www.arga.com.au

IPM is simply integrating all your management activities with the aid of an action plan developed for specific crop stages. Effective management of any pest or disease is rarely achieved with a single management measure.

Dormancy	Leaf Growth	Flowering	Harvest	Dormancy
				

The Pest Management module of the *Rubus Integrated Fruit Production Manual* provides background information on IPM. Contact the RABA office to source the *Rubus IFP Manual.*

Nezara viridula — Green Vegetable Bug, GVB

BUGS	**Adults overwinter in maize crops (non-feeding), under tree bark or in farm sheds In warmer coastal areas green vegetable bug (GVB) will feed and breed all year round** — **GVB invade crops at flowering. Eggs are laid underneath leaves in rafts. Nymphs and adults feed by piercing flower buds and fruitlets. Damage is visible as distorted growth, usually *after* infestation has occurred** — **Overwintering GVB adults are purple-brown**
Monitoring	Monitor weeds and trap borders to manage GVB populations during non-bearing periods — Check 5 bushes per block each week for adults, nymphs and egg rafts by tapping flowers and laterals over white sampling tray. Use threshold of 5 bugs per 5 bushes
Cultural Activities	GVB move from crop to crop as their numbers increase through the season. Use trap crops to reduce movement into the berry crops at flowering. Sow triticale, sorghum, millet, buckwheat, and sunflower, and use tall, open seed-headed varieties. Trap crops are most preferred by GVB when seeds are forming up to soft-dough. Sow trap species to overlap and extend flowering and seed maturation around berry flowering. Use GVB monitoring records to know the high risk periods for different berry varieties
Biological Activities	*Spined predatory shield bug, GVB parasitic fly* (Trichopoda giacomellii) *and GVB egg parasite* (Trissolcus basalis) *will naturally seek out GVB in trap crops* — *There are no commercially available predators or parasitoids for management of green vegetable bug*
Chemical Controls	*There is no chemistry approved for use on green vegetable bugs in raspberries or blackberries. Sprays targeting aphids are likely to have some effect but control is not guaranteed. Check* www.arga.com.au *for products currently approved for use in berries*

Photos *(Left Top)* Newly hatched GVB nymphs are red but change colour when they moult, through brown to black & yellow, to adult green. *(Left Bottom)* 4th instar nymphs are still oval-shaped *(Right)* Adult GVBs are shield-shaped, bright green and well camouflaged in foliage. They are good fliers and best monitored in early - midmorning in the top third of the canopy.

Carpophilus spp — Dried Fruit Beetle

CARPOPHILUS	**Larvae, pupae and adults overwinter in fruit dumps and mummified fruit** — **Larvae pupate underground. Adults become active and mate in-situ** — **Populations peak late spring to mid summer. Adults lay eggs in maturing and rotten fruit. Larvae move underground to pupate. Carpophilus beetles will carry disease spores to clean fruit and cause infections where their eggs are laid inside fruit** — **Beetles continue breeding over winter in rotten fruit**
Monitoring	Crop Hygiene is Key — Maintaining block hygiene by removing rotten fruit is the best control for beetles because they can speedily re-infest a block after an insecticide treatment — Begin weekly monitoring of carpophilus pheromone traps in the earliest varieties once dusk temperatures reach 22ºC. Hang traps 1.5m high. Use trap threshold of 2 beetles — Check 10 fruit trusses on 5 bushes per block (50 trusses). Use threshold of 5 beetles per block — Monitor fallen fruit and fruit dumps where serious fruit losses occurred in the season
Cultural Activities		Remove rotten and fallen fruit regularly. Adults are excellent flyers and will move in from other blocks and farms. Beetles can emerge from buried fruit - composting or shallow burial of waste fruit does not reduce infestations. Buried fruit must be below 40cm underground — Slash or remove rotten fruit in blocks. Burn or bury waste fruit under 40cm soil
Biological Activities		*There are no commercially available predators or parasitoids of carpophilus*
Chemical Controls		Use Attract and Kill Bait Traps to reduce carpophilus numbers. An area-wide treatment is ***essential*** and should begin well before harvest

Photos *(Left)* Carpophilus beetles are 1 to 2mm long, oval shaped and dark brown to black. *(Right)* Adult carpophilus beetles will fly over 1km in warm weather and are attracted to the scent of maturing and rotten fruit. Attract-and-Kill Traps contain 2 specific attractants plus an insecticide strip. Put traps out before fruit begins to ripen.

Bactrocera tryoni — Queensland Fruit Fly, QFF

Q FLY	**Adults survive mild winters in protected places** — **Adults emerge in spring and seek out maturing fruit to lay eggs under skin** — **Larvae feed inside the fruit, creating internal rots and fruit-fall. Pupation occurs underground. Females only mate once in their life & require protein before egglay begins. Fly activity increases when temperatures cool off & rainfall occurs**
Monitoring		Put out male fruit fly traps at 400m intervals and check weekly throughout season — Monitor temperature and rainfall throughout season Use threshold of 20 flies per trap to begin bait spraying — Check 25 trusses of fruit per block. Use threshold of 5 trusses per block with maggots to begin cover sprays
Cultural Activities	Remove neglected host trees close to blocks	High fruit fly numbers require a continuous source of ripening fruits through the season. Manage fruit fly in alternative hosts near the berry crop at the same time as the crop. For very large areas use mass-baiting of males at 10-20 traps/ha — Minimise unharvested fruit left after picking Slash / mulch or remove all fallen fruit from the block
Biological Activities		*There are no commercially available predators or parasitoids for management of Queensland fruit fly*
Chemical Controls		Use baiting program when trap thresholds indicate fruit fly activity has started. **Regular baiting is essential** to reduce immature females before egg-laying. Decrease intervals between bait application when rain occurs. Use bait thickeners during periods of high pressure. Avoid using broad spectrum insecticides for cover sprays

Photos *(Left)* Raspberry fruit with recent internal larval damage *(Right)* A female fruit fly lays 6 to 8 eggs at a time. Females mate once only and require a protein feed before laying, to mature their eggs. Bait sprays attract these females before their eggs are ready. Female adults can live for up to 2 months, laying continuously.

Helicoverpa spp — TSM

HELIOTHIS	**Larvae pupate through winter in cool regions but are active all year in northern regions** — **First flight occurs in spring-early summer. Eggs are laid in top third of canopy. Larvae damage soft tip growth and when fully grown drop to the ground to pupate below soil surface** — **Second or third cycles are common in warmer regions** — **Pupation can extend to 300 days in unfavourable conditions**
Monitoring		Check weekly for grubs and damage in 50 growing tips per block. Use threshold of 5 grubs in 50 tips. Look for single round eggs with vertical ribs. Flag leaves with attached eggs and monitor daily for hatching. Thresholds for unparasitised eggs are regional-specific. In high pressure areas use pheromone traps to record moth flights and estimate level of egg-lay
Cultural Activities	Disrupt pupal cavities down to 10cm below soil surface	Grow a range of grasses and broad-leaf plants between rows to ensure flowers are present all season. Plants producing many small flowers are safer for minute insects than large single flowers. Where migrating heliothis cause problems in most years consider growing trap crops which can be turned under — Disrupt pupal cavities to 10cm below soil surface to reduce high populations in spring
Biological Activities	*Pollen and nectar sources allow parasitoid adults to live longer, and to lay more eggs*	Earwigs, spiders, predatory bugs, parasitoids and predatory fly larvae reduce grub numbers. Ladybeetles, lacewing larvae and parasitoids reduce egg numbers. Release *Trichogramma* for high numbers of eggs found. Apply *Bt* to grubs less than 12mm when thresholds are exceeded — Encourage diverse soil biology to reduce numbers of moths surviving pupation
Chemical Controls		Apply IPM-compatible insecticides when grub thresholds are exceeded or when pheromone traps indicate hatching of extensive egg-lay is imminent. Check *www.arga.com.au* for products approved for use in berries

Photos *(Left)* *Helicoverpa armigera.* Heliothis are generally tip feeders and are rarely as big as loopers when fully-grown. *(Right)* Heliothis moths lay eggs in singles. A *Trichogramma* wasp lays her egg in a heliothis egg (note the striations). *(Inset)* Healthy pale egg and dark parasitised egg.

Epiphyas postvittana — Light Brown Apple Moth

LBAM	**Light brown apple moth larvae overwinter in ground cover** — **Larvae pupate in ground cover** — **Adult moths emerge and first flight occurs. Females lay eggs on foliage in rafts of pale, flat overlapping eggs. Grubs emerge, roll leaves and damage fruit. Up to three flights can occur in one season. Eggs, grubs and pupae can all be present when generations overlap** — **Grubs migrate to ground cover for winter**
Monitoring		Put out pheromone traps at 2/ha — Check pheromone traps weekly for moth flights. When a flight occurs calculate degree days (DD) to gauge timing of grub hatch. Use threshold of 5 moths/ha (refer to DD calculation at bottom of poster). Check 50 growing tips weekly for rolled leaves. Use threshold of 5 grubs in 50 shoots
Cultural Controls	Control capeweed & clover to reduce overwintering larval numbers	Use LBAM pheromone ties in large blocks — Plant diversity is essential to maintain pollen and nectar sources for beneficials. Grow a range of grasses and broad-leaf plants between rows to ensure flowers are present all season. LBAM will stay out of crop canopy where inter-rows provide preferable food and shelter — 'Messy' borders and inter-rows over winter assist in maintaining beneficial populations
Biological Controls	*Earwigs, lacewings, spiders and parasitoids reduce numbers of LBAM grubs and eggs*	Release 2-3 batches of Trichogramma wasps 10 to 14 days apart at 120DD from first flight or spray *Bt* at 130DD - late afternoon to avoid deactivation by the sun, before grubs are big enough to roll leaves for protection — Consider running poultry in late autumn / winter to reduce grub numbers
Chemical Controls		Apply IPM-compatible insecticides for LBAM grubs when DDs are reached. Smallest grubs are the most susceptible to grub sprays Maintain cover if trap thresholds are exceeded over several consecutive weeks. Check *www.arga.com.au* for products approved for use in berries

Photos *Left:* A green LBAM grub with characteristic leaves bunched together with webbing. When disturbed grubs play dead, wriggle vigorously or escape on a silk thread. *(Top right)* Grubs pupate within webbing inside rolled leaves. This pupa has a parasite beside it. *(Bottom right)* The tell-tale white cocoon of a parasitoid that ate the grub and pupated in its place.

Chloroclystis spp & Ectropis spp — Dry Berry

LOOPERS	**Loopers overwinter as pupae under weed leaves or in plant debris** — **Looper moths fly from October onwards Eggs are laid close to flowers & new foliage** — **Eggs hatch 3-5 days after laying. Larvae feed on leaves and flowers and pupate within plant debris** — **Summer and autumn flights occur with various species Newly hatched grubs move into ripening fruit** — **Larvae can be found in foliage up to June. Loopers overwinter as pupae**
Monitoring		Use pheromone traps for *C.argentifera* and check weekly. Thresholds are region-specific — Look for single round eggs and monitor daily for hatching. Check weekly for 'looping' grubs and leaf feeding in 50 growing tips per block. Use threshold of 5 grubs in 50 tips
Cultural Activities	Use mulch to increase ground-dwelling predators that eat overwintering pupae	Grow a range of grasses and broad-leaf plants between rows to ensure flowers are present all season. Plants producing many small flowers are safer for minute insects than large single flowers — 'Messy' borders and inter-rows over winter assist in maintaining beneficial populations
Biological Activities		Earwigs, spiders, predatory bugs, parasitoids and predatory fly larvae reduce grub numbers. Ladybeetles, lacewing larvae and parasitoids reduce egg numbers — Consider running poultry in late autumn/ winter to reduce numbers in spring
Chemical Controls		Apply IPM-compatible insecticide when threshold has been reached. Use *Bt* for grubs less than 12mm — In areas where loopers are problematic maintain cover with *Bt* for harvest period

Photos *Left:* A newly-hatched looper is harder to spot in raspberry foliage but far more vulnerable to *Bt* sprays than later stages. Loopers are mainly leaf eaters but small grubs can be found in packaged ripe fruit. *(Right)* Loopers move with a distinct looping action and can grow to 35mm in length

Thrips imaginis, Thrips tabaci — Plague thrips & Onion thrips

THRIPS	**Thrips overwinter as adults in weeds and grasses, leaf litter and other protected places** — **Adults move from ground cover to berry flowers. Silvering in ripe fruit is mostly done at flowering, by nymphs and adults piercing developing drupelets close to the calyx. Pupation occurs in the soil** — **Adults migrate back to flowering grasses and weeds before winter**
Monitoring		Monitor flowers in inter-row for presence of pest thrips before crop flowers — Shake 25 trusses per block upside down onto white container each week. Use threshold of 75 thrips in 25 samples — Monitor maturing fruit for thrips damage
Cultural Activities	Plant diversity is essential to maintain pollen and nectar sources for beneficials but can also provide great habitat for pest thrips. Ensure trap-crops and inter-row plants do not dry off before crop has finished flowering — Encourage carabid beetles and other ground-dwelling predators to reduce pupating thrips and emerging adults	
Biological Activities	*Pirate bugs, lacewing larvae, ladybeetles, and predatory mites* montdorensis *and* cucumeris *will reduce thrips numbers*	In tunnel blocks inundate with *montdorensis* and *cucumeris* predatory mites and soil-dwelling predatory mite *Hypoaspis* In field crops inundate with pirate bugs *Orius armatus*
Chemical Controls		Apply IPM-compatible insecticide when bees are inactive (early morning or late evening) —

Photos *Left:* Plague thrips and *(Centre)* onion thrips appear similar in size and colour. Western Flower Thrips are darker and slightly larger than plague and onion thrips. *(Right)* *Montdorensis* predatory mite attacking a thrip larva. Female *montdorensis* lay only 3 to 4 eggs per day, but can consume up to 14 thrips per day.

Tetranychus urticae — TSM

TWO-SPOTTED MITE	**In cold winters females go into diapause on old prunings or ground-cover - no feeding occurs** — **Females emerge from diapause from September onwards. Colonies occur on the underside of leaves. Severe infestations have webbing and leaves turn yellow and fall off. Egg-to-egg cycle can be as short as 7 days at 30ºC and populations build very quickly in hot dry weather** — **In warmer regions diapause may not occur and all life stages feed through the winter**
Monitoring	Overwintering colonies are orange. Predatory mites will overwinter close to TSM colonies — Check weekly for all mite stages on undersides of leaves. Target older leaves with bronzing appearance. Look for predatory mites in TSM colonies. Sample 10 older leaves from 5 bushes per block (50 leaves) and record numbers of predators and TSM. Use threshold of 80% leaves have TSM present OR TSM increasing faster than predators for 3 consecutive weeks
Cultural Activities	*TSM predators include green lacewings, stethorus beetles and predatory mites* Typhlodromus occidentalis *and* Phytoseiulus persimilis	Avoid synthetic pyrethroid insecticides for 8 weeks before introduction of predatory mites. Avoid releasing predators in heavy rain or during overhead irrigation. Encourage plant diversity in inter-rows to provide alternative food sources for predatory mites and other beneficials
Biological Activities		In protected crops introduce *persimilis* early and regularly. Introduce predatory mites to field crops at first sighting of TSM. *Stethorus* beetles are voracious consumers of TSM
Chemical Controls	In tunnels apply white oil as plants emerge from dormancy to reduce mite pressure	Apply IPM-compatible miticides when threshold is reached and TSM are increasing faster than predatory mites. Overlapping generations of TSM may require a general miticide 10 days following first application. Avoid broad spectrum insecticides as they encourage pest mite flares.

Photos: *(Left)* TSM adult attacked by two *Typhlodromus occidentalis* predatory mites, with pearly predator eggs nearby. Typhlodromus is suited to warm dry conditions. *(Bottom Right)* Orange predatory mite *persimilis* with TSM adult, amongst TSM and predator eggs. *Persimilis* is suited to shady humid conditions - look inside the canopy. *(Top Right)* Leaf damage appears on lower foliage first.

Botrytis cinerea — Grey Mould

BOTRYTIS	***Botrytis* overwinters on diseased canes and mummified fruit. Spores spread by rain and wind** — **Spores germinate and penetrate plant tissue using natural openings or micro wounds** — **92% of fruit infections begin during flowering & remain latent until fruit matures or warm moist conditions occur** — **Latent infections develop as fruit ripens. New infections start in drupelets near collar and spread across the fruit** — **Botrytis overwinters on diseased canes, dead leaves and other decaying material**
Monitoring	*Botrytis spores are always present - complete eradication from the crop is not possible*	Monitor plants for physical damage - frost, hail, wind, insects, wires, other diseases — Monitor weather for cool moist conditions (temperatures 18 to 21ºC favour *Botrytis* germination) — Check 10 fruit trusses on 5 bushes per block each week to determine severity — Review monitoring records to assess botrytis severity for next season
Cultural Activities	Remove, mulch or compost prunings to reduce *Botrytis* spores. Prune and train canes for airflow	Encourage free air movement around flowers to speed up drying after rain. Separate primocanes from fruiting canes and keep row bases clean and narrow. Minimise dead material inside the canopy — Maintain airflow and use drip irrigation to keep canopy dry. Remove and destroy affected fruit. Minimise mummified fruit — Where high losses occur annually, consider raincovers or biennial cropping
Chemical Controls	Calibrate your sprayer	Apply protective fungicide if physical damage occurs *(eg hail)* — Apply preventative fungicides - reduce *Botrytis* infections at flowering to reduce disease pressure at harvest — Maintain protectant coverage on developing fruit during wet conditions

Photos *(Far Left) Botrytis* spores on ripe fruit. *(Centre) Botrytis* infection of green berries. *(Right) Botrytis* infection on boysenberry. At flowering include dead sucker material when applying protectant fungicides to foliage and flowers to reduce spore load.

Peronospora sparsa — Dry Berry

DOWNY MILDEW	**Downy mildew overwinters in roots, crowns, canes, and floricane buds** — **Fungal growth occurs on new leaf growth. Infected leaves have light yellow-green areas which become angular & purple. Whole leaves may brown and fall off. Spores are released after 30 minutes of leaf-wetness at 20-25ºC** — **Spore release causes secondary infection of fruit & leaves. Infected berries shrivel and die, often splitting in half** — **Fungal mycelium overwinters in protected plant parts of roots, crowns and buds**
Monitoring	*This disease is more common in blackberries and boysenberries.*	Monitor weather for high-risk periods: temperatures over 20ºC coinciding with leaf-wetness for over 30 minutes, on 10 days or more in the month. When humidity is high, look for symptoms on primocanes and leaves close to the ground and towards the centre of the canopy
Cultural Activities	Use downy-tolerant varieties and avoid areas with downy history. Remove alternative hosts	Maintain an open canopy to increase airflow, reduce humidity and duration of leaf-wetness, and maximise spray penetration. Use drip irrigation. Use row or crop covers to keep leaves dry. Utilise pruning, trimming and nutrition to avoid dense canopies — Remove and destroy old fruiting canes after harvest
Chemical Controls	*Alternative hosts include wild blackberries and roses*	Apply IPM-compatible fungicides during high-risk periods

Photos *Far Left:* Downy mildew can cause blackberry fruit to split in two. *(Centre)* Blackberry leaves show angular dead spots close to leaf veins. *(Far Right)* Downy mildew symptoms are not 'downy' in appearance.

Podosphaera aphanis — Yellow Rust of Raspberry

POWDERY MILDEW	**Powdery mildew overwinters in infected cane tips and dormant buds** — **Infections start on dry leaves in high humidity over 15ºC. Visible signs appear 4 weeks after infection** — **Optimum conditions are 18-25ºC and over 97% humidity. Pale patches develop on leaves with powdery white growth underneath. Fruit develops a mealy grey mat of fungus. Severe infections stunt canes and kill berries** — **Severe infections reduce winter hardiness**
Monitoring	*This disease is more common in raspberries*	Monitor weather for temperatures over 15ºC and high humidity — Monitor weather conditions for temperature and humidity. Check 5 canes per block weekly for symptoms — Check fruit weekly for white powdery symptoms. Check 5 bushes per block — Review monitoring records to develop management plan for next season
Cultural Activities	Plant resistant cultivars Remove wild blackberry hosts	Ensure good airflow through the canopy to maximise spray penetration. Prune, train & thin out primocanes early to reduce humidity in canopy. Manage nutrition and irrigation to avoid a highly vigorous canopy — Remove late-forming infected primocanes — Use tip pruning to remove some infection sources before next season
Chemical Controls	Apply lime sulphur as a dormant spray	Apply protective fungicides when conditions suit infection (before symptoms are visible) — Apply IPM-compatible curative fungicides if symptoms appear

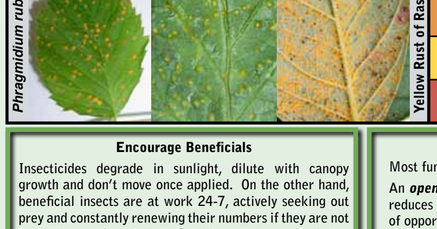
Photos *Far Left:* Powdery symptoms and leaf mottling on raspberry leaves. *(Centre)* Powdery mildew infected flower buds and curled stunted leaves in raspberry. *(Far Right)* Powdery symptoms on green fruit. Powdery mildew is much less of a problem in wet seasons.

Phytophthora var. rubi — Yellow Rust of Raspberry

PHYTOPHTHORA	**Fungal mycelium survives inside infected root pieces within the soil** — **Spores germinate in wet soils over 10ºC. New roots & crowns are infected in spring** — **Primocanes of infected plants wilt and die. Floricane laterals are stunted with small, chlorotic leaves with scorched edges. Infected plants have few fibrous roots. Main roots have brick-red staining underneath the outer root layer** — ***Phytophthora* spores can remain viable in the soil for many years**
Monitoring		Check wet areas for plants showing symptoms, infections often occur in patches. Dig up the crown and roots of any plants with symptoms and check for red staining and lack of fibrous roots
Cultural Activities	Plant on raised beds with good drainage. Use disease-free stock that is tolerant or resistant. Water-logged roots are under stress and more susceptible to infection	AVOID over-irrigation. Destroy infected plants and prevent movement of soil or water from infected areas to clean areas. Prevent soil compaction which occurs with traffic in wet conditions. *Phytophthora* is suppressed in conditions of low soil compaction, high levels of organic matter and good biological activity — Plant into clean ground. Increase soil calcium levels
Chemical Controls		Apply IPM-compatible fungicides to reduce phytophthora symptoms in spring — Apply IPM-compatible fungicides to reduce phytophthora symptoms in autumn

Photos *Far Left:* Whole primocanes wither and die amongst healthy growth. *(Centre)* Floricane laterals are droopy, chlorotic and have scorched leaves. *(Far Right)* Infected roots are brick-red when the top layer of root bark is peeled away.

Phragmidium rubi-idaei — Yellow Rust of Raspberry



RUSTS	**Yellow rust overwinters as black teliospores on leaves and in cracks on bark** — **Raised yellowish spots appear on top side of leaves, releasing spores from orange rings around the spots** — **Yellow rust spots appear on the lower leaf surface. The secondary infection cycle continues through summer** — **As temperatures cool in autumn, black overwintering spores appear in the centre of the yellow rust spots**
Monitoring	*Leaf wetness, high humidity and mild temperatures (11ºC to 25ºC) favour infection*	Check weekly from early spring for pinhead-size yellow raised spots on tops of leaves in known hot spots Look on the underside of leaves for yellow rust spots, particularly where there is old leaf debris
Cultural Activities	Use pruning / training for optimum cane density for lower humidity, better airflow and spray penetration	Manage primocane density to maintain an open canopy to increase airflow, reduce humidity and maximise spray penetration. Keep ground cover low to reduce humidity around canes — Remove, mulch or compost prunings and leaf litter to reduce spore load next spring Where losses are consistently high, consider biennial cropping
Chemical Controls	Late dormant application of protective fungicide may be beneficial	Apply fungicide at first sign of rust on upper sides of leaves. Maintain protective cover for 4 to 5 weeks

Photos *Far Left:* Raised rust spots on the upper leaf surface. *(Centre)* Close-up of rust pustules. *(Right)* Underneath the leaf rust-coloured spores are released. The black spots are teliospores - hardened spore vessels designed to withstand harsh winter conditions.

Encourage Beneficials

Insecticides degrade in sunlight, dilute with canopy growth and don't move once applied. On the other hand, beneficial insects are at work 24-7, actively seeking out prey and constantly renewing their numbers if they are not sprayed out. Sustain beneficial insects by manipulating their micro-environment to be more suitable for them.

- Maintain nectar and pollen-producing plants as alternative sources of food and shelter
- Reduce the use of chemicals which kill these insects
- Reduce or change cultural activities that destroy their habitat

Canopy Management for Disease Control

Most fungi require a film of water to germinate their spores.

An ***open canopy*** provides sunlight and air movement that reduces humidity. Wet berries dry more quickly and the window of opportunity for fungi to grow and sporulate is shorter.

- Reduce excessive vigour by reviewing variety, trellis type, lateral growth, fertiliser and water inputs
- Increase canopy airflow by trimming foliage and keeping in-row weeds short, to reduce risk of botrytis and rusts
- Keep records that help to show which production practises have increased or decreased disease from season to season

Spore Load = Spores per square metre

The number of fungal spores present can change how effective your fungicide **appears** to be in controlling specific diseases.

When a very high spore load is present, a spray that is 99%-effective will ***appear* not to work**. Even though only 1% of spores remain viable, they are high enough in number to infect a **visible proportion of your crop**.

High spore loads cannot be controlled in wet conditions.

Managing your disease severity in high-disease seasons is critical for keeping spore numbers low for moderate and low disease seasons.

Toxicity of Chemical Sprays

All sprays that you apply will change the balance of beneficial arthropods and fungi in your berry patch.

Never spray for insect pests "just in case". Know your pest and beneficial levels by regular monitoring and record keeping.

Check the toxicity of sprays before applying them, at

- www.cottoncrc.org.au (Pest Management Guide PDF)
- www.side-effects.koppert.nl
- www.biobest.be (Side Effects)

When inundating your crop with beneficial wasps, mites or bugs, plan ahead to avoid residue toxicity from previous sprays.

Calculating Degree Days for Targeted LBAM Control

90% of LBAM eggs hatch within 130 degree days (DD or ºD) of the first major moth flight (more than 5 in a trap or per ha).

- Record maximum and minimum daily temperatures starting at the first flight caught in your pheromone traps
- Find the average temperature each day, by adding max and min, and dividing the answer by 2
- Subtract 7 from the average temperature to get the day degrees for one day (replacing negative numbers with zero)
- Add each day's DDs together up to a total of 130DD. Time your grub spray to go on at 130DD after the first moth flight

Timing and Coverage

When caterpillars hatch the first thing they eat is their egg capsule. Good spray coverage ensures pest grubs contact and consume the spray in their first meal. Coverage depends on having the right sprayer for the canopy type, and also having it calibrated to deliver the right amount of chemical to the right place in the canopy. *Get your sprayer calibrated every year.* Consider contractors as an expert alternative if your spray gear is not up to the job.

Timing a spray to the most vulnerable insect stage is done with regular and consistent monitoring and recording. Monitoring answers the questions "*Do I need to spray?*" and if Yes, "*When do I spray?*" Monitoring also gives excellent feedback each week on how effective your IPM activities are for the season. If monitoring is not for you, consider a crop scout for the essential months of the year.

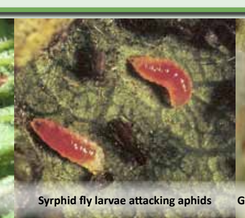

Trichogramma wasp on LBAM egg raft


Netelia caterpillar parasite


Parasitoid eggs laid onto a caterpillar


Assassin bug sucking contents out of caterpillar


Ladybird larva eating aphids


Syrphid fly larvae attacking aphids


Green lacewing larva with camouflage


Hatching lacewing eggs

Photo Acknowledgements Clockwise from immediate left **Lacewings**-Bugs for Bugs; **Lacewing**-DCrawford; **Syrphids**-HortResearch, NZ; **Ladybeetle** -ASteinhauser (FGT); **Assassin Bug** - CO'Hora; **Caterpillar** - JDay; **Netelia**-EDaley; **Trichogramma**-DCrawford (Bugs for Bugs); **Rusts** JStark (WSU PPDEN); PBristow (QSU); MBolda (UCANR); **Phytophthora**(2) Washington State University (Whatcom); **Powdery Mildew**(2) Cornell University; **Downy Mildew** J Pscheidt; SKoike (UCCE); PBachi (UKREC); **Botrytis** Washington State University (Whatcom); SChapman (Chapples); Washington State University (Whatcom);**TSM** -HortResearch; PFisher (OMAFRA); The Good Bug Book; **Thrips** (3) MSteiner (NSW DPI);**Looper** MBolda (UCANR); MCrossley; **LBAM** ; MBolda (UCANR); PDomeney (TIA); PRapley (DPIPWE); **Heliothis** DPopack (Bugs For Bugs); ; TNAU; JWessels (Qld DPI); **Q-Fly** (2) QDPI; **Carpophilus** (2) MHossain; **Bugs** (3) Anon

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Horticulture Australia

Designed and researched by P.Domeney & M.Buntain TIA, Hobart, Tasmania - www.tia.tas.edu.au

TIA TASMANIAN INSTITUTE OF AGRICULTURE

UTAS TIA is a joint venture between the University of Tasmania and the Tasmanian Government

TIA Perennial Horticulture Centre
University of Tasmania, New Town
13 St Johns Ave New Town Tasmania 7008
Phone +61 (3) 6233 6826 | Fax +61 (3) 6233 6145
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Survey of growers who received the Rubus Integrated Pest Management Calendar Poster, 2012

Dear Rubus grower,

1. Invitation

My name is Michele Buntain. I work for the Tasmanian Institute of Agriculture (TIA) in the Perennial Horticulture Centre. I assisted Penny Domeney in the development of the Rubus Integrated Pest Management Calendar poster on behalf of Raspberries and Blackberries Australia Inc, funded by levy funds and Horticulture Australia Ltd. I wish to conduct a phone survey to evaluate how useful the poster is to you and what improvements could be made in future editions.

2. What is the purpose of this study?

The purpose of the phone survey is to find out how useful the Rubus Integrated Pest and Disease Management poster is to you, how you use it, and if it can be improved in the future.

3. Why have I been invited to participate?

You are invited to participate in this survey because you are either a rubus grower or involved in service to the rubus industry (agronomist, specialist consultant).

RABA selected participants to represent the cross section of RABA members, including enterprises of different size and type, and from different growing regions around Australia. RABA has sent you this information on my behalf, and if you do not object to participating, will supply me with your phone contact details.

You are not obliged in any way to participate in the survey which is completely voluntary. If you **do not** wish to participate, please indicate this by return email to RABA, secretary@arga.com.au.

4. What will I be asked to do?

You will be asked to answer around 15 questions relating to the *Rubus Integrated Pest and Disease Management Calendar Poster*. This should take no longer than 15 minutes.

- The first questions will help to provide some background about your rubus growing experience and the type of rubus enterprise you are associated with.
- The main questions I will ask relate to how useful *The Poster* is to you or your employees
- In the final questions, I will ask for feedback on what could be improved in future posters or training.

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5. Are there any possible benefits from participation in this study?

RABA wish to provide the most useful tools for growers to assist in the management of rubus crops. Feedback from your participation will help RABA to continue to improve and be responsive to your needs.

6. Are there any possible risks from participation in this study?

The risks involved from participating in this phone interview are extremely low, I will avoid calling during a thunder storm and hopefully make it much more pleasant than a phone call to Telstra.

7. What if I change my mind during or after the study?

You are free to withdraw at any time from this study without any explanation. However, any data you supply will not be removed from the study as it has been recorded anonymously and cannot be re-identified.

8. What will happen to the information when this study is over?

The information you supply will not be able to be linked to you or your business. Raw data from this trial will be kept at the University of Tasmania in a password protected file on my personal computer, and will be destroyed after 5 years from the date of first publication. Data will not be archived, and will be treated in a confidential manner.

9. How will the results of the study be published?

Aggregated (not individual) results from the survey will be supplied to RABA and published as a final report submitted to Horticulture Australia Ltd. RABA will email you a copy of the results for your interest. Individuals will not be identifiable in the aggregated results.

10. What if I have questions about this study?

If you have any questions about this phone survey please contact:

Michele Buntain

Email: michele.buntain@utas.edu.au | **Phone** 03 6233 6814

This study has been approved by the Tasmanian Social Sciences Human Research Ethics Committee. If you have concerns or complaints about the conduct of this study, please contact the Executive Officer of the HREC (Tasmania) Network on (03) 6226 7479 or email human.ethics@utas.edu.au. The Executive Officer is the person nominated to receive complaints from research participants. Please quote ethics reference number H0013174

This information sheet is for you to keep. If you DO NOT wish to participate in this survey, please send return email to secretary@arga.com.au with NO SURVEY in the subject line. Thank you for taking the time to read this information.

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Rubus Integrated Pest Management Calendar 2012

Survey of rubus growers: Project RB12000

Grower Code: ☐

Did the Poster arrive

Did you receive the poster?

Yes No

If did not receive the poster – establish possible reasons for not receiving (eg it came mid-harvest and was missed, not receiving other RABA mail?)

As a RABA member would you like to receive a copy?

Demographic:

How long have you been a raspberry/blackberry grower?

< 5 years <10 years >10 years

Which of the following would describe your fruit growing business (can chose more than 1)?

PYO Punnet Fruit Outdoor Punnet fruit protected cropping Processing Organic

---

Poster use and location

What did you do with your poster in the first week after you received it?

Any comments

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Have you (or your staff) referred to the poster during this last growing season?

Yes No

Comments?

If YES how often would you (or your staff) have referred to the poster?

Once Weekly Daily

Where do you plan to keep your poster?

Response:

Poster layout

How clear is the layout of information in the poster?

Confusing *Information is clear and easy to find*

0 10

Any comments?

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RELEVANCE/ Usefulness of POSTER

Which of the pests/diseases on the poster have you seen in your crop or have affected your crop:

Bugs	Yes	No	Not sure
Carpophilus	Yes	No	Not sure
QFF	Yes	No	Not sure
Heliothis	Yes	No	Not sure
LBAM	Yes	No	Not sure
Loopers	Yes	No	Not sure
Thrips	Yes	No	Not sure
Two spotted Mites	Yes	No	Not sure
Botrytis	Yes	No	Not sure
Downy Mildew	Yes	No	Not sure
Powdery Mildew	Yes	No	Not sure
Phytophthora	Yes	No	Not sure
Rust	Yes	No	Not sure

Do you have any major pests or diseases that are not represented on the poster?

Comments

How useful are the photos of the pests and diseases on the poster

Not useful *Very Useful*

0 10

Any comments

How useful are the photos of the beneficial insects on the poster

Not useful *Very Useful*

0 10

Any comments

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What you currently do, what new information you found useful:

Monitoring (ORANGE)

In the past, how often have you monitored your crops health? (for pest, diseases beneficials or other factors such as weather for disease risk and crop hot spots in your management)

Never *Sometimes/some pests/diseases* *Frequently / many factors monitored*

How useful is the monitoring information on the poster? (ORANGE)

Not useful *Very Useful*

0 10

Comments

Cultural activities (YELLOW)

How relevant/useful is the cultural activity information on the poster

Not useful *Very Useful*

0 10

Comments

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Biological controls and strategies (GREEN)

Do you currently use any form of biological controls/management strategies in your crop?

Never *Some years* *Every Year*

How useful is the Biological activity information on the poster?

Not useful *Very Useful*

0 10

Comments

Chemical management (RED)

Do you currently use any chemical control/management in your crop?

Never *Some years* *Every year*

Comments?

How useful is the information on chemical controls?

Not useful *Very Useful*

0 10

Comments?

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Are you likely to change any aspect of your management based on information from the calendar?

Not likely *Highly Likely*

0 10

Comments

What do you find are the most useful features of the poster?
Comment?

Which parts of the poster are least useful to you?
Comment?

Is there anything you would like to see on a poster that is not already on this one (or maybe an additional poster)? (explanations, how to measure thresholds, web links to resources)

Comment?

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What other resources do you think would help you with IPDM? Please select the 3 most useful resources

1. IPM Record keeping resources (monitoring, spraying, etc)
2. Pocket guide/Glove box guide
3. Fact sheets
4. Group training
5. Farm walks
6. Phone app.
7. Website links to IPDM information

Other? Please comment

Would you like to make any other comment about the poster?