

INTEGRATED PEST & DISEASE MANAGEMENT

Raspberries and Blackberries

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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
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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**.

Species	Life Stage	Monitoring	Cultural Activities	Biological Activities	Chemical Controls	
Necara 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.	Monitor weeds and trap borders to manage GVB populations during non-bearing periods.	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. Use thistle, 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.	There are no commercially available predators or parasitoids for management of green vegetable bug.	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. Use thistle, 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 glacomelli) and GVB egg parasite (Trissolcus basalis) will naturally seek out GVB in trap crops.				
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. Carophilus 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	Begin weekly monitoring of carophilus pheromone traps in the earliest varieties once dusk temperatures reach 22°C. 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.	Slash or remove rotten fruit in blocks. Burn or bury waste fruit under 40cm soil.	
	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.				
	Biological Activities	There are no commercially available predators or parasitoids of carophilus.				
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 egg-laying. Fly activity increases when temperatures cool off & rainfall occurs.	Check 25 trusses of fruit per block. Use threshold of 5 trusses per block with maggots to begin cover sprays.	
	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.	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.	
	Cultural Activities	Remove neglected host trees close to blocks.				
	Biological Activities	There are no commercially available predators or parasitoids for management of Queensland fruit fly.				
Helicoverpa spp Helicoverpa armigera	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 parasitised eggs are regional-specific. In high pressure areas use pheromone traps to record moth flights and estimate level of egg-lay.	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.	Encourage diverse soil biology to induce numbers of moths surviving pupation.	
	Cultural Activities	Disrupt pupal cavities down to 10cm below soil surface.				
	Biological Activities	Pollen and nectar sources allow parasitoid adults to live longer, and to lay more eggs.				
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.	'Messy' borders and inter-rows over winter assist in maintaining beneficial populations.	Consider running poultry in late autumn / winter to reduce grub numbers.	
	Cultural Controls	Control capeweed & clover to reduce overwintering larval numbers.	Use LBAM pheromone traps 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.		
	Biological Controls	Earwigs, lacewings, spiders and parasitoids reduce numbers of LBAM grubs and eggs.				
Chlorothrips spp & Ectophasia spp 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.				
	Biological Activities	Pirate bugs, lacewing larvae, ladybeetles, and predatory mites montdorensis and cucumeris will reduce thrips numbers.				
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 of up to 1000 females develop 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 30°C 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 life 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 over 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.				
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.	Botrytis overwinters on diseased canes, dead leaves and other decaying material.	
	Monitoring	Monitor plants for physical damage - frost, hail, wind, insects, wires, other diseases.	Monitor weather for cool moist conditions (temperatures 18 to 21°C 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.	
Peronospora sparsa Downy Mildew	DOWNY MILDEW	Downy mildew overwinters in roots, crowns, canes, and floricanes 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 20-25°C.	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	Monitor weather for high-risk periods: temperatures over 20°C 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.			
Podosphaera aphanis Powdery Mildew	POWDERY MILDEW	Powdery mildew overwinters in infected cane tips and dormant buds.	Infections start on dry leaves in high humidity over 15°C. Visible signs appear 4 weeks after infection.	Optimum conditions are 18-25°C 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	Monitor weather for temperatures over 15°C 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.		
Phytophthora var. rubi Phytophthora	PHYTOPHTHORA	Fungal mycelium survives inside infected root pieces within the soil.	Spores germinate in wet soils over 10°C. New roots & crowns are infected in spring.	Primocanes of infected plants wilt and die. Floricanes 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.	
Phragmidium rubi-ideale 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	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	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.				
	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.		Remove, mulch or compost prunings and leaf litter to reduce spore load next spring. Where losses are consistently high, consider biennial cropping.	

<p>Encourage Beneficials</p> <p>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.</p> <ul style="list-style-type: none"> Maintain neutral 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. 	<p>Canopy Management for Disease Control</p> <p>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.</p> <ul style="list-style-type: none"> 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 practices have increased or decreased disease from season to season. 	<p>Spore Load = Spores per square metre</p> <p>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.</p> <p>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.</p>	<p>Toxicity of Chemical Sprays</p> <p>All sprays that you apply will change the balance of beneficial arthropods and fungi in your berry patch.</p> <p>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.cottoncnc.org.au (Pest Management Guide PDF) and www.side-effects.koppert.nl and www.biobest.be (Side Effects).</p> <p>When inundating your crop with beneficial wasps, mites or bugs, plan ahead to avoid residue toxicity from previous sprays.</p>	<p>Calculating Degree Days for Targeted LBAM Control</p> <p>90% of LBAM eggs hatch within 130 degree days (DD or °D) of the first major moth flight (more than 5 in a trap or per ha).</p> <ul style="list-style-type: none"> 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 (repeating 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. 	<p>Timing and Coverage</p> <p>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.</p> <p>Timing a spray to the most vulnerable insect stage is done with regular and consistent monitoring and recording. Monitoring answers the question "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.</p>
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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