KEEP WHAT WORKS WORKING

Managing brown rot resistance in summerfruit

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The resistance problem

Summerfruit (peaches, plums, apricots, nectarines and cherries) are affected by several diseases caused by fungal and bacterial pathogens that can be difficult to control.

Management relies on the application of fungicides over the blossom period and pre-harvest as the fruit is ripening.

The repeated use of fungicides of the same mode of action (MOA) group through the season and across multiple seasons increases the risk of resistance developing.

The fungal pathogen that causes brown rot (*Monilinia fructicola*) has a high risk of developing resistance to key fungicides used for controlling the disease in New Zealand orchards.

What is Brown rot?

Brown rot, caused by *Monilinia fructicola*, is a fungal disease of summerfruit (peaches, plums, apricots, cherries) causing blossom blight in spring and rapid, soft brown decay in ripening fruit, often leading to yield losses and post-harvest decay.

It is characterized by small, circular brown spots that spread rapidly in wet, humid conditions.



Brown rot on peach, cherry, plum, apricot (Credit: SNZ Summergeen Manual).



Brown rot blossom blight infected flowers turn brown, wither, and either become a gummy mass or drop like unpollinated flowers. Credit: MSU Extension IPM

Screening for changes in *Monilinia* sensitivity

Early detection of shifts in pathogen sensitivity to fungicides is an essential component of effective integrated pest management programmes.

Monitoring changes in sensitivity allows resistance issues to be identified early and supports timely updates to disease management strategies.

Industry commissioned resistance testing surveys showed that disease control efficacy of some fungicides was being eroded.



Summerfruit NZ has undertaken fungicide resistance monitoring in collaboration with the Bioeconomy Science Institute (BSI) (formerly Plant & Food Research).

A survey conducted in 2017 across 20 Hawke's Bay orchards (peaches and nectarines) identified resistance to several fungicide groups used to control brown rot (*Monilinia* spp.) (Elmer et al. 2019) (see table, page 3).

Following the resistance monitoring surveys, further "truthing" studies (plant infection tests to assess fungicide efficacy) demonstrated that disease control efficacy of some fungicides were being eroded. These studies showed that the active ingredient cyprodinil no longer protected peach flowers from blossom blight caused by cyprodinil-resistant strains.

Similarly, the active ingredient carbendazim was no longer effective at protecting fruit from infection by carbendazim-resistant strains. Tests with iprodione also demonstrated variable levels of disease control against iprodione-resistant strains.

These resistance surveys highlighted that the efficacy of several fungicides used for brown rot control was being eroded.

In 2018, Luna® Sensation was registered for use in summerfruit for the control of brown rot. This product contains a mixture of two active ingredients: fluopyram, a succinate dehydrogenase inhibitor (SDHI; Group 7), and trifloxystrobin, a quinone outside inhibitor (QoI; Group 11).

More recent resistance monitoring carried out by BSI during the 2024–25 season indicated that some *Monilinia fructicola* populations in Hawke's Bay peach orchards were showing a shift in sensitivity to fluopyram. In contrast, trifloxystrobin showed no evidence of reduced sensitivity in the populations tested.

Resistance survey for *Monilinia* sensitivity (from Elmer et al. 2019, Wood et al. 2025)

FRAC code	MOA group	Active ingredient	Trade name	Resistance risk	Resistance management guidelines (2024)*
1	methyl benzimidazole carbamates (MBC)	carbendazim	Various e.g. Protek, Prolific®, Chief	Low/Medium	1x application per season. Use during blossom period only.
2	dicarboximide (DCA)	iprodione	Rovral Aquaflo, Ippon 500SC, Rapid 500	Low/Medium High frequency of reduced sensitivity.	3x applications per season. Best used as a preventative only. Do not use where disease has become established. Preferred use period is pre-harvest.
3	demethylation inhibitors (DMI)	tebuconazole	various e.g. Folicur® WG, Hornet 430SC, Compass	High	2x applications per season. Use in only one part of the growing season, either during flowering or pre-harvest. Apply with an effective protectant fungicide. Do not use DMIs against brown rot if resistance is suspected.
7 +11	succinate dehydrogenase inhibitor (SDHI) + quinone outside inhibitors (QoI)	boscalid + pyraclostrybin	Pristine®	Low/Medium SDHI actives have a medium risk	2x applications per season. Preferably use in a mixture. If used alone, apply in strict alternation with an effective protectant fungicide. Pristine use restricted to pre-shuck fall in apricot, nectarine, peach & plum.
7 + 11	SDHI + QoI	fluopyram +trifloxystrobin	Luna® Sensation	SDHI actives have a medium risk	2x applications per season. Preferably use in a mixture. If used alone, apply in strict alternation with an effective protectant fungicide.
9	anilino-pyrimidines (AP)	cyprodinil	Chorus®, Mirano®	High	3x applications per season. Use during the blossom period. Alternate each application with an effective protectant fungicide.

*Summerfruit NZ (2024) Fungicide resistance management guidelines.

High resistance Medium resistance

Development of resistance management guidelines

The goal of resistance management is to limit the prevalence of resistant pathogen strains within the population. This can be achieved through limiting the selection pressure of any one type of fungicide (MOA group) and decreasing total pathogen population through good disease management.

Summerfruit NZ have communicated the importance of integrated disease management and compliance with resistance management guidelines for prolonging the efficacy of key fungicides used for brown rot control.

Key recommendations for high-risk fungicides

- Limit the number of applications of high-risk fungicides
- Mix each high-risk fungicide with a 'broad spectrum' protectant fungicide that is not at risk
- Alternate each high-risk MOA group with application of a different MOA group.
- Restrict each high-risk group to one crop stage e.g. blossom
- Apply fungicides preventatively – when conditions are favourable for disease but before the disease has established.

Good disease management is essential for resistance management

Good disease management underpins fungicide resistance management. A lower pathogen inoculum load means there is a lower chance for resistant strains to occur or establish disease and spread.

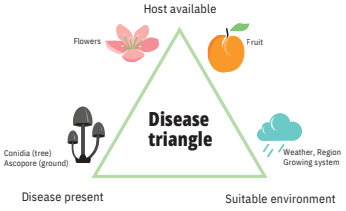
Alongside the resistance management guidelines, a *Brown rot action plan* was developed to help growers manage brown rot. This action plan considers the brown rot life cycle and the actions and interventions that growers can implement throughout the season.

Implementing practices such as crop hygiene to reduce disease inoculum levels in the orchard, optimising timing of fungicide applications, regular monitoring, using infection risk models, ensuring good sprayer calibration and even spray coverage. These actions should result in lower disease occurrence and hence decrease the risk that resistant strains become established.

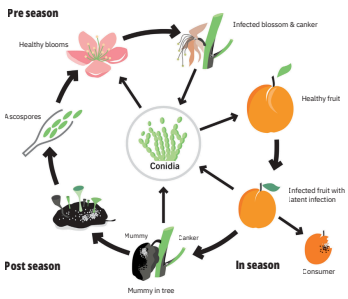
Summerfruit New Zealand

Brown rot action plan

	POST SEASON	PRE SEASON	INSEASON			
	Autumn	Early Spring	Spring	Summer		Harvest
Chemical		Anti-sporulant (productscontaining carbendazim if R-Test negative)	Intensive spraying at flowering and pre-harvest to harvest according to brown rot infection events. Fungicide choice guided by resistance management strategies, PHIs and R-Tests*			Treat high risk fruit (Rovral WP dip) Check thisisstillan allowed option
			Post shuck fall, mid season protectants (eg captan) to protect immature fruit			
Fertiliser			Foliar calcium (6 applications)			
			Nitrogen (nil,little or slow release)			
Cultural	Prune infected wood and cankers	Calibrate sprayer	Thin early (pre-pithardening, speed breakdown with mulch and liquid fertiliser)	Summer prune for better spray penetration (once or twice)		
	Destroy mummies from ground and tree		Remove blossom blight strikes and destroy	Remove blossom blight strikes and split fruit (1-3 times)		
				Remove brown rot infected fruit (1-3 times)		
Monitor	Soil test (nitrogen)	Monitor spray deposition with water sensitive papers	Leaf test (nitrogen)		Monitor for Carpophilus beetles and spray if required	Data Loggers (check temperature through cool chain)
	Fungicide resistance test**				ONFIT 3 weeks pre harvest	



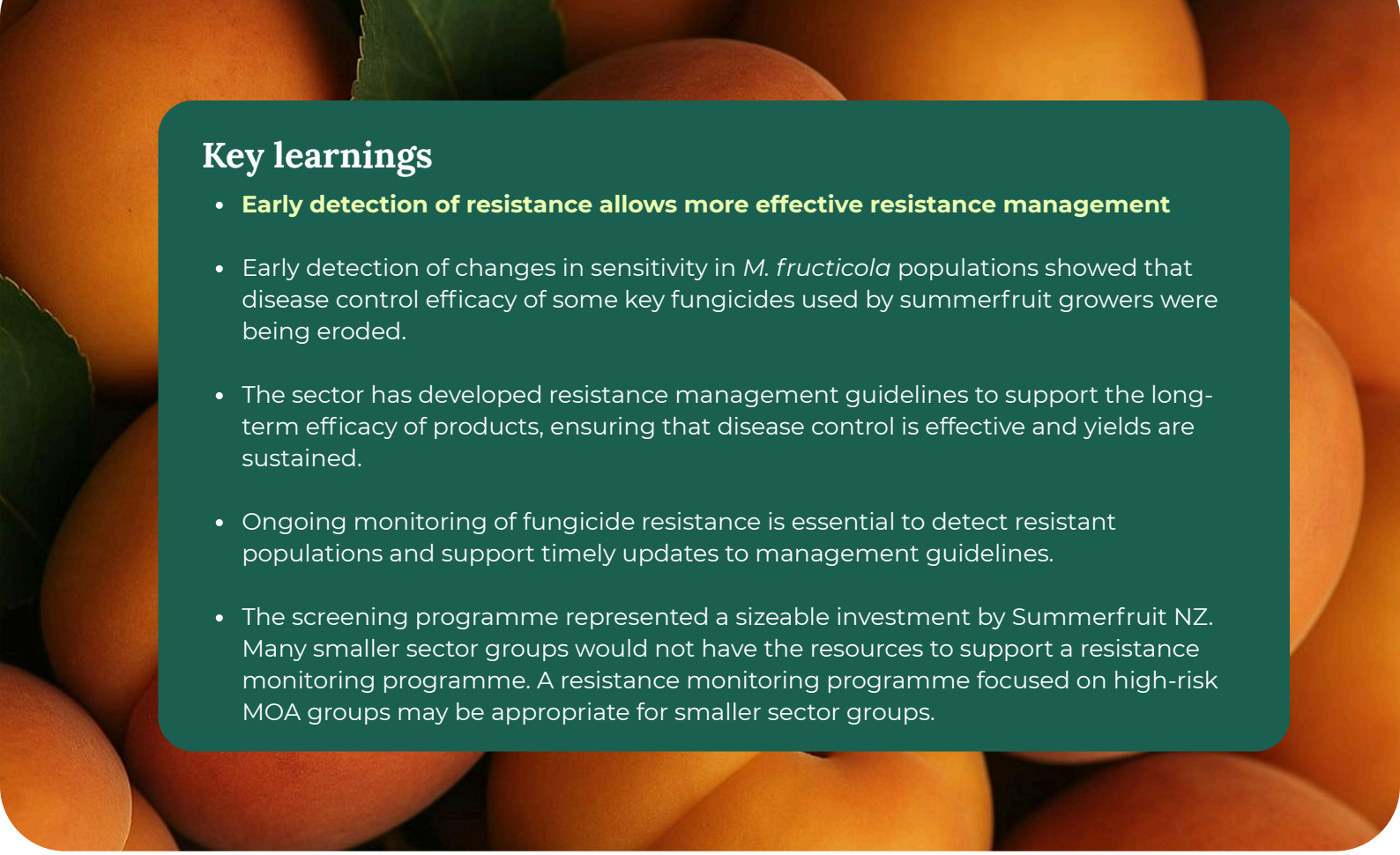
Simplified brown rot life cycle
Monilinia fructicola



This document is based on information contained in the Summerfruit NZ portal under:
– Tools/SummerGreen manual/Diseases/Blossom blight-brown rot
– Main Menu/All Documents/Brown rot can it be managed?

* See Summerfruit NZ portal/Main Menu/Agrichemicals/Resistance management
** Contact your SummerGreen facilitator or Plant Diagnostics Ltd, phone 03 377 9026 email enquiries@plantdiagnosticslimited.co.nz

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Key learnings

- **Early detection of resistance allows more effective resistance management**
- Early detection of changes in sensitivity in *M. fructicola* populations showed that disease control efficacy of some key fungicides used by summerfruit growers were being eroded.
- The sector has developed resistance management guidelines to support the long-term efficacy of products, ensuring that disease control is effective and yields are sustained.
- Ongoing monitoring of fungicide resistance is essential to detect resistant populations and support timely updates to management guidelines.
- The screening programme represented a sizeable investment by Summerfruit NZ. Many smaller sector groups would not have the resources to support a resistance monitoring programme. A resistance monitoring programme focused on high-risk MOA groups may be appropriate for smaller sector groups.

Reports and resources

Elmer PAG, Marroni V, Wood PN. (2019). SNZ–SFF Managing pathogen resistance in fungal and bacterial pathogens (2016–2019). A Plant & Food Research report prepared for: Summerfruit New Zealand. January 2019. Milestone No. 68306. Contract No. 33610. Job code: P/342067/01. SPTS No. 17417.

Elmer PAG, Marroni V, Wood PN, Colhoun K, Parry FJ, Ah Chee A, Braithwaite M, Attfield B, Thompson S, Hernandez L, Fisher B. and Parry J. (2019). Managing pathogen resistance in summerfruit — final report to SNZ and MPI. A Plant & Food Research report prepared for: Summerfruit New Zealand. June 2019. Milestone No. 69973; M10. Contract No. 33610. Job code: P/342067/01. SPTS No 18071.

Summerfruit NZ (2024) Fungicide resistance management guidelines. Available on request from Summerfruit NZ.

Wood P, Parry F, Park N, Fisher B, Ah Chee A, Fehlmann C, Marshall S, Elmer P. May 2025. Brown rot – Establish baselines and *Monilinia fructicola* sensitivities to Luna® Sensation in selected Hawke's Bay orchards (Project #5). A Plant & Food Research report prepared for: Summerfruit New Zealand. Milestone No. 103144. Contract No. 43546. Job code: P/383014/01. PFR SPTS No. 27228.

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