Department of **Industry, Tourism and Trade**

THE TERRITORY

Pollinating honey bees: are they plant disease vectors?

A summary of the potential risks to the Australian cucurbit industry.

VM18008 Understanding and managing the role of honey bees in CGMMV epidemiology.

Key contact

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Managed pollination

In Australia, 65% of horticultural and agricultural production is pollinator dependent. Managed pollination services are predominantly provided by *Apis mellifera* (Hymenoptera: Apidae), the European honey bee. The provision of pollination services can improve both the quality and the quantity of production. What is less well understood is how managed pollinators can negatively impact production by spreading plant pathogens.

Pollinators as vectors of plant disease

There are relatively limited examples of demonstrated spread of plant pathogens by floral visitors e.g. thrips spreading *Prunus necrotic ringspot virus* (PNRSV, Bromovidae) in stone fruit and chrysomelid beetles spreading bacterial wilt (*Erwinia tracheiphila*) to cucurbits.

Bees spreading plant pathogens is even less reported.

Buzz pollinators, like bumble bees, can introduce plant pathogens when they damage flowers and surrounding plant tissue with their buzzing. Buzz pollinators are used in solanaceous crops.

There are few examples of demonstrated plant pathogen spread by European honey bees (*Apis mellifera*). All of the examples below involve plant pathogen entry via flowers:

* *Cucumber green mottle mosaic virus* (CGMMV, Tobamovirus) in melons and watermelons

* *Prunus necrotic ringspot virus* (PNRSV, Bromoviridae) in cherries

* *Blueberry shock ilarvirus* (BIShV, Ilarvirus) in highbush blueberry

Where honey bees have been demonstrated to spread plant pathogens the bees are likely to act as mechanical, rather than propagative/circulative, vectors. This means that honey bees physically carry the plant pathogen to new plants during floral visits. This may either be in pollen or by plant pathogens adhering to their bodies. Some fungi that are expressed in flowers have been demonstrated to be carried by honey bees. The fungi in Table 1 below all affect plant roots and are soil borne.

There are very limited examples of plant pathogens replicating inside honey bee bodies.

When bees are capable of spreading a plant pathogen they do not generally represent the most important source or carrier of the pathogen, although the long distance movement of bee hives can present a particular risk of introducing plant pathogens into new environments.

Honey bees and plant pathogens of biosecurity concern to Australian cucurbit production

There are 13 plant pathogens of cucurbits listed as high or medium risk to the Australian vegetable and melon industry (Industry Biosecurity Plans, 2020; Table 1). They are predominantly viruses and fungi but include one bacteria and one nematode. None of these pathogens have been demonstrated to be transmitted by honey bees.

It is difficult to generalise about potential spread of plant pathogens by pollinating honey bees. In Table 1 we have assessed the likelihood of these plant pathogens being spread by honey bees. We have used the following criteria:

- is the pathogen expressed in the pollen;
- are there other known insect vectors;
- are there other pathogens in that group that are spread by insects?

Based on these criteria we have assigned a rating of HIGH to:

- the tobamoviruses: because two other tobamoviruses (CGMMV and *Tomato brown rugose fruit virus* (ToBRFV)) have been shown to be transmitted by bees
- Cucurbit bacterial wilt (*Erwinia tracheiphila*): because a closely related bacteria, *Erwinia amylovora* is very likely to be transmitted by honey bees.

Table 1. High and medium priority pests of cucurbits identified in the Australian Melon and Vegetable Industry Biosecuity Plans (IBP 2020)

Cucurbit plant pathogens				Risk of honey bee transmission		
Plant pathogen group	**Name**	**IBP[a]**	**Overall risk[b]**	**Found in pollen[c]**	**Known insect vectors**	**Likelihood of honey bee transmission**
Nematode	Root knot nematode (*Meloidogyne enterolobii* (Syn. *Meloidogyne mayaguensis*))	V	High	No	No. Moved in soil and plant material	Negligible
Virus Orthotospovirus (Tospoviridae)	*Groundnut bud necrosis virus* (GNNV)	V & M	High	Unknown	Thrips (Thysanoptera)	Low
	Watermelon bud necrosis virus (WBNV)	V & M				
	Melon yellow spot virus (MYSV), *Watermelon silver mottle virus* (WMSMOV) and serogroup IV, *Melon severe mosaic virus*	M				
Virus Tobamovirus (Virgaviridae)	Kyuri green mottle mosaic virus (KGMMV), Zucchini green mottle mosaic virus (ZGMMV), Watermelon green mottle mosaic virus (WGMMV), Cucumber fruit mottle mosaic virus	M	Medium	Yes	No	High
Virus Gammacarmovirus (Tombusviridae)	*Melon necrotic spot virus* (MNSV)	M	Medium	Unknown	Unlikely. Moved in soil and by oomycetes.	Medium
Bacteria	Cucurbit bacterial wilt (*Erwinia tracheiphila*)	M	Medium	Yes	Beetles (Coleoptera)	High
Fungi	Fusarium root and stem rot of melons (*Fusarium oxysporum f.sp. melonis* (exotic races), *Fusarium oxysporum f.sp. niveum* (exotic races), *Fusarium oxysporum f.sp. radiciscucumerinum*, *Fusarium oxysporum f.sp lagenariae*)	M	High	Unknown	No. Moved in soil and plant material	Negligible
	Monosporascus root rot (*Monosporascus cannonballus*)		Medium			
	Melon root rot (*Acremonium cucurbitacearum*)					
	Melon black rot (*Phomopsis cucurbitae*) (syn. *Diaporthe melonis*)					
	Texas root rot (*Phymatotrichopsis omnivora*)					
	Sudden collapse of melons (*Rhizopycnis vagum*)					

[a] V = vegetable, M = melon

[b] Overall risk as estimated in the IBP

[c] This information was not available for each individual species so is provided for the plant pathogen group as whole

What else influences pathogen transmission?

It is difficult to generalise about potential spread of plant pathogens by pollinating honey bees because there is little specific published information. In the absence of specific details there are some additional factors to consider:

- Pathogen transmission is likely to be time dependent. That is, the time that has lapsed since the honey bees visited a plant affected with a pathogen and the survivability of the pathogen inside a bee hive will affect honey bees' ability to transmit it. The window for transmission will be specific to each pathogen and ranges from several hours to several weeks in currently available published studies.
- Floral traits can influence the transmission of vectored plant pathogens. This includes the likelihood of pathogen establishment and the likelihood of pathogen transmission
- Pollen transmission of viruses is complex. Transmission may be horizontal but not vertical, that is, pollen from one plant may infect another plant, without the virus being carried to their resultant offspring. Additionally, viruses may be detectable on pollen surfaces but not be naturally transmitted to plants

For further reading

Industry biosecurity plans
https://www.planthealthaustralia.com.au/about-us/documents/

References used to prepare this document are available at https://www.horticulture.com.au/growers/help-your-business-grow/research-reports-publications-fact-sheets-and-more/vm18008/

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