PERSPECTIVES IN
Biosecurity
VOLUME 6/2021

Published ahead of print

Received: March 2021
Accepted: April 2021

Short Communication: Observation of western honeybee (*Apis mellifera*) foraging urediniospores from myrtle-rust-infected maire tawake (*Syzygium maire*), Ōwairaka/Mt Albert, Tāmaki Makaurau/Auckland, New Zealand

Luzie M.H. Schmid, Mark F. Large, Mel Galbraith and Peter J. de Lange (corresponding author, pdelange@unitec.ac.nz)

Keywords: *Austropuccinia psidii*, myrtle rust, western honeybees (*Apis mellifera*), bee foraging myrtle rust, biosecurity, New Zealand

This publication may be cited as: Schmid, L., Large, M., Galbraith, M., de Lange, P. (2021). Short Communication: Observation of western honeybee (*Apis mellifera*) foraging urediniospores from myrtle-rust infected maire tawake (*Syzygium maire*), Ōwairaka/Mt Albert, Tāmaki Makaurau/Auckland, New Zealand, *Perspectives in Biosecurity, 6*, 1–7.

Contact:
epress@unitec.ac.nz
www.unitec.ac.nz/epress/
Unitec Institute of Technology
Private Bag 92025, Victoria Street West
Auckland 1142
New Zealand

ISSN 2538-0125

Short Communication: Observation of western honeybee (*Apis mellifera*) foraging urediniospores from myrtle-rust-infected maire tawake (*Syzygium maire*), Ōwairaka/Mt Albert, Tāmaki Makaurau/Auckland, New Zealand

Luzie M.H. Schmid, Mark F. Large, Mel Galbraith and Peter J. de Lange (corresponding author, pdelange@unitec.ac.nz)

Abstract

Following the detection of myrtle rust disease, caused by the rust fungus *Austropuccinia psidii*, in New Zealand in May 2017, concerns were raised that western honeybees (*Apis mellifera*) might forage for and collect *Austropuccinia* spores. Whilst inspecting cultivated maire tawake (*Syzygium maire*) trees on the Mt Albert Unitec New Zealand campus infected with myrtle rust, we observed honeybees collecting the urediniospores of this rust. Here we document this observation with images to add further evidence that honeybees present a potentially serious vector in the spread of this rust throughout New Zealand.

Introduction

Myrtle rust, a disease of numerous species of Myrtaceae, is caused by the rust fungus *Austropuccinia psidii* (G. Winter) Beenken. It was first reported from New Zealand in May 2017, after which it has spread rapidly throughout the North Island and northern South Island (Galbraith & Large 2017; Beresford et al. 2018).

At the time of its detection in New Zealand, concern was raised that western honeybees might harvest *Austropuccinia psidii* urediniospores, with Pattemore et al. (2018) confirming that this was happening in Australia, where that rust is now widespread. Their research showed that *Austropuccinia* spores foraged by bees remain viable on worker bees and within beehives up to nine days following their collection. As such, they concluded that honeybees are a vector for *Austropuccinia psidii*, and so a potentially serious biosecurity issue for containment of that rust. This is because undetected contaminated hives can potentially be moved many kilometres from

Figure 1. Myrtle-rust-diseased leaves of maire tawake (*Syzygium maire*), Te Wai Unuroa o Wairaka, Unitec New Zealand campus, Mt Albert, 25 January 2021. Photograph: © P.J. de Lange.

Figure 2. Myrtle-rust-diseased maire tawake (*Syzygium maire*) inflorescences, Te Wai Unuroa o Wairaka, Unitec New Zealand campus, Mt Albert, 25 January 2021. Photograph: © P.J. de Lange.

Figure 3. Close-up of myrtle-rust-diseased maire tawake (*Syzygium maire*) flower buds. Note yellow urediniospores of *Austropuccinia psidii* on pedicels, hypanthia and sepals. Te Wai Unuroa o Wairaka, Unitec New Zealand campus, Mt Albert, 25 January 2021. Photograph: © P.J. de Lange.

myrtle-rust-infected areas to sites as yet free from the *Austropuccinia*. However, direct observation of bees visiting and harvesting *Austropuccinia* spores in New Zealand was not reported by Pattemore et al. (2018) and, as far as we are aware, has yet to be formally reported from this country.

On 23 January 2021, Wendy Johns (Friends of Oakley Creek Te Auaunga) discovered two myrtle-rust-diseased maire tawake (*Syzygium maire* (A.Cunn.) Sykes et Garn.-Jones) trees, which were growing beside Te Wai Unuroa o Wairaka, a wāhi tapu puna (spring) located on the campus of Unitec New Zealand, Mt Albert, Auckland (https://inaturalist.nz/observations/68482642, accessed: 2 March 2021). On 25 January, two of the authors (M. Large and P. de Lange) inspected the trees to give an assessment on the severity of the infection and whether the disease could be managed. Unfortunately, both trees were seriously infected (https://inaturalist.nz/observations/68579934, accessed: 2 March 2021). Most of the young vegetative growth was covered in red or maroon blotches and bright yellow urediniospores (Figure 1); in addition, the young floral primordia, buds and hypanthia of opened flowers were also covered in lesions and spores (Figures 2, 3). Both trees were judged to be so seriously infected that we recommended they be destroyed, an action undertaken on the evening of the same day by Tree Tops (https://nztreetops.com/2016/11/14/tree-removal, accessed: 2 March 2021). During that inspection it was also observed that western honeybees (*Apis mellifera* Linnaeus, 1758) were visiting the infected inflorescences and harvesting the urediniospores (Figure 4). We noted that many visiting bees had yellow urediniospores attached to their corbicula, and further that their heads, thoraxes and abdomens were copiously coated in spores (Figures 4, 5). To make certain that the bees were collecting *Austropuccinia* urediniospores, we examined the spores dusted off a captured bee (Figure 5), and these match the morphology of the spores as described by Shivas et al. (2014) and Beenken (2017). Notably, the spores examined (Figure 6) measured 17–20 × 13–17 µm; are often slightly pedicellate, otherwise globose, ellipsoid to ovoid, pale yellow to yellowish-brown, with light-yellow or hyaline walls; and with the surfaces distinctly echinulate ornamented, though with a smooth area at the spore base.

This foraging behaviour confirms the view of Pattemore et al. (2018) that honeybees are another potentially serious vector of *Austropuccinia psidii* in New Zealand; both through their spreading the rust to other locally growing myrtaceous species within the bee foraging range, and contaminating hives as reported by Pattemore et al. (2018).

Figure 4. Western honeybee (*Apis mellifera*) harvesting *Austropuccinia psidii* urediniospores from the pedicels and hypanthia of maire tawake (*Syzygium maire*) inflorescences, Te Wai Unuroa o Wairaka, Unitec New Zealand campus, Mt Albert, 25 January 2021. Photograph: © M.F. Large.

Bee movement of fungal pathogens

Honeybees have been a suggested vector of fungi and bacteria, including pathogens, for some time (Alexandrova et al. 2002; Dedej et al. 2004; Gasparoto et al. 2017; Pattemore et al. 2014; Shaw 1999; Parish et al. 2019), and both Shaw (1999) and Carnegie et al. (2010) have reported bees collecting the urediniospores of *Austropuccinia*. This knowledge has resulted in changed biosecurity procedures in some countries (Parish et al. 2019), whilst in New Zealand, following the detection of *Austropuccinia psidii*, the role of honeybees as a possible vector of that rust has been reviewed (Pattemore et al. 2018). Although Pattemore et al. (2018) discussed the risk bees posed as a vector for the rust, at that time this role had yet to be detected, or rather reported, happening in New Zealand. Further, Pattemore et al. (2018) noted that surveys of myrtle-rust-infected plants at field sites where hives were present showed little evidence of bees actively collecting spores.

Figure 5. Western honeybee (*Apis mellifera*) specimen collected whilst harvesting *Austropuccinia psidii* urediniospores from infected maire tawake (*Syzygium maire*) inflorescences, at Te Wai Unuroa o Wairaka, Unitec New Zealand campus, Mt Albert, 25 January 2021. Note the legs and body covered in yellow myrtle rust urediniospores, and the remnant of a urediniospore aggregation on the corbicula. Photograph: © M.P. Galbraith.

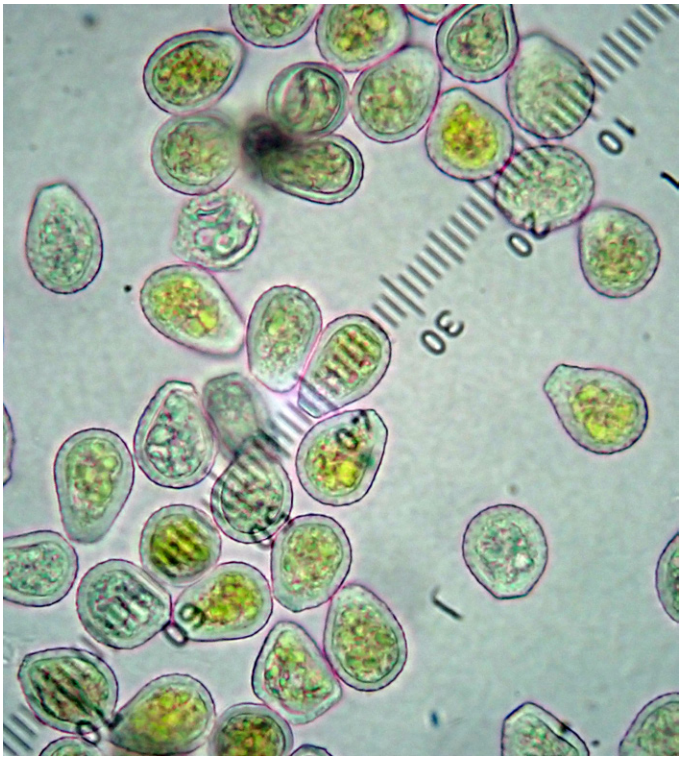

Figure 6. *Austropuccinia psidii* urediniospores (6000× magnification) sampled from western honeybee (*Apis mellifera*) specimen (Figure 5) collected harvesting *Austropuccinia psidii* urediniospores from infected maire tawake (*Syzygium maire*) inflorescences, at Te Wai Unuroa o Wairaka, Unitec New Zealand campus, Mt Albert. Photograph: © P.J. de Lange.

Our observations, limited to a few hours before the infected maire tawake were destroyed, noted bees preferentially harvesting urediniospores rather than visiting other nectar-rich sources (see Walsh 1967) such as white clover (*Trifolium repens* L.), houhere (*Hoheria populnea* A.Cunn.) and tree lucerne (*Chamaecytisus palmensis* (Christ) F.A.Busby et K.W.Nicholls) growing nearby. This included the few uninfected open maire tawake flowers present on the infected trees.

This strengthens the view posited by Pattemore et al. (2018) and others (M.A.M. Renner and C. Beard, personal communication, February 2021) that bees may play a larger role in dispersing *Austropuccinia psidii* to other myrtaceous hosts within their foraging range, as well as through movement of hives and bee products around New Zealand, than had been thought. It also suggests that bees might preferentially harvest myrtle rust spores under some as-yet undetermined situations, and as such the movement of bees and bee hives needs to be considered as a further biosecurity issue for mitigating the spread of myrtle rust.

Acknowledgements

We thank Drs Maj Padamsee, Matt Renner and Catherine Beard for their comments about bee movement of myrtle rust urediniospores. Wendy Johns reported the myrtle-rust-diseased maire tawake trees to Peter de Lange, so enabling us to make these observations prior to the removal of the infected trees.

References

Alexandrova, M., Cimini, B., Bazzi, C., Carpana, E., Massi, S., Sabatini, A.G. (2002) The role of honeybees in spreading *Erwinia amylovora*. *Acta Horticulturae*. 590. pp. 55–60.

Beenken, L. (2017) *Austropuccinia*: A new genus name for the myrtle rust *Puccinia psidii* placed within the redefined family Sphaerophragmiaceae (Pucciniales). *Phytotaxa*. 297. pp. 53–61.

Beresford, R.M., Turner, R., Tait, A., Paul, V., Macara, G., Yu, Z.D., Martin, R. (2018) Predicting the climatic risk of myrtle rust during its first year in New Zealand. *New Zealand Plant Protection*. 71. pp. 332–347. Available at: https://doi.org/10.30843/nzpp.2018.71.176

Carnegie, A.J., Lidbetter, J.R., Walker, J., Horwood, M.A., Tesoriero, L., Glen, M., Priest, M.J. (2010) *Uredo rangelii*, a taxon in the guava rust complex, newly recorded on Myrtaceae in Australia. *Australasian Plant Pathology*. 39. pp. 463–466.

Dedej, S., Delaphane, K.S., Scherm, H. (2004) Effectiveness of honey bees in delivering the biocontrol agent *Bacillus subtilis* to blueberry flowers to suppress mummy berry disease. *Biological Control*. 31. pp. 422–427. Available at: https://doi.org/10.1016/j.biocontrol.2004.07.010

Galbraith, M.P., Large, M.F. (2017) Implications for selected indigenous fauna of Tiritiri Matangi of the establishment of *Austropuccinia psidii* (G. Winter) Beenken (myrtle rust) in northern New Zealand. *Perspectives in Biosecurity*. 2. pp. 6–26. Available at: https://www.unitec.ac.nz/epress/wp-content/uploads/2017/12/Implications-for-Selected-Indigenous-Fauna-of-Tiritiri-Matangi.pdf

Gasparoto, M.C.G., Lourenco, S.A., Tanaka, F.A.O., Sposito, M.B., Marchini, L.C., Silva, G.J., Amorim, L. (2017) Honeybees can spread *Colletotrichum acutatum* and *C. gloeosporioides* among citrus plants. *Plant Pathology*. 66. pp. 777–782. Available at: https://doi.org/10.1111/ppa.12625

Pattemore, D.E., Goodwin, R.M., McBrydie, H.M., Hoyte, S.M., Vanneste, J.L. (2014) Evidence of the role of honey bees (*Apis mellifera*) as vectors of the bacterial plant pathogen *Pseudomonas syringae*. *Australasian Plant Pathology*. 43. pp. 571–575. Available at: https://doi.org/10.1007/s13313-014-0306-7

Pattemore, D.E., Bateson, M., Buxton, M., Pegg, G., Hauxwell, C. (2018) Assessment of the risks of transmission of myrtle rust (*Austropuccinia psidii*) spores by honey bees (*Apis mellifera*). A Plant & Food Research report prepared for Ministry for Primary Industries, Wellington, New Zealand.

Shaw, D.E. (1999) Bees and fungi, with special reference to certain plant pathogens. *Australasian Plant Pathology*. 28. pp. 269–282. Available at: https://doi.org/10.1071/ap99044

Shivas, R.G., Beasley, D.R., McTaggart, A.R. (2014) Online identification guides for Australian smut fungi (Ustilaginomycotina) and rust fungi (Pucciniales). *IMA Fungus*. 5. pp. 195–202. Available at: https://collections.daff.qld.gov.au/web/key/rustfungi/Media/Html/about.html [Accessed: 28 April 2021].

Walsh, R.S. (1967) *Nectar and pollen sources of New Zealand*. National Beekeepers Association of New Zealand (Inc). Carterton, New Zealand: Agricultural Press Company Ltd.

Authors

Luzie Schmid is a second-year student in the Bachelor of Applied Science programme at Unitec New Zealand. With an interest in botany and taxonomy, she has been working in the Unitec Herbarium for nearly a year, curating specimens and researching *Coprosma* leaf spot fungi. Luzie has an active research project on plant pathogenic fungi. lschmid@unitec.ac.nz

Dr Mark Large is an Associate Professor in Botany in the School of Environmental and Animal Sciences, Unitec New Zealand. mlarge@unitec.ac.nz

Mel Galbraith is a Senior Lecturer in the School of Environmental and Animal Sciences, Unitec New Zealand, teaching applied ecology in the areas of biodiversity and biosecurity. Mel's research interests are in ecological restoration, socioecology and ornithology. mgalbraith@unitec.ac.nz

Dr Peter J. de Lange is an Associate Professor teaching at the School of Environmental and Animal Sciences, Unitec New Zealand. A biosystematist, Peter has published numerous papers on plant taxonomy and conservation, threat listing, and the flora of South Pacific and outlying New Zealand islands. He is a Fellow of the Linnean Society (elected 2003) and a lifetime member of the New Zealand Plant Conservation Network. He is also a recipient of the New Zealand Botanical Society Allan Mere Award (2006) and Loder Cup (2017). pdelange@unitec.ac.nz

ePress

Unitec Institute of Technology
TE WHARE WĀNANGA O WAIRAKA