Preparedness in biological control of priority biosecurity threats

The potato psyllid, *Bactericera cockerelli* (Šulc)

Introduction

The psyllid *Bactericera cockerelli* Šulc (Hemiptera, Triozidae) is a significant crop pest, which causes damage through feeding, and also transmits the bacterial pathogen *Candidatus* Liberibacter solanacearum (zebra chip disease). This disease can cause serious economic losses in potato and tomato as well as a wide range of other solanaceous and non-solanaceous crops in its native region (Western USA, Mexico and Central America) and in New Zealand where it has been introduced. Both the psyllid and the pathogen it vectors are regulated in the EU (EPPO, 2012; 2013).

Given its current distribution, *B. cockerelli* would be able to establish and overwinter outdoors in Southern and Central Europe and areas with mild winters in Northern Europe, such as the UK (EPPO, 2013). If *B. cockerelli* was introduced into Europe, its migratory behaviour means it could potentially rapidly disperse over long distances putting the whole region at risk.

History of classical biological control against *Bactericera cockerelli*

Tamarixia triozae (Hymenoptera: Eulophidae) is a naturally occurring parasitoid of *B. cockerelli* in its native range. Adult parasitoids were released in 2017 in non-crops in Hawke's Bay in the North Island, and Canterbury in the South Island, of New Zealand (Vereijssen, 2020). Post-release monitoring has demonstrated that *T. triozae* has established self-sustaining populations and spread in the regions of release in New Zealand. Rates of parasitism are reported to average 15%, with a maximum rate of 40% in psyllid infested plant material collected from the field (Anderson, 2020).

Most promising natural enemies for classical biological control

Tamaraxia triozae is an eulophid wasp that preferentially parasitizes fourth and fifth instar nymphs of *B. cockerelli*. Although the adult female can lay more than one egg on the body of the host, only a single egg completes development. Under laboratory conditions, females lay an average of 165 eggs (range 98 - 279) during their lifetime parasitizing an average of 143 (range 85 – 241) *B. cockerelli* nymphs. The reported sex ratio favours females (86%). Furthermore, a comparison between the net reproductive rate, and intrinsic rate of increase, of *T. triozae* and *B. cockerelli* suggests that *T. triozae* has the potential to be an effective biocontrol agent against this psyllid. Reproductive capacity of this parasitoid is therefore good. However, optimal reproductive capacity is only achieved when the adult wasps are provided with a source of honey indicating that a source of carbohydrate, such as nectar, needs to be available for the adult parasitoids (Rojas *et al.*, 2015).

Although *T. triozae* is described as one of the more abundant parasitoids of *B. cockerelli* in the USA and Mexico, there are some instances where low levels of parasitism are reported in the field despite an abundance of hosts. It has been suggested that the cause of such unexpectedly low rates of parasitism could be due to the sensitivity of *T. triozae* to several insecticides that are often used to control its host, resulting in failure of adult parasitoid emergence (Rojas *et al.*, 2015).

Tamarixia triozae may not be suitable for control of *B. cockerelli* in all instances. This might particularly be the case if control of the psyllid is primarily required because of its role in vectoring disease; the parasitoid attacks later instar nymphs and therefore may not provide plants with sufficient protection against the disease before the psyllid is killed. That said, there are instances where *T. triozae* could be a useful tool against *B. cockerelli*, such as in crops where transmission of disease is less of an issue or in preventing the build-up of pest populations in non-crop host plants (Rojas *et al.*, 2015).

Other natural enemies for classical biological control

Bactericera cockerelli is attacked by a number of generalist predators (e.g. *Melanostoma fasciatum* (Diptera: Syrphidae), *Micromus tasmaniae* (Neuroptera: Hemerobiidae) and *Engytatus varians* (Hemiptera: Miridae)) in the different geographic areas where it is present, but little is known about their effects on psyllid populations (CABI, 2022). Some of these could be considered for classical biological control if *B. cockerelli* were to invade and establish in regions where these predators do not naturally exist.

References

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