Millipedes! How to manage populations so they do not become damaging at vintage

Millipedes are an unwanted visitor during vintage as they may cause damage to grapes and wine taint. **Mary Retallack,** from The University of Adelaide and Retallack Viticulture, presents management tips so winegrape growers are better able to manage the impact of millipedes during vintage.

Introduction

Economic damage is caused to grapevines each season by grapevine pests. Damage caused by the invasive black Portuguese millipede *Ommatoiulus moreleti* (Julida: Julidae) (Figure 1a) may result in wine taint if they are accidentally fermented with grapes. In this article, I will highlight ways that winegrape growers can manage populations of the black Portuguese millipede.

Background

This invasive millipede was introduced to Coffin Bay, near Port Lincoln on the Eyre Peninsula in 1953, then Bridgewater near Adelaide in 1964 (Baker *et al.* 2013), and is now widespread in southern Australia including parts of Western Australia, ACT, Victoria (Norton *et al.* 2015) and Tasmania (Figure 1b). It has a potential broader distribution outside these areas (Figure 1c).

Millipedes prefer high relative humidity and moderate temperatures (Baker 1980). They typically inhabit areas with mean annual rainfall of >300 mm, mean daily minimum temperatures in winter of 0-15°C and mean daily maximum temperatures in summer of 18-33°C (Baker *et al.* 2013). Several species of native millipede occur in southern Australia, but they are found infrequently in agricultural environments. The black Portuguese millipede is tolerant of much drier conditions than native species (Paoletti *et al.* 2007). Millipedes are generally considered to be important macro-detritivores due to their capacity to breakdown organic matter (Baker 1985, Paoletti *et al.* 2007).

Issues

Millipedes are an unwelcome pest at harvest due to their capacity to cause damage to grapes and wine taint. They may damage the skins of berries by feeding on them, thereby predisposing bunches to botrytis and other bunch rots. This may result in a quality downgrade, or rejection of fruit from the vineyard. Populations of the black Portuguese millipede are not susceptible to predation due to their chemical defense mechanism *(Eisner et al.* 1998). Highly repellent chemical compounds include benzoquinones, phenols, hydrogen cyanide, quinazolinones, and alkaloids. These are ejected by the millipede from its defensive glands when attacked, rendering them inedible to most predatory arthropods and birds (Sekulic *et al.* 2014, Vujisic *et al.* 2014, Shear 2015, Makarov *et al.* 2017). Their presence in grape ferments (Figure 2a and b) often results in wine taint as the defensive excretions produce unpleasant flavour compounds (Coulter 2014, Stankovic *et al.* 2016).

Key messages

- Millipedes may cause damage to grape berries and wine taint if they are fermented with grapes at harvest.
- Black Portuguese millipedes are not susceptible to predation as they excrete chemical compounds when attacked which render them inedible to most natural enemies and birds.
- It is possible to reduce millipede populations via the release of the parasitic nematode *Rhabditis necromena*, which may also provide a long-term biocontrol option for suppression of millipedes in vineyards.

Even though millipedes do not move much more than several hundred metres a year (Bailey and Baker 2016) they have the capacity to colonise areas quickly. Grape berries may provide an attractive source of food if ground cover is lignified and dry. Millipedes are mainly active at night (Waterhouse and Sands 2001) and are attracted to light. This explains why they are often a nuisance, congregating in high abundances inside dwellings, including wineries and toilet

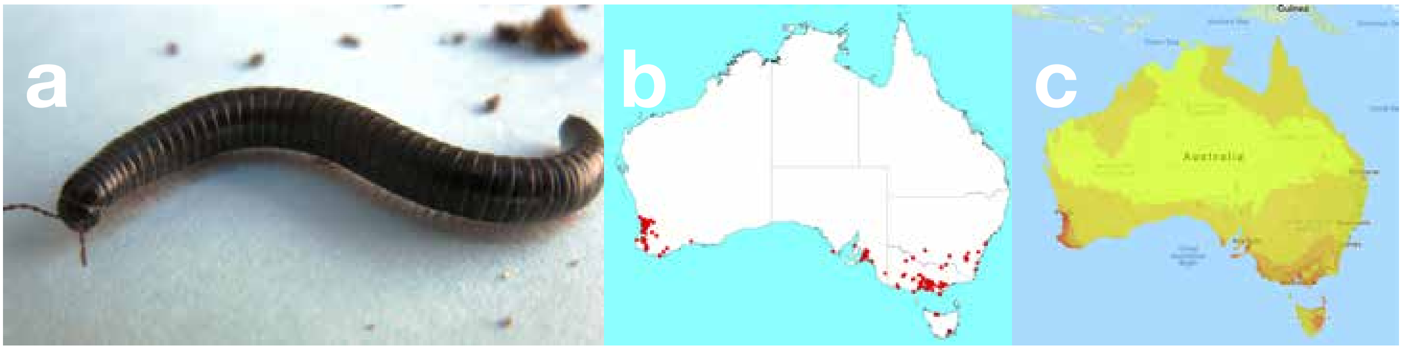

Figure 1. The black Portuguese millipede, *Ommatoiulus moreleti* [Photo: Stuart Pettigrew] (a), occurrence of the black Portuguese millipede visualised using DIVA-GIS (b), and predicted potential distribution generated using the Atlas of Living Australia (c). Regions with darkest colour represent highest likelihood of occurrence, and yellow least [CC BY 4.0].

Figure 2. Millipedes in a grape bin at vintage (a and b) and outside a building (c).

blocks (Figure 2c). Up to 20 times more millipedes may invade a lit versus an unlit area (Waterhouse and Sands 2001).

Research

Research by Retallack *et al.* (2019) found that populations of the black Portuguese millipede were highest on grapevines in some Adelaide Hills and Barossa vineyards early in the growing season during November, and declined during the warmer months of December to February. However, following rainfall events in February, millipedes represented 92% of all individual arthropods on grapevine canopies in March 2014. Higher than average rainfall occurred in February 2014 with 110.8mm falling in the Barossa (February LTA 26.0mm Nuriootpa) and 125.4mm in the Adelaide Hills (February LTA 28.5mm Lenswood). Samples of arthropods were collected using a modified beat net in Adelaide Hills and Barossa vineyards over a season (Retallack 2019). An observed peak of black Portuguese millipede numbers in grapevine canopies in March 2014 (Figure 3), was consistent with reports that millipedes are more active in autumn after significant rainfall events (Bailey and Baker 2016).

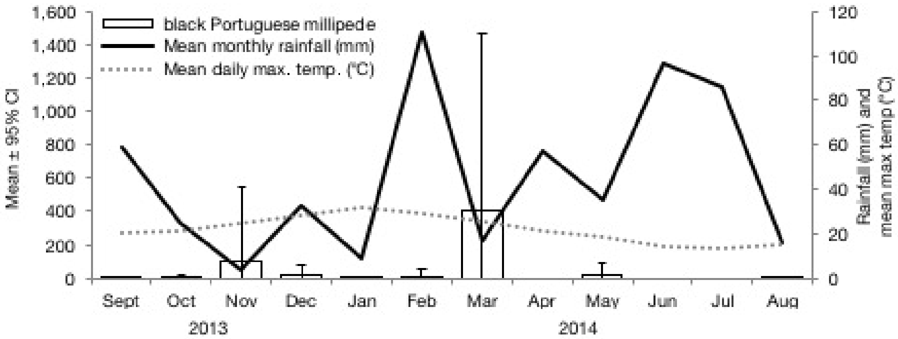

Figure 3. Temporal abundance of the black Portuguese millipede on grapevines pooled across all traps over a 12-month period (mean ± 95% CI per month). Rainfall (mm) and mean maximum temperature (°C) data sourced from the Bureau of Meteorology Nuriootpa site for comparison.

Solutions

Parasitic nematodes

It is possible to control millipede populations in domestic backyard situations via the release of the parasitic nematode *Rhabditis necromena* (Nematoda: Rhabditidae) which occurs naturally near Bridgewater, SA (McKillup *et al.* 1991, Jaworska 1994, Hensel 1999, Bailey and Baker 2016). The nematodes are available commercially. They are distributed initially using baiting stations (Figure 4a and b). The nematodes are ingested by millipedes and bore through their gut wall lining. Bacteria from the gut then infect millipedes which kills them (Bailey and Baker 2016). It may take several seasons after introduction for the nematodes to reduce millipede populations. They may also provide an effective long-term biocontrol option in vineyards. Further research is required to test this. A combination of several control methods may be required to resolve the problem.

Light traps and barriers

The most practical way to prevent millipedes from invading well-lit dwellings, including a winery, is to limit the light source when it is not in use using a timer or form a barrier around the structure. Examples include a moat and trap system (or existing drain), a

Figure 4. An example of a millipede baiting station (a and b), and a light trap and water bath (c). Photos: Mary Retallack

smooth vertical barrier, and/or light trap (Figure 4c) which can be purchased commercially (Bailey and Baker 2016).

Other management options

Millipedes are generally not numerous in cultivated areas or bare ground. They tend to be more abundant where leaf litter and soil moisture are present (Paoletti *et al.* 2007) and inhabit bushland litter of native woodlands and grasslands (Baker *et al.* 2013).

There are a number of chemical control options registered for the control of millipedes. However, pesticides have a limited active life, must be re-applied for ongoing control, are not registered for use in vineyards or are restricted for use by some wineries. The use of broad spectrum pesticides may also have unintended consequences, leading to the death of natural enemies or facilitate secondary pest outbreaks (Hill *et al.* 2017). Higher populations of the black Portuguese millipede were also reported by Nash *et al.* (2010) under high cumulative pesticide metric scores. This highlights the vigilance needed to minimise collateral damage to predatory arthropods via pesticide use in vineyards.

For more information on this article contact Mary Retallack: mary@viti.com.au

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