

## The *Jatropha webber* (*Sciota divisella*): a potential biological control agent for *Jatropha gossypifolia* (bellyache bush) from India

Elizabeth L. Snow, Kunjithapatham Dhileepan and Dianne B.J. Taylor

Biosecurity Queensland, Department of Agriculture and Fisheries, Ecosciences Precinct, Boggo Road, Dutton Park, Queensland 4102, Australia  
(liz.snow@daf.qld.gov.au)

**Summary** *Jatropha gossypifolia* L. (bellyache bush) is a deciduous shrub from tropical America that was introduced into Australia as an ornamental and has since become a serious weed of rangelands and riparian zones in northern Australia. It forms dense thickets that degrade habitat, including suppressing pasture growth and rendering flood plains unproductive. All parts of the plant are toxic and cattle deaths have been attributed to bellyache bush. Opportunistic surveys in India identified the moth *Sciota divisella* (Duponchel) (Lepidoptera: Pyralidae) as a potential biological control agent for bellyache bush and in December 2014 the insect was imported into the quarantine facility at the Ecosciences Precinct at Dutton Park in Brisbane. The larvae of this moth feed on the leaves and fruits and, in the absence of these, the larvae bore into the stem from the shoot-tip. The moth causes defoliation, fruit loss and shoot die-back. Host testing of the insect has begun with no-choice testing of larvae on 40 species to ascertain whether the agent is specific to bellyache bush. Larval feeding and complete development occurred only on bellyache bush, on the closely related *J. curcas* (another approved target for biological control) and on *Euphorbia grantii* a highly toxic, uncommon exotic ornamental). Aside from these two seemingly acceptable non-target hosts, if the agent proves to be host specific then approval to release will be sought through the Australian government.

**Keywords** *Jatropha gossypifolia*, bellyache bush, *Jatropha curcas*, *Sciota divisella*, *Jatropha webber*.

### INTRODUCTION

*Jatropha gossypifolia* L. (bellyache bush), a Weed of National Significance (WoNS), is a deciduous shrub from Central and South America, possibly native to the drier islands of the Caribbean and coastal Venezuela (Heard *et al.* 2009). The plant was introduced into Australia as an ornamental and has since become a serious weed of wet and dry tropical rangelands and riparian zones in northern Australia. It forms dense thickets that degrade habitat, including suppressing pasture growth and rendering flood plains unproductive (Dhileepan *et al.* 2014). All parts of the plant are

toxic and livestock deaths have been attributed to bellyache bush, particularly during times of drought (Csurhes 1999, Oliveira *et al.* 2008). The foliage of bellyache bush varies in colour from deep red-purple to bright green and depends on leaf age and plant biotype (Queensland green, bronze or purple, Darwin purple or Katherine green and Kununurra green) (Taylor and Dhileepan 2014). Bellyache bush requires ongoing chemical treatments making chemical control expensive in extensive grazing areas (Bebawi *et al.* 2007a). The plant is capable of a high rate of reproduction with seed production being estimated as high as 12,000 seeds per plant per year. In addition, the plant has the capacity to flower and produce seed year round, with seeds that are viable for up to four years (Bebawi *et al.* 2007b). To keep the weed in check, control must be regular, ongoing and widespread. For these reasons, biological control is highly desirable for bellyache bush in Australia.

Bellyache bush has been a target for biological control since 1997. Native range surveys in Mexico, central and northern South America, and the Caribbean resulted in the release of the seed-feeding jewel bug (*Agonosoma trilineatum* F.) in 2003, which failed to establish (Heard *et al.* 2012). The leaf rust, *Phakopsora arthuriana* Buriticá & J.F. Hennen was also identified and host specificity testing is in progress at CABI in the UK.

Recent opportunistic surveys in India identified *Sciota divisella* (Duponchel) (Lepidoptera: Pyralidae) (Figure 1) feeding on bellyache bush, *J. curcas* L. and *Euphorbia grantii* Oliv., all members of the family Euphorbiaceae. The moth was subsequently imported into the QC3 quarantine facility at the Ecosciences Precinct in Brisbane to determine its host range and study its biology.

This paper outlines the progress of host testing, preliminary biological observations, taxonomy and possibilities for future research.

### MATERIALS AND METHODS

**Insect source** The first importation of *S. divisella* larvae from Tamil Nadu, India, was in December 2014. This colony failed to establish in quarantine. A second

importation of 192 larvae and 41 pupa occurred in July 2015, with a further importation of 150 larvae in October 2015 to augment the colony.

**Insect culture** Moths were reared in quarantine glasshouse facilities at the Ecosciences Precinct at Boggo Road, Dutton Park, Queensland. Six to eight bellyache bush plants (mixed biotypes) were placed in cages (900 × 888 × 560 mm) covered with polyester voile mesh (45 gsm) and adult moths were introduced to the cages. The number of adults used was dependent on availability of moths from culture. A container of Gatorade® with a cotton wick was also supplied to provide a source of sugar and salt for female feeding. The moths were cultured in controlled climatic conditions of 22°C (night) and 26°C (day) temperature and 60% relative humidity. During late autumn 2016, day lengths were extended over winter with the use of ultra-violet lighting between 5–7am and 5–7pm to encourage egg laying and larval development.

**Test plants** Forty test plant species from the Euphorbiaceae and closely related families were included in the host test list. *Jatropha* is the only representative of the tribe Jatropheae in Australia with five introduced species—*J. gossypifolia*, *J. curcas* L., *J. multifida* L., *J. integerrima* Jacq. and *J. podagrica* Hooker. The latter three are ornamental plants and only *J. gossypifolia* and *J. curcas* are naturalised.

**Host specificity tests** Eggs (less than a day old) were harvested from bellyache bush by cutting the egg batch from plant surface and placing in a Petri dish with moistened filter paper to await eclosion. Ten newly emerged larvae were then placed onto each test plant using a single bristle paint brush. There are a minimum of five replicates for every species. No-choice larval survival and development tests and no-choice oviposition tests are being done first and only those test plant species on which the moth lays eggs and or those on which the larvae feed and complete development will be subjected to choice oviposition and larval feeding and development tests.

## RESULTS

**Insect culture** The mean number of adults ( $\pm$  SEM) from a colony cage was  $83 \pm 10$  ( $n = 23$ ) (mean number of adults to start colony cage was  $103 \pm 17$ ). There was no diapause phase during the culturing of the insect under controlled conditions and one generation took approximately six weeks to complete. The adults laid eggs on leaves and stems of bellyache bush plants, but eggs were most commonly found on the underside of leaves in clumps or in rows along vein

margins and on the main trunk, toward the apex. Plants were extensively damaged during the insect culturing process with leaf-webbing and stem damage caused by feeding (Figure 2).

**Host specificity** Host specificity tests are partially completed for 25 species (Table 1) and tests are in progress for the remaining 15 test plant species. Larval feeding and complete development has occurred only on the target plant (bellyache bush), on the closely related *J. curcas* (another approved target for biological control) and on *Euphorbia grantii* (highly toxic, uncommon exotic ornamental). At this stage there has been no development on any of the other 22 species tested.

**Insect identification** The species was originally identified as *Morosaphycita morosalis* (Saalmüller). Specimens were sent to Marianne Horak, (CSIRO, NRCA, Canberra) for verification of species identity due to the complex and cryptic nature of this sub



Figure 1. Adult *Sciota divisella*.



Figure 2. Larval damage to bellyache bush leaves and stems.

**Table 1.** Host range tests completed.  
(Rep = number of replicates currently completed,  
Dev = agent development).

Test Species	Rep	Dev
CROTONOIDEAE		
Jatrophaeae		
<i>Jatropha gossypifolia</i> L.	13	Y
<i>Jatropha curcas</i> L.	3	Y
<i>Jatropha multifida</i> L.	3	N
<i>Jatropha podagrica</i> Hook.	2	N
Crotonaeae		
<i>Croton insularis</i> Baill.	3	N
<i>Croton acronychioides</i> F.Muell.	1	N
Manihotaeae		
<i>Manihot esculenta</i> Crantz.	1	N
Adenoclineae		
<i>Endospermum myrmecophilum</i> L.S.Smith	2	N
Codiaeae		
<i>Codiaeum variegatum</i> Blume	1	N
Ricinocarpeae		
<i>Beyeria lechenaultii</i> (DC.) Baill.	1	N
<i>Beyeria viscosa</i> (Labill.) Miq	2	N
EUPHORBIOIDEAE		
Euphorbieae		
<i>Euphorbia pulcherrima</i> Willd.	2	N
<i>Euphorbia grantii</i> Oliv.	1	Y
Hippomaneae		
<i>Homolanthus nutans</i> (G.Forst) Guill.	3	N
ACALYPHOIDEAE		
Acalypheae		
<i>Ricinus communis</i> L.	1	N
<i>Macaranga tanarius</i> (L.) Muell.Arg	1	N
<i>Mallotus phillipensis</i> (Lam) Muell.Arg	2	N
PHYLLANTHACEAE – PHYLLANTHOIDEAE		
Wielandiaeae		
<i>Actephila lindleyi</i> (Steud.) Airy Shaw	4	N
Brideliaceae		
<i>Cleistanthus hylandii</i> Airy Shaw	2	N
Phyllanthaeae		
<i>Flueggia virosa</i> (Willd.) Voight	2	N
<i>Breynia oblongifolia</i> Muell.Arg.	2	N
<i>Glochidion ferdinandi</i> (Muell.Arg.) F.M.Bailey	1	N
<i>Glochidion sumatranum</i> Miq	1	N
Picrodendraceae		
<i>Petalostigma pubescens</i> Muell.Arg.	2	N
Putranjivaceae		
<i>Drypetes deplanchei</i> (Brongn. & Gris.) Merr.	1	N

family and genus. She advised that after consulting with Dr David Lees at the Natural History Museum in London, that the species is *S. divisella* and not *M. morosalis*. Genetic barcoding will be used to confirm this identification.

#### DISCUSSION

The *Jatropha* webber shows potential as an effective biological control agent for bellyache bush based on significant damage to leaves, stems and reproductive parts of the plant (when present). Development of the moth on *J. curcas* was expected given observations in the home range of the insect and the close relationship of *J. curcas* to bellyache bush. Further research will be conducted to assess the impact and implications of development on any other alternative host plants. At this stage the development has only been on plants that are closely related and are either weeds or exotic and uncommon ornamentals; and none on any Australian native Euphorbiaceae plants. The short generation time and lack of a diapause phase may be advantageous to eventual field establishment by allowing populations to build up more quickly and provide more prolonged periods of control of the weed under field conditions. While host range studies are being conducted, further research in quarantine will assess how well the moth reproduces on plants with no foliage as plants in the field experience periods of leaf loss. During these periods, the importance of possible alternative hosts such as *J. curcas* may also need to be considered.

Studying the viability of seeds that have been damaged by larval feeding on fruits would also be valuable, given high seed production is characteristic of this weed. The extreme climate where bellyache bush has established in Australia may present challenges for agent establishment in terms of excessive temperatures, variable humidity and unreliable rainfall and their effect on the various life stages of the insect.

This moth species was initially thought to be *M. morosalis* as this has been documented as a pest of *J. curcas* in India. The revised species *Sciota divisella* is a known pest of *J. curcas* in India (Durairaj *et al.* 1999) and in Benin, West Africa (Datinon *et al.* 2013). There is also reference to *S. divisella* on a Euphorbia species in arid zones (Singh and Harsh 1996). Sharma and Srivastava (2011) reported a similar lepidopteran pest as *M. morosalis*, which is likely to also be a misidentification. Sharma and Srivastava (2011) do not give details of how their moth was identified. It is likely that a species complex exists and further genetic work may help elucidate the taxonomy of the moth. Should the agent prove to be host specific (beyond the three exotics recorded so far) then approval to release will be sought through the Australian government.

#### ACKNOWLEDGMENTS

This project was funded by Queensland Government's War on Western Weeds initiative. We thank Dr A. Balu and S. Murugesan (Institute of Forest Genetics and Tree Breeding, Coimbatore, India) for their help with the overseas field studies. We are extremely grateful to Dr Marianne Horak from the CSIRO National Research Collection in Canberra and Dr David Lees from the Natural History Museum in London for their efforts in determining the taxonomy of the insect. Thanks also to Dr Tony Pople for his comments on manuscript.

#### REFERENCES

- Bebawi, F.F., Vitelli, J.S., Campbell, S.D., Vogler, W.D., Lockett, C.J., Grace, B.S., Lukitsch, B. and Heard, T.A. (2007a). The biology of Australian weeds 47. *Jatropha gossypifolia* L. *Plant Protection Quarterly* 22, 42-58
- Bebawi, F.F., Lockett, C.J., Davies, K.M., Lukitsch, B.V. (2007b). Damage potential of the introduced biological control agent (*Agonosoma trilineatum* F.) on bellyache bush (*Jatropha gossypifolia* L.). *Biological Control* 41, 415-22.
- Csurhes, S.M. (1999). Bellyache bush (*Jatropha gossypifolia*) in Queensland. Pest Review Series – Land Protection. Queensland Government Department of Natural Resources.
- Datinon, B.D., Glitho, A.I., Tamo, M., Amevoin, K., Goergen, G. and Douro Kpindou, O.K. (2013). Inventory of major insects of *Jatropha curcas* L. (Euphorbiaceae) and their natural enemies in southern Benin. *ARPN Journal of Agriculture and Biological Science* 9, (10) 711-18.
- Dhileepan, K., Nesar, S. and De Prins, J. (2014). Biological control of bellyache bush (*Jatropha gossypifolia*) in Australia: South America as a possible source of natural enemies. Proceedings of the XIV International Symposium on Biological Control of Weeds, pp. 5-10, eds. F.A.C. Impson, C.A. Kleinjan and J.H. Hoffman, Kruger National Park, South Africa.
- Durairaj, S., Srinivasan, G., Balu, A. and Raja Rishi, R. (1999). Ecofriendly methods of control the *Jatropha* shoot and fruit borer *Sciota divisella* (Duponchel) (Lepidoptera: Pyralidae). Paper presented in the National Symposium on biological control of insects in Agriculture, Forestry, Medicine and Veterinary Science, 21 January 1999, Bharathiyar University, Coimbatore, India (Abstract).
- Heard, T.A., Chan, R.R., Senaratne, K.A.D., Palmer, W.A., Lockett, C. and Lukitsch, B. (2009). *Agonosoma trilineatum* (Heterophera: Scutelleridae) a biological control agent of the weed bellyache bush, *Jatropha gossypifolia* (Euphorbiaceae). *Biological Control* 48, 196-203.
- Heard, T.A., Dhileepan, K., Bebawi, F., Bell, K.L. and Segura, R. (2012). *Jatropha gossypifolia* L. – bellyache bush. In 'Biological Control of Weeds in Australia', pp. 324-33.
- Oliveira, L.I., Jabour, F.F., Nogueira, V.A. and Yamasaki, E.M. (2008). Experimental poisoning by the leaves of *Jatropha gossypifolia* (Euphorbiaceae) in sheep. *Pesquisa Veterinária Brasileira* 28 (6), 275-78.
- Sharma, R.P. and Srivastava, C.P. (2011). Assessment of biological and morphometric parameters of *Jatropha* Leaf Webber Cum Fruit Webber, *Pempelia morosalis* (Saalm Uller) along with associated natural enemies in eastern Uttar Pradesh of India. *Journal of Entomology* 8 (1), 88-94.
- Singh, M.P. and Harsh, L.N. (1996) *Denticera divisella* Duponchel (Pyralidae: Lep) infesting *Euphorbia antisyphilitica* in the arid zones. *Entomon* 21, 263-4.
- Taylor, D.B.J. and Dhileepan, K. (2014). Application to import *Morosaphycita morosalis* into quarantine for evaluation as a weed biological control agent for bellyache bush *Jatropha gossypifolia*. Department of Agriculture, Fisheries and Forestry, Queensland Government.