Southern Forests: a Journal of Forest Science
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/tsfs20

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Published online: 03 Oct 2014.

To cite this article: Carlos A Rodas, Rubén Serna, Brett P Hurley, Maria D Bolaños, Ginna M Granados & Michael J Wingfield (2014) Three new and important insect pests recorded for the first time in Colombian plantations, Southern Forests: a Journal of Forest Science, 76:4, 245-252, DOI: 10.2989/20702620.2014.965983

To link to this article: http://dx.doi.org/10.2989/20702620.2014.965983

Southern Forests 2014, 76(4): 245–252

SOUTHERN FORESTS
ISSN 2070-2620 EISSN 2070-2639
http://dx.doi.org/10.2989/20702620.2014.965983

Three new and important insect pests recorded for the first time in Colombian plantations

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Subsequent to 1950, commercially propagated and non-native trees, including *Pinus, Eucalyptus* and *Cupressus* species in Colombian plantations, have been damaged by several native defoliating insects, residing mainly in the Lepidoptera (Geometridae), Phasmatodea (Heteronemiidae) and the Hymenoptera (Formicidae). We report on the relatively recent appearance of three important and damaging new insect pests of plantation-grown *Pinus* and *Eucalyptus* spp. in Colombia, two of which are not native to this country. These include *Monalonion velezangeli* (Hemiptera: Miridae), *Glycaspis brimblecombei* (Hemiptera: Psyllidae) and *Pineus boerneri* (Hemiptera: Adelgidae). This report provides information on the basic biology of these new pests, their hosts, areas of occurrence, likely origin and prospects for their management in the future.

Keywords: insect pest, invasive, *Pinus*, *Eucalyptus*

Introduction

Plantation forestry in Colombia is based mainly on non-native species of *Pinus* and *Eucalyptus* and it supports major solid wood and paper industries. At present, there are 327 000 ha of trees established in plantations in the country and this area is likely to expand in the future (MADR 2010). Of this area, 75 000 ha are planted to *Pinus* species and 46 000 ha to *Eucalyptus* species, with the remaining 206 000 ha planted to species in the genera *Hevea*, *Tectona*, *Gmelia* and *Acacia* (Anon. 2011; MADR 2014). As is true in other parts of the world (Wingfield et al. 2011a), insect pests and pathogens pose a very serious threat to plantation forestry in Colombia.

In Colombia, as in many other countries of the tropics and Southern Hemisphere, plantations of *Pinus* species and *Eucalyptus* species were initially separated from their natural enemies. Pests and diseases have gradually begun to appear and in some cases these are threatening the sustainability of plantation resources (Wingfield 2003; Wingfield et al. 2010, 2011a). These pests and pathogens include those that are native to the areas where they occur and others that have been introduced from the areas where they are native, or elsewhere where they have become established as invasive aliens. This is a trend that is likely to continue as has been suggested in a number of recent reviews (Wingfield 2003; Wingfield et al. 2010, 2011a, 2011b, 2013).

Colombian plantations of *Pinus* and *Eucalyptus* have been challenged by various native insects, particularly defoliators residing in the Lepidoptera (Geometridae) (Gallego 1959; Vélez 1972; Bustillo 1976; Rodas 1994, 1996), Hymenoptera (Formicidae) (Mackay and Mackay 1986), and Phasmatodea (Heteronemiidae) (Madrigal and Abril 1994). These infestations have been managed largely through the implementation of biological control strategies (Bustillo 1976; Bustillo and Drooz 1977; Bustillo 1978; Rodas 1997; Madrigal 2003; Ortiz and Guzmán 2007). An exception has been the very serious infestations of native leaf-cutting ants, where chemical control has been implemented (Ortiz 1998; Forti et al. 2007; CAR unpublished data).

The monitoring of Colombian *Pinus* and *Eucalyptus* plantations for detection of new pests and pathogens is an ongoing and important activity. The systematic monitoring is made every three months on the commercial planted area of 43 000 ha of the forest company Smurfit Kappa Cartón de Colombia. During the last decade, this monitoring process has led to the discovery of three serious insect pests not previously known in Colombia. These are *Monalonion velezangeli*, *Glycaspis brimblecombei* and *Pineus boerneri.* These insects have been increasing in importance and they represent a threat to Colombian plantations. The aim of this study was to formally report the occurrence of *M. velezangeli* and *G. brimblecombei* on *Eucalyptus* species and *P. boerneri* on *Pinus* species in Colombia, and to provide information on their biology and relative importance.

Monalonion velezangeli (Hemiptera: Miridae)

Monalonion velezangeli (Hemiptera: Miridae) was first recorded in Colombia in 1984 on avocado (*Persea americana*) (Carvalho and Costa 1988). The origin of the

genus *Monalonion* is believed to be Central and South America where it is known on various crop plants, especially on cocoa (Vélez 1997). In recent years, *M. venezangeli* has become a significant pest on a number of Colombian tree crops, including avocado (Carvalho and Costa 1988; Londoño and Vargas 2010a), coffee (*Coffea arabica*) (Ramírez et al. 2007), guava (*Psidium guajava*) and cocoa (*Theobroma cacao*) (Giraldo et al. 2009, Londoño and Vargas 2010b). *Monalonion velezangeli* was reported for the first time on *E. grandis* in 2011 in the Valle del Cauca department (Table 1), and the identification was made using taxonomic keys of Carvalho and Costa (1988) (Figure 1a–f).

The main damage caused by *M. velezangeli* is sap-sucking on young tissues such as buds and twigs. This results in the rapid appearance of dark necrotic lesions after 1 h, apparently due to the production of toxic enzymatic saliva by the insect (Figure 1g–i). Damage includes the loss of apical dominance, dried leaves and decreased growth. Careful observation of the trees has shown that the main damage occurs on *Eucalyptus* during the night and it is this nocturnal behaviour of *M. velezangeli* that resulted in it not being identified for many years. Both nymphs and adults are responsible for the damage to young *Eucalyptus* species. Severe damage can be observed in trees with relatively low levels of infestation by *M. velezangeli*. This is due to secondary infections by the fungal pathogen *Neofusicoccum ribis* (Rodas et al. 2009). This is consistent with observations of similar symptoms associated with damage due to *Heliopeltis* spp. (Miridae) on *Eucalyptus*, where Botryosphaeriaceae have been found causing secondary infections (MJW unpublished data).

Monalonion venezangeli is clearly an insect pest of emerging importance on *Eucalyptus* in Colombia. Damage is most severe on young trees growing in moist and shaded sites. While trees appear to recover from infestation as they become older, they can be very seriously malformed and this is associated with secondary infections by *N. ribis* (Rodas et al. 2009). There is good evidence that clones differ in their susceptibility to damage (CAR unpublished data) and this is linked to the differing susceptibility of clones to infection by *N. ribis* (Rodas et al. 2009). Thus, planting clones tolerant to infestation holds substantial promise. In addition, the use of natural enemies requires further investigation.

Glycaspis brimblecombei (Hemiptera: Psyllidae)

Glycaspis brimblecombei, commonly known as the Eucalyptus red gum lerp psyllid, is a native pest in Australia (Moore 1964), but is rapidly moving to new areas globally. The first report outside Australia was in 1998 in Los Angeles, USA (Dahlsten and Rowney 2000). Three years later, *G. brimblecombei* was recorded in Hawaii, USA (Nagamine and Heu 2001) and northern Mexico (Castillo 2003). The pest was recorded for the first time in South America (Chile) in 2002 (Sandoval and Rothman 2002); it was recorded in Brazil in 2003 (Wilcken et al. 2003), Madagascar in 2004 (Hollis 2004), in Argentina in 2005 (Bouvet et al. 2005), and it was found in Venezuela in 2007 (Rosales et al. 2008). The pest was first detected in Europe in 2007 when it was found on the border between Portugal and Spain (Valente and Hodkinson 2009). It was later reported in the Iberian Peninsula and Morocco in 2008 and Italy in 2010 (Laudonia and Garonna 2010; Peris-Felipo et al. 2011). Most recently, *G. brimblecombei* was reported from South Africa in 2012 (BPH pers. comm.). In Colombia, *G. brimblecombei* was noted for the first time in 2005 on various *Eucalyptus* species in the Casanare department (LY Rodríguez unpublished data) (Table 1).

Glycaspis brimblecombei is characterised by a white conical cover, commonly called a lerp, which is composed principally of crystallised honeydew and wax, which protects the nymphs (Figure 2a–c) (Paine et al. 2000; Nagamine and Heu 2001). Once they reach the adult stage, the wings are fully developed and these insects colonise new substrates (Figure 2d). Damage is principally on the foliage, shoots and branches where sap-sucking from young tissues results in defoliation, branch dieback and, in the case of heavy levels of infestation, trees can die (Dahlsten and Rowney 2000; Nagamine and Heu 2001). Defoliation and reduction in leaf area most likely also contributes to a decrease in wood production (Figure 2e). *Glycaspis brimblecombei* feeds on a

Table 1: Details on location and host species from the first reports of *M. velezangeli*, *G. brimblecombei* and *P. boerneri* in Colombia

Insect	Department[1]	Farm	Coordinates		Altitude (masl)[2]	Precipitation (mm y^{-1})	Planted species	Plantation age (y)
			Latitude	Longitude				
Monalonion velezangeli	Valle	La Tigresa	3°49′44″	76°34′54″	1 647	1 334	*E. grandis* seed	2.2
	Valle	La Mesa	3°43′59″	76°12′16″	1 885	1 720	*E. grandis* clone	1.5
	Cauca	Buenavista	2°23′03″	76°35′02″	2 151	2 421	*E. grandis* seed	0.5
Glycaspis brimblecombei	Casanare	Villanueva	4°39′10″	72°54′58″	358	2 845	*E. teriticornis*, *E. pellita*, *E. urophylla*	3
	Valle	La Estancia	3°41′31″	76°32′48″	951	984	*E. urograndis*	0.5–2.6
	Risaralda	El Nogal	4°42′60″	75°36′26″	2 004	2 772	*E. grandis*	2.3
	Antioquia	La Guamo	3°48′38″	75°41′02″	600	1 000	*E. tereticornis*, *E. camaldulensis*	0.5
Pineus boerneri	Valle	Aguaclara	3°41′31″	76°32′48″	1 489	1 489	*P. kesiya*	2.1–3
	Cauca	Potrerito	2°58′11″	76°43′34″	1 664	2 760	*P. tecunumanii*	2.2
	Valle	La Gaviota	3°47′43″	76°35′36″	1 530	1 130	*P. maximinoi*	3.4
	Valle	La Quebrada	3°47′30″	76°34′26″	1 605	1 218	*P. maximinoi*	3.4
	Cauca	Parcela	2°59′02″	76°43′29″	1 573	2 820	*P. oocarpa*	2.3

[1] Department: Colombian region

[2] Metres above sea level

wide range of *Eucalyptus* species; however, it shows strong preference for the species commonly referred to as the river red gums, including *E. camaldulensis* (Paine et al. 2000).

Glycaspis brimblecombei disperses and becomes established very rapidly and for this reason it is difficult to control (Santana and Buckhardt 2007). Furthermore, chemical control is both expensive and environmentally undesirable (Santana and Buckhardt 2007). The best option to reduce the impact of *G. brimblecombei* is classical biological control. This has been very effective using the parasitoid *Psyllaephagus bliteus* (Hymenoptera: Encyrtidae), which is a host-specific parasitoid of *G. brimblecombei* and also very useful for biological control programs in other parts of the world (Brennan et al. 1999; Dahlsten and Rowney 2000; Paine et al. 2006). Other reported families that might be useful for biological control include Anthocoridae, Chrysopidae, Coccinellidae, Hemerobiidae and Syrphidae (Dahlsten and Rowney 2000). In Colombia, an unidentified species of a Hymenopteran parasitoid and a Hemipteran predator have been found and are currently under study as potential control agents (Figure 2f and g).

Pineus boerneri (Hemiptera: Adelgidae)

Pineus species are well-known sap-sucking insects that have caused serious damage on *Pinus* species such as in Christmas tree plantations (Triplehorn and Johnson 2005) and in commercial plantations (Havill and Foottit 2007; Petro and Madoffe 2011). The Adelgidae are known to feed exclusively on conifers (Scholtz and Holm 1985; Triplehorn

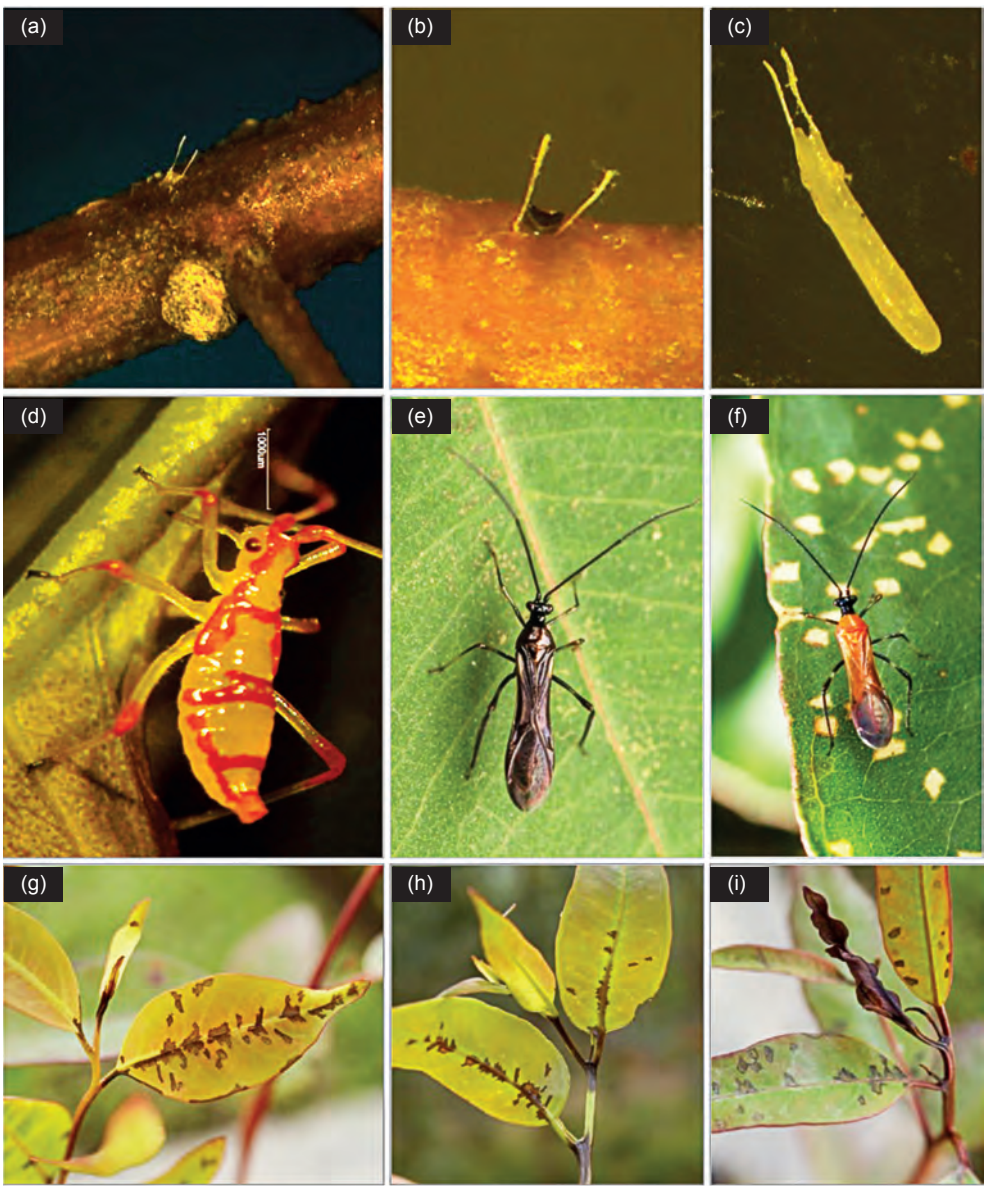

Figure 1: Life stages of *Monalonion velezangeli* (Hemiptera: Miridae). (a, b) Appendices of the egg inserted into branch tissue. (c) Egg with two exposed appendices. (d) Third nymphal stage feeding on young leaf tissue. (e, f) Adult mirid. (g, h) Early damage symptoms. (i) Advanced damage caused by the insect

and Johnson 2005) and this is true for species of *Pineus*, which are commonly referred to as pine adelgids, pine woolly aphids or common pine aphids (FAO 2007). The name 'woolly aphid' reflects the white wool-like masses of wax that are produced by the insects on the branches and between needles on which they live and feed (Scholtz and Holm 1985).

The first appearance of a *Pineus* species in plantations of non-native pines was when *Pineus pini* was recorded simultaneously in Kenya and Zimbabwe in 1968 where it was believed to have been introduced from Australia on *Pinus taeda* in 1962 (Barnes et al. 1976; Petro and Madoffe 2011). However, genetic analyses on samples confirmed not only the introduction from Australia but the true identity of the pine woolly aphid as *Pineus boerneri* (Blackman et al. 1995). The pine woolly aphid has spread to other African countries including Ethiopia, Tanzania, Malawi and South Africa (Murphy et al. 1991; Blackman and Eastop 1994;

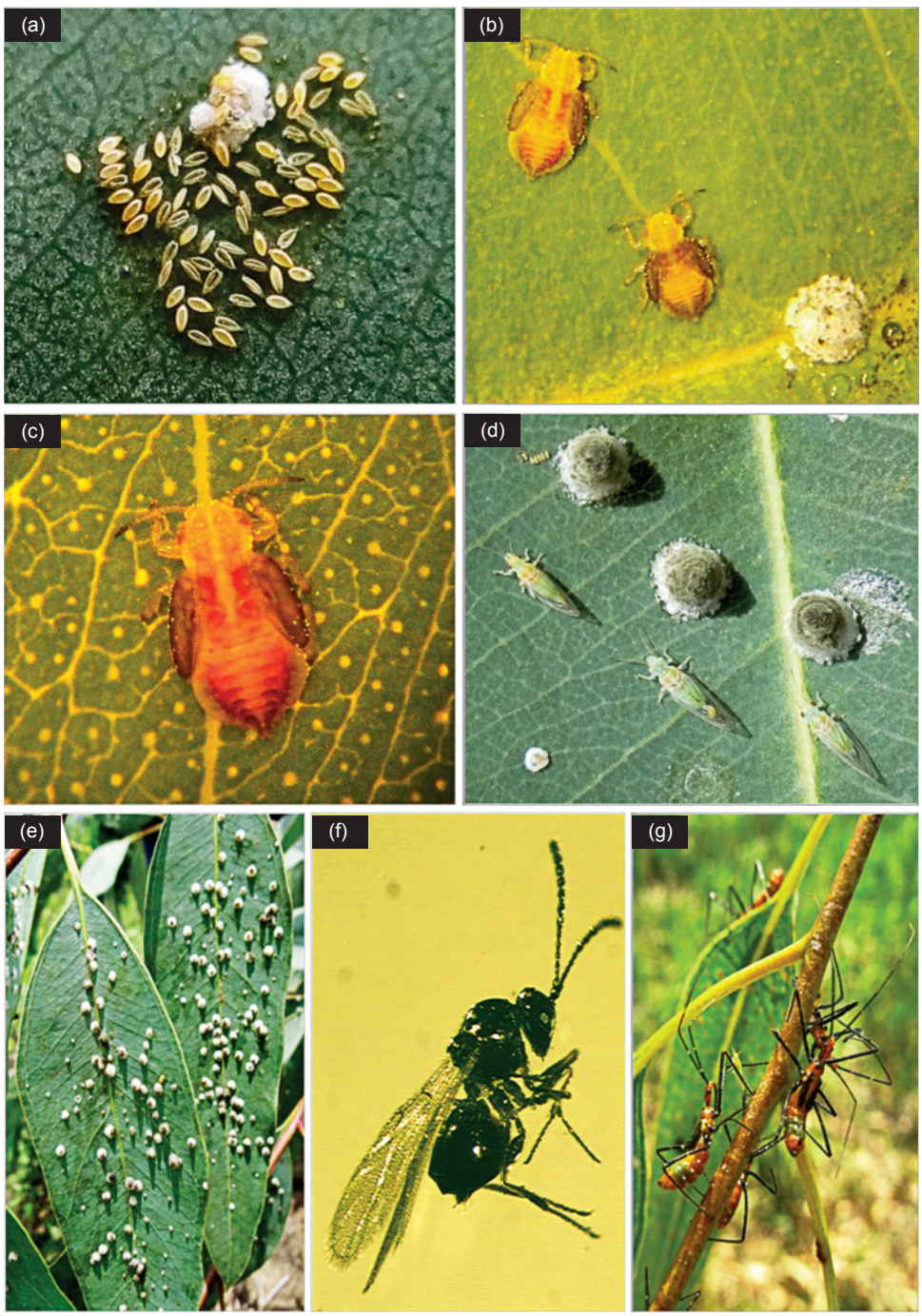

Figure 2: Life stages of the lerp psyllid *Glycaspis brimblecombei* (Hemiptera: Psyllidae) and biological control agents. (a) Eggs on leaf surface. (b, c) Uncovered nymphs. (d) Adult male and female and conical lerps of nymphs. (e) Abundant presence of nymphs on *E. camaldulensis*. (f) Unidentified *G. brimblecombei* parasitoid (Hymenoptera). (g) Unidentified Reduviidae (Hemiptera) as predators

Chilima and Leather 2001; Lazzari and Cardoso 2011), South American countries such as Brazil (Oliveira et al. 2008; Lazzari and Cardoso 2011) and Chile (Blackman and Eastop 1994), as well as North America, New Zealand and Australia (Blackman and Eastop 1994; Blackman et al. 1995). The first report of *Pineus boerneri* in Colombia was in 2008 on 2.1-year-old *Pinus kesiya* in the Valle del Cauca department (Table 1).

Symptoms of *Pineus boerneri* infestation become obvious when populations are high and these include masses of eggs, nymphs and adults covered by white cottony tufts of a wax-like substance that the insects exude to cover themselves. This results in chlorosis of the needles and a reduction of tree growth, followed by shoot death, die-back of branches, infested cones and, in extreme cases, death of trees (Figure 3a–c). In Colombia, microscopic examination

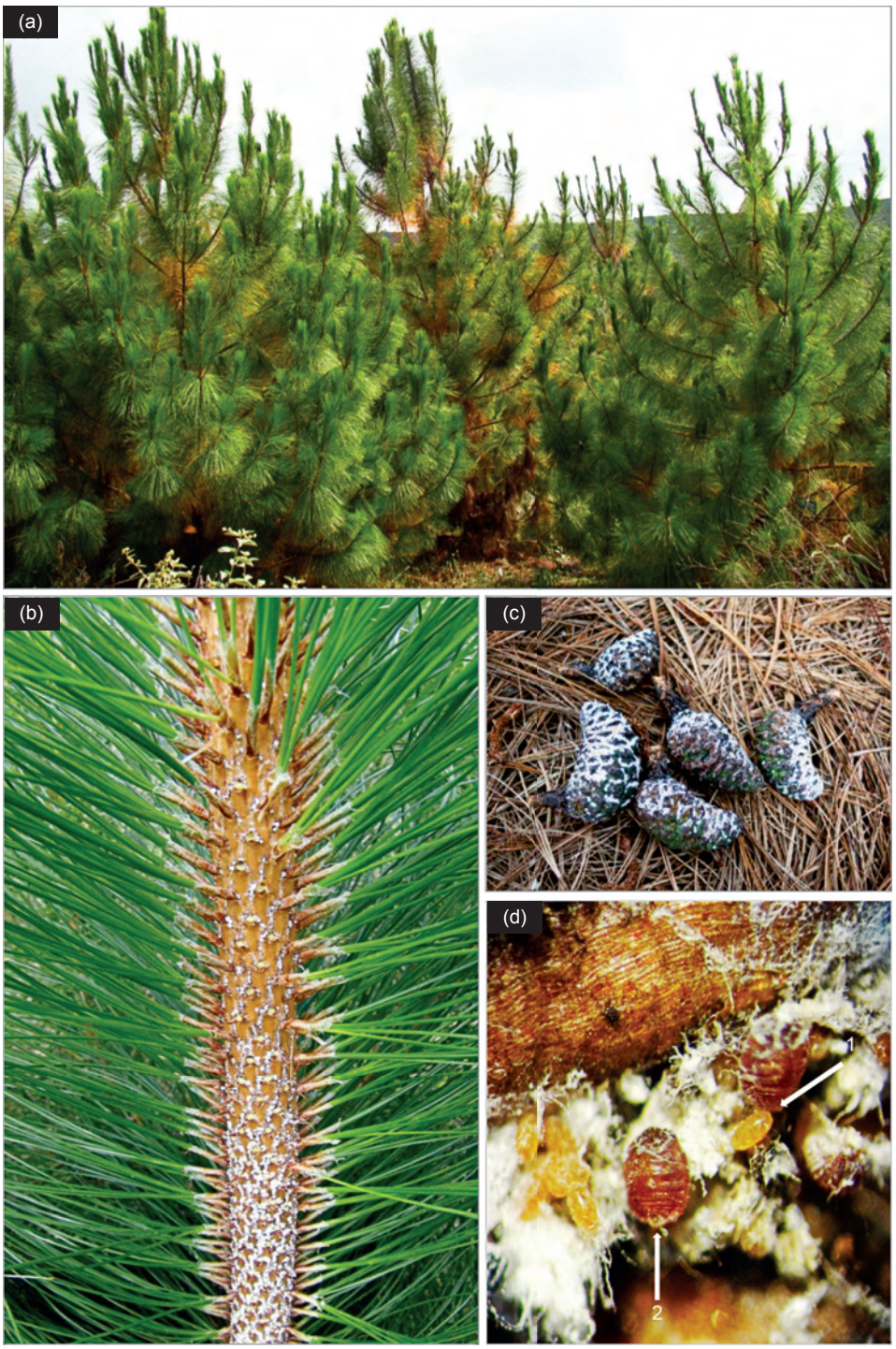

Figure 3: Life stages and symptoms of infestation by *Pineus boerneri* (Hemiptera: Adelgidae). (a) Affected *Pinus kesiya* plantation. (b) Severe infestation on bark of *P. kesiya*. (c) Infested cones of *Pinus maximinoi*. (d) Microscopy of eggs (1) and female adults (2) (indicated by arrows)

of infested branches has shown that adult males are not present (Figure 3d). Individual trees in plantations differ in their susceptibility to infestation by *Pineus boerneri*. In many cases, there are sufficiently high numbers of uninfected trees to enable productive forestry to continue, other than in the case of highly susceptible species such as *Pinus kesiya*. Biological control found for *Pineus boerneri* includes different species of the Chrysopidae, such as *Ceraeochrysa* and *Chrysoperla* species, and some of the Coccinelidae such as *Harmonia axyridis* (Brown et al. 2011).

Conclusions

This study has recorded the relatively recent appearance of three important and damaging new insect pests of plantation-grown *Pinus* and *Eucalyptus* species in Colombia. Prior to the appearance of these pests, native insects caused all entomological problems affecting plantation forestry in the country. This situation appears to be changing with two of the three insects recorded in this study being non-natives. There is a large number of seriously damaging insect pests of *Eucalyptus* and *Pinus* already in South America but not in Colombia. These insects include the Eucalyptus gall wasp *Leptocybe invasa* (Costa et al. 2008), the Eucalyptus winter bronze bug *Thaumastocoris peregrinus* (Carpintero and Dellapé 2006; Wilcken et al. 2010), the Sirex wood wasp *Sirex noctilio* (Hurley et al. 2007) and various bark beetles on *Pinus* (Marvaldi and Lanteri 2005). The imminent arrival of these pests represents a huge threat to plantation forestry in Colombia and every effort must be made to establish early detection systems and management strategies.

The continuous expansion of global trade in plants and wood products increases the risk of new pest introductions and consequently the establishment of pests in new areas. This situation demands the need for strict phytosanitary measures, which is the most effective means to reduce the global spread of pests and pathogens. Since these insects have been increasing in importance and they represent a threat to Colombian plantations, quarantine programmes are in the process of being formulated. The hope is that they will reduce the economic impact of new pests and pathogens to the forestry industry.

While pests and pathogens represent a very substantial challenge to sustainable plantation forestry in Colombia and globally (Wingfield et al. 2010, 2011b), there are many opportunities to deal with these problems. Breeding and selection for disease- and pest-tolerant planting stock provides one such opportunity that has already been very effective. There are also numerous examples of substantial success in reducing populations of insect pests using biological control (Garnas et al. 2012). Furthermore, new technologies are constantly emerging including those linked to DNA-based diagnostics and breeding tools (Wingfield et al. 2013). Investment in these opportunities will allow progressive forestry companies to remain competitive.

Acknowledgements — We thank Smurfit Kappa Cartón de Colombia for financial support, as well as the National Research Foundation (NRF) and the Forestry and Agricultural Biotechnology Institute (FABI), University of Pretoria, South Africa, for their support of this study. We also thank Dr Nathan Havill (US Department of Agriculture, Northern Research Station, USA) for confirming the identification of *Pineus boerneri*.

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Received 1 December 2013, revised 16 June 2014, accepted 22 June 2014