First Report of *Eriococcus ironsidei* Williams (Hemiptera: Coccomorpha: Eriococcidae) on Macadamia (*Macadamia integrifolia* Maiden & Betche and *Macadamia tetraphylla* Johnson: Proteaceae) in South Africa

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First report of *Eriococcus ironsidei* Williams (Hemiptera: Coccomorpha: Eriococcidae) on macadamia (*Macadamia integrifolia* Maiden & Betche and *Macadamia tetraphylla* Johnson: Proteaceae) in South Africa

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It is not clear when macadamias were first planted in South Africa, but according to De Villiers (2003) the Durban botanical garden already had a tree by 1915. The first commercial seedlings were established about 16 years later in the Nelspruit area, but the industry only got underway during 1957 when approximately 60 000 seedlings were sold by the Reims nursery in KwaZulu-Natal (De Villiers 2003).

Since these humble beginnings, the industry has grown significantly, and currently there are more than 23 000 ha under production in South Africa. According to Giuricich (2016), it is expected that the 2018 crop will be in excess of 55 000 t.

Initially, pest and disease problems were negligible. The polyphagous pest *Pseudotheraptus wayi* Brown (Hemiptera: Coreidae) was only identified on macadamias during 1977. The main pest of macadamia, *Bathycoelia distincta* Distant (Hemiptera: Pentatomidae), was identified seven years later, but Bruwer (1992) already recorded 35 kernel-feeding Hemiptera species in the Levubu area. By 2016 annual crop losses due to the Hemiptera pest complex ranged upwards of R400 million. This value is based on current crop volumes and long-term average annual stink bug-induced crop losses of 10 % (Anon. 2015).

Since the 1990s, large macadamia monocultures have been established in all major production regions. Most of the trees planted since then have now matured, and because macadamia trees are very large as well as dense, the orchards have provided excellent sheltering sites for a plethora of new pests. Van den Berg *et al*. (2001) listed about 60 pests or potential pests from six insect orders on macadamia.

In April 2017 severe infestations of another new insect pest, *Eriococcus ironsidei* Williams (Coccomorpha: Eriococcidae), were observed in the Barberton valley in Mpumalanga (25°42′11″S 30°59′37″E) on approximately 16 ha of mature macadamias. The method of introduction of this species is currently unclear, but it is suspected that it may have been accidentally imported with propagative material. The newly introduced species joins three other introduced eriococcid species (*E. coccineus* Cockerell, *E. araucariae* Maskell and *E. leptospermi* Maskell) and the only native species (*Calycicoccus merwei* Brain) (Gullan *et.al*. 2006). Specimens from the Barberton locality were submitted to the South African National Collection of Insects (ARC-Plant Protection Research, Pretoria), where their identity was confirmed as *Eriococcus ironsidei* by the second author (I.M.M.). Slide mounts of the specimens were deposited in the National Collection under accession number HC 7291 for permanent reference.

Ironside (1970) reported on the damage which this insect caused to macadamias in Queensland, Australia, and named it the 'Macadamia felted coccid'. Soon after this, it was described as a new species, *Eriococcus ironsidei* by Williams (1973) in his account of scale insects that occur on macadamia. Miller & Gimpel (1996) transferred this species to the genus *Acanthococcus* Signoret, 1875. They subsequently considered *Acanthococcus* to be a synonym of *Eriococcus* Targioni Tozzetti, 1868 and the species returned to its original placement in the latter genus (Miller & Gimpel 2000). However, the status of *Acanthococcus* is currently not resolved and certain authors (*e.g*. Kozár 2009; Hodgson & Miller 2010) retain its validity.

Slide-mounted specimens of *E. ironsidei* can be readily diagnosed as this species by comparison with the detailed illustration and morphological account in the original description by Williams (1973). It is the only member of the scale insect family Eriococcidae which is known so far to occur on macadamia, and can thus be readily distinguished from other Coccomorpha species that

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feed on this crop host. *Eriococcus ironsidei* is host specific, occurring only on species of *Macadamia* (Miller & Gimpel 2000).

In the field, *E. ironsidei* can be recognised by the 'felted' appearance of its protective sac or scale cover. Certain armoured scale insect species (Diaspididae) that colonise macadamia may appear superficially similar, but differ by having smoother, hard scale covers with the exuviae of the first and second stages embedded in the adult female scale cover. The adult female scale of *E. ironsidei* is dirty white or pale yellow, about 1.5 mm in length, with a raised circular opening at the posterior end, while that of the male is white and about 1.0 mm long (Williams 1973). Important features of the adult female can be observed under a stereo microscope by dislodging the scale cover from the bark or leaves of the plant with fine forceps and turning it over to expose the specimen beneath. The body is elongate-oval to rotund, 0.75 to 1.25 mm long, with a pair of pointed, conical elongate lobes at the end of the abdomen (Williams 1973), and is orange in colour. Colour photographs of the various life stages are provided in Zarders & Wright (2016).

The macadamia felted coccid is native to Australia and is a significant quarantine pest threat which will affect trade and movement of propagative material between various producing countries. Williams (1973) reported that it was intercepted in 1954 on macadamia species imported into Hawaii. Fifty years later, this pest was found to have become established there, when it was observed for the first time in the Kona area of Hawaii (Conant *et al.* 2005). It had probably been accidentally introduced shortly before then. Populations of the coccid caused substantial damage to well-established trees in the region. Damage included leaf malformation and die-back of large portions of the trees. Ironside (1973) also mentioned that dense infestations could cause flower drop, leaf die-back and subsequent reductions in nut set.

Wright & Conant (2009) observed that natural dispersal rates of this pest are very low and that dispersal tends to occur primarily within infested trees. This is of particular interest for South African growers as it indicates that this introduction could be relatively contained by quarantining the area and by treating affected trees diligently with appropriate pesticides.

Macadamias are large trees and Drew (2003) mentioned that canopy volumes/ha often exceed 60 000 m^3. This means that spray coverage in the apical regions of trees is often inadequate. Fortunately, Wright & Conant (2009) found that in big trees *E. ironsidei* prefers basal tree portions (tree trunks, branches and foliage). Smaller trees on the other hand are often infested right to the uppermost parts of the canopy.

According to Wright & Conant (2009), *E. ironsidei* is a severe pest of macadamias in Hawaii but occurs at low densities for long periods of time. Sporadic outbreaks, however, have a devastating impact on the trees and this pest is therefore expected to have direct negative impacts on the long-term profitability of the crop in South Africa. Insecticidal oils have a low negative environmental impact and are very effective in controlling the sessile adults. Unfortunately, this remedy will have a lower impact on immature stages as severe encrustations of adults often shield immature stages from the effect of pesticides. A follow up application a few weeks after the initial application may therefore be required. An appropriate commercially available insect growth regulator should also be effective against immature stages. According to Wright & Conant (2009) parasitism in Hawaii was relatively high at more than 80 % mortality, suggesting that serious consideration should be given to an integrated pest management programme, which may include the importation of parasitoids from Australia. The current pesticide-focused crop protection programme in South African macadamia orchards should, however, be re-examined as a matter of utmost urgency as this practice will be detrimental for biological control of *E. ironsidei*.

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