

Recent establishment of many alien insects in South Africa – a cause for concern

J.H. Giliomee

Department of Botany and Zoology, University of Stellenbosch, Private Bag X1, Matieland, 7602 South Africa
E-mail: jhg@sun.ac.za

Any new alien insect that succeeds in reaching and establishing in South Africa is a cause for concern, especially if it is phytophagous and feeds on commercially important plants. It is important that this should be detected early and documented so that the status of the insect as a pest can be assessed. Where necessary, the agricultural sector, trading partners and neighbouring countries should be alerted and consideration given to the possibility of eradication. The rate at which these insects establish in a region gives an indication of the adequacy of phytosanitary procedures which are aimed at preventing this. The aim of this paper is to draw attention to the number of alien insect species (excluding pet insects and those introduced for the biological control of pest insects and weeds) which have recently (arbitrarily the last 12 years) established in South Africa, particularly in the Western Cape Province, and to consider possible pathways by which they have entered the country. Indications are that new introductions are taking place at an alarming rate, pointing to deficiencies in the regulatory procedures and constraints faced by the South African regulatory system.

Long-distance range expansion of arthropods occurs when they are translocated from one continent or one country to another through human actions, such as travel, trade in commodities and the importation of plant material. This has often happened in the past in South Africa: a rough estimate shows that 53 of about 320 species of commercial importance discussed by Annecke & Moran (1982) have been introduced into South Africa. (In the estimate the species they consider to be 'cosmopolitan' and 'African' were regarded as being indigenous, although some of them may have been introduced into South Africa, which would increase the number of introduced species.) Among the introduced species are some of our most severe agricultural pests, like the codling moth, *Cydia pomonella* (L.) (Lepidoptera: Tortricidae), which arrived in South Africa in 1885 from Madeira (Giliomee & Riedl 1998).

Some exotic species first arrived somewhere on

the African continent and then gradually spread, reaching South Africa. Thus, the tobacco whitefly, *Bemisia tabaci* (Gennadius) (Hemiptera: Aleyrodidae), probably of Indian origin (Fishpool & Burban 1994), is widespread in Africa (Annecke & Moran 1982), and according to records in the National Collection of Insects, Pretoria, occurs in Gauteng, Mpumalanga, KwaZulu-Natal and the Eastern Cape Province as far south as East London. Recently, this whitefly was found at Lutzville (Northern Cape Province) and at Klipheuwel and Stellenbosch in the Western Cape (T. Swanepoel, Syngenta, pers. comm.). The potato leaf miner, *Liriomyza huidrobensis* (Blanchard) (Diptera: Agromyzidae), from South America is known to occur in Kenya and Zimbabwe, and was first detected in South Africa during 1999 in the Sandveld and Ceres regions (Western Cape Province), where it caused severe damage to potatoes (Visser 2000). The destructive Asian fruit fly *Bactrocera invadens* (Drew, Tsurutha & White) (Diptera: Tephritidae) was first noticed during 2003 in Kenya and Tanzania from where it rapidly spread in all directions (Drew *et al.* 2005), including southwards, to Namibia and Mozambique. In South Africa it was first caught during May 2010 in traps placed along the northern border of Limpopo, adjacent to Zimbabwe. An attempt is being made to eradicate it (http://www.hortgro.co.za/images/fresh%20notes2013%20_july%2010.pdf). The larger grain borer, *Prostephanus truncatus* (Coleoptera: Bostrychidae), was introduced into Tanzania in the 1980s (Farrell 2000) and spread southwards to reach South Africa in 1999 (Roux 1999). Likewise, the Australian gall-inducing wasp, *Leptocybe invasa* Fisher & LaSalle (Hymenoptera: Eulophidae), was first detected in Africa in 2002 when it was discovered on *Eucalyptus* in Ethiopia. From there it moved southwards via Kenya, Tanzania and Zimbabwe and reached Pretoria in 2007 (Dittrich-Schröder *et al.* 2009).

Two other *Eucalyptus* feeders probably arrived in South Africa directly from Australia. The sap-sucking bug, *Thaumastocoris peregrinus* (Hemiptera: Thaumastocoridae), (previously thought to be

T. australicus Kirkaldy (Carpintero & Delappé 2006)) was first detected in Gauteng in 2003 and later found in Mpumalanga and the North West provinces, where heavy infestations were observed (Jacobs & Naser 2005; Nadel *et al.* 2010). The second species was the eucalyptus shoot psyllid, *Blastopsylla occidentalis* Taylor. It has probably been in South Africa since 2004, and in 2006 caused flowering of *Eucalyptus sideroxylon*, an important source of nectar for honey bees, to fail (Anon. 2007). These species thus joined a number of other *Eucalyptus*-infesting insects from Australia, such as the beetles *Gonipterus scutellatus* Gyllenhal (Coleoptera: Curculionidae), *Trachymela tincticollis* (Blackburn) (Chrysomelidae) and *Phoracantha* spp. (Coleoptera: Cerambycidae), which earlier became established in South Africa.

Another introduced psyllid, whose presence in South Africa was discovered in 2001 in Bloemfontein (I. Millar pers. comm.), is *Calophya schini* Tuthill (Hemiptera: Psylloidea). This species originates from Peru and induces pit galls on leaves of the pepper tree, *Schinus molle* (Burckhardt & Basset 2000).

In 2007 it was reported that the fungus gnat *Bradysia difformis* Frey (Sciaridae), an alleged vector of a pine seedlings disease, *Fusarium circinatum*, had been found in South Africa (Hurley *et al.* 2007). It probably came from the northern hemisphere and could have been introduced into South Africa on infested plant material.

Recent new introductions to the Western Cape, mainly from the northern hemisphere, are the Mediterranean black fig fly, *Silba adipata* McAlpine (Diptera: Lonchaeidae) (Giliomee *et al.* 2007); the harlequin beetle or multicoloured Asian ladybird beetle, *Harmonia axyridis* (Pallas) (Coleoptera: Coccinellidae) (Stals & Prinsloo 2007), the woolly whitefly of citrus, *Aleurothrixus floccosus* (Maskell) (Hemiptera: Aleyrodidae) (Giliomee & Millar 2009), *Polistes dominulus* (Christ) (Hymenoptera: Vespidae) (Eardley *et al.* 2009) and the pomegranate whitefly, *Siphoninus phillyreae* (Haliday) (Giliomee & Millar, 2010).

In most cases the pathway of introduction of alien species into Africa, and more specifically South Africa, is not clear. Table 1 proposes possible pathways for the insects mentioned above. Where it is known that plants and/or plant products of possible hosts have entered South Africa in the recent past, the insects are listed as contaminants; if this is not known, they are considered as stow-

aways on international transport vehicles. This follows Hulme *et al.* (2008) who concluded that the main pathways or routes of insect invasions are as contaminants of a commodity that was imported, and stowaways on transport vectors, while some arrive unaided through natural range expansion. In the U.S.A., McCullough *et al.* (2006) found that over a 17-year period roughly 62 % of intercepted pests (mostly at airports) were associated with baggage, 30 % with cargo and 7 % with plant propagative material. Nearly half of all pests intercepted in baggage came from confiscated fruit.

The introduction and establishment of alien phytophagous insects can be detrimental to agriculture, requiring regular and costly crop protection measures which mostly include the spraying of broad-spectrum pesticides. It can also have a major effect on current export programmes or impede requests for new market access. Others may cause significant ecological disturbance, such as the harlequin beetle with its indiscriminate predatory behaviour (Koch 2003). The latter also cause economic damage due to its tendency to feed on fruit and it is inclined to bite humans (Kovach 2004). The only cases where introduction of alien insects are of human and ecological benefit are biological control agents introduced to reduce the numbers of alien invasive weeds or pest insects and even then they may have unintended impacts on non-target organisms (Pearson & Callaway 2005).

The rate at which potential insect pests are accidentally being introduced into South Africa is disconcerting. A rough calculation shows that about 60 of these species established here in the 350 years prior to 2000, *i.e.* the 53 mentioned by Annecke & Moran (1982) plus those that were introduced between 1982 and 2000, such as the western flower thrips, *Frankliniella occidentalis* (Pergande) (Thysanoptera: Thripidae), first recorded in South Africa in 1989 (Giliomee 1989), and the oriental fruit moth, *Cydia molesta* Busck (Lepidoptera: Tortricidae), first recorded in 1990 (Blomefield & Geertsema 1990). However, if one arbitrarily uses the last 12 years as an indication of what is presently happening in this regard, it appears that at least 13 alien pest species new to South Africa established here fortuitously (Table 1) and that the rate of introduction is increasing. This is also the case in Europe and the U.S.A. (McCullough *et al.* 2006). Globalization and the increased traffic of goods and people across inter-

Table 1. Alien insects that have established in South Africa during the past 12 years, with their probable introduction pathway and impact.

Species	Order	Date of first record	Source of record	Probable introduction pathway	Impact
Western Cape					
<i>Liriomyza huidrobensis</i>	Diptera	1999	Visser (2000)	Range expansion	Leaf miner of potatoes, peas
<i>Silba adipata</i>	Diptera	2007	Giliomee <i>et al.</i> (2007)	Contaminant	Damage to fig fruits
<i>Harmonia axyridis</i>	Coleoptera	2007	Stals & Prinsloo (2007)	Stowaway	Predation and competition
<i>Aleurothrix floccosus</i>	Hemiptera	2009	Giliomee & Millar (2009)	Contaminant	Sap sucking and leaf drop on citrus
<i>Siphoninus phillyreae</i>	Hemiptera	2009	Giliomee & Millar (2010)	Contaminant	Sap sucking on various crops
<i>Polistes dominulus</i>	Hymenoptera	2009	Eardley <i>et al.</i> (2009)	Stowaway	Nuisance, competition
Gauteng					
<i>Thaumasto-corus peregrinus</i>	Hemiptera	2003	Jacobs & Nesor (2005)	Stowaway	Sap sucking on <i>Eucalyptus</i>
<i>Blastopsylla occidentalis</i>	Hemiptera	2004	Anon. (2007)	Stowaway	Sap sucking on <i>Eucalyptus</i>
<i>Leptocybe invasa</i>	Hemiptera	2007	Dittrich-Schröder <i>et al.</i> (2009)	Stowaway	Induces galls on <i>Eucalyptus</i>
Free State					
<i>Calophya schini</i>	Hemiptera	2001	I. Millar (pers. comm.)	Stowaway	Induces galls on <i>Schinus molle</i>
Mpumalanga/KwaZulu-Natal					
<i>Prostephanus truncatus</i>	Bostrychidae	1999	Roux (1999)	Range expansion	Attacks stored grain
<i>Bradysia difformis</i>	Diptera	2007	Hurley <i>et al.</i> (2007)	Contaminant	Possibly transmits pine fungus disease
Limpopo					
<i>Bactrocera invadens</i> *	Diptera	2010	Internet	Range expansion	Attacks citrus and other fruit

*Eradication is being attempted.

national boundaries are probably the main reasons for this (Hulme 2009; Tatem 2009). It is clear that these developments have not been accompanied by the development of effective strategies for excluding the accidental transport of exotic pests (Liebhold & Tobin 2008). The question must be posed whether the present procedures for the importation of plant material and customs inspections in South Africa have kept pace with these trends and are still adequate in preventing the introduction of undesirable organisms into this country and its neighbours. For instance, no questions are asked of travellers entering South Africa about the possession of plant material, in contrast to Australia, for example, where incoming international travellers have to sign a declaration in this regard and have their baggage subjected to an

X-ray scan (Liebhold *et al.* 2006, personal experience). In view of this, and the commendable stringent requirements in terms of the Agricultural Pests Act (Act 36 of 1983) for the importation of planting material, unscrupulous growers are tempted to circumvent these measures and illegally bring in live plant material, not noticing cryptic insects or sessile, diapausing stages. It thus appears that our quarantine services presently lack adequate capacity to properly police our ports of entry.

There are still many serious pests in foreign countries that South Africa should be vigilant about. Amongst them are the polyphagous light brown apple moth, *Epiphyas postvittana* (Walker) (Lepidoptera: Tortricidae), a native of Australia which has recently spread to California (Lewis &

Hodges 2010) and the polyphagous solenopsis mealybug, *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae), from North America which is devastating cotton in India and Pakistan (Hodgson *et al.* 2008).

The Global Invasive Species Database of the IUCN attempts to keep track of alien invasions around the globe and lists 15 insect species for South Africa (<http://www.issg.org.database>). In terms of section 70 of the National Environmental Management Act (Act 10 of 2004), South Africa has to produce a list of invasive species, which are defined as 'any species whose establishment and spread outside of its natural distribution range (a) threatens ecosystems, habitats or other species; and (b) may result in economic or environmental harm or harm to human health'. Subsequently, a draft list of invasive species was published as a schedule to Government Notice 350/2009 in Government Gazette 32090 on 3 April 2009 for public comment. It contained four insect species and subspecies, viz. *Apis mellifera capensis* Esholtz

and *A. mellifera scutellata* (Lepeletier) outside their natural distribution, *Harmonia axyridis* (Pallas) and *Vespula germanica* (Fabricius). The species listed in Table 1, with the exception of *H. axyridis*, were not included in the draft list, although they partly qualify in terms of the definition of an invasive species as they may or will cause economic harm. However, they are not known to 'threaten, ecosystems, habitats or species' in a significant way as they have not as yet been observed to compete directly with native species. Attempts to eradicate them, as required by law for listed species, would be expensive and probably futile. The focus of the regulating authorities should rather be on improving the measures aimed at preventing such species from crossing our borders.

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