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First record, current status, symptoms, infested cultivars and potential impact of the blueberry bud mite, *Acalitus vaccinii* (Keifer) (Prostigmata: Eriophyidae) in South Africa

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ABSTRACT

Acalitus vaccinii (Keifer, 1939) is reported for the first time in South Africa, on cultivated blueberries (Ericaceae: *Vaccinium* spp.). This is the first known occurrence outside its likely native range in North America where it is a pest on cultivated and wild blueberries. In South Africa it has first been identified in 2014 and now occurs between Amsterdam and Lothair, and near Lydenburg and Dullstroom in the Mpumalanga Province. The morphology of the South African *A. vaccinii* specimens was compared with previous published taxonomic descriptions and differences were found. Infestation levels in South Africa were high, and reduced flower and berry formation considerably on various *Vaccinium corymbosum* L. cultivars, and on rabbiteye blueberry *Vaccinium virgatum* Aiton. 'Centurion'. The current status of, symptoms, and cultivars infested by the mite in South African blueberry plantings are presented and discussed in the context of published information in North America. *Acalitus vaccinii* is a potential threat to cultivated blueberries in South Africa, but the threat varies according to climate and the susceptibility of different cultivars to this mite. *Acalitus vaccinii* will unlikely infest South Africa's indigenous vegetation, apart from possibly the native *Vaccinium exul* Bolus.

Keywords Trombidiformes, Eriophyoidea, mite pest, new record, plant protection, invasive mite, adventive mite

Introduction

Acalitus vaccinii (Keifer, 1939) (blueberry bud mite) (Eriophyoidea: Eriophyidae) is an economically important pest of blueberries (Ericaceae: *Vaccinium* spp.) (Fulton 1940; Keifer 1941) occurring up to date only in North America, where it is considered native. It occurs essentially throughout most of the eastern (Keifer 1941), north-central and southern areas (Isaacs *et al.* 2004; Weibelzahl and Liburd 2010) of the USA. It is the only economically important eriophyoid pest on blueberries (de Lillo and Duso 1996), apart from a potential pest, a *Calacarus* sp., which was found in Florida and which might be a vector of the blueberry necrotic ring blotch virus (BNRBV) (Burkle *et al.* 2012).

Keifer (1939) first described *A. vaccinii* from "*Vaccinium* sp. hybrid var. Rancocas" (Ericaceae), a northern highbush blueberry (*Vaccinium corymbosum* L.) cultivar (Bian 2012), in Atkinson, North Carolina. Keifer (1939) placed the species in *Eriophyes* von Siebold, 1851, but it was later transferred to *Aceria* Keifer, 1944 (Keifer 1946) and then to *Acalitus* Keifer, 1965 (Baker and Neunzig 1970). It is one of nine eriophyoid species recorded on *Vaccinium* spp. but the only in the genus *Acalitus* (2016 J.W. Amrine Jr and E. de Lillo,

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unpublished personal electronic database of world eriophyoid species, unreferenced). *Acalitus vaccinii* occurs on various wild and cultivated blueberry species and on *Gaylussacia baccata* (Wangenh.) K. Koch (black huckleberry) (Keifer 1941).

Acalitus vaccinii was first reported as an economic pest in North Carolina by Fulton (1940). When *A. vaccinii* populations build up to high infestations they can be devastating and an entire crop can be destroyed, largely due to reduced fruit formation and yield (Keifer 1941; Darrow *et al*. 1944; Baker and Neunzig 1970; Isaacs and Gajek 2003; Isaacs *et al.* 2010). Vegetative growth may also be negatively affected (Keifer 1941; Isaacs and Gajek 2003; Weibelzahl and Liburd 2010). Severe economic damage is, however, sporadic and is related largely to weather conditions, with mild winters resulting in higher mite populations and more economic injury (Darrow *et al*. 1944; Neunzig and Sorensen 1976; Isaacs *et al*. 2004). The pest is actively managed with acaricides particularly in North Carolina (Keifer 1941; Marucci 1966; Isaacs and Gajek 2003), Georgia (Isaacs and Gajek 2003) and Florida (Finn 2003).

In 2014, the author identified *A. vaccinii* from cultivated blueberries in South Africa. This is the first report of this species in this country. Notes on taxonomic morphological observations, current status, symptoms, infested cultivars and infestation levels are presented and discussed along with possible pathways of introduction and the threat posed to blueberries and natural flora in South Africa.

Materials and methods

Field observations and specimens collection

Cultivated blueberry plantings between Amsterdam and Lothair, Mpumalanga, South Africa, infested by the blueberry bud mite, *A. vaccinii*, were visually inspected by the author at two different localities and on two different dates (Table 1). The blueberry plants were cultivated under 60% white shade net. All plants were grown from young seedlings propagated with tissue culture by distribution companies in the Western Cape, South Africa (2014 personal communication with blueberry farmer, unreferenced).

Symptoms caused by the *A. vaccinii* infestation were visually assessed by walking between the plant rows of all plants of six blueberry cultivars, namely *V. Corymbosum* 'Berkeley', 'Bluecrop', 'Elliott', 'Ivanhoe' and 'Spartan', and *V. virgatum* 'Centurion'. The number of galled buds, and how much undamaged berries and/or flowers were present in stretches of about 10 plants were visually estimated.The red galls caused by the mites were obvious and easily detected at the short distance, and high infestations assisted with the estimates. The percentage of mite infestation and resultant damage were extrapolated from the visual information. Symptomatic shoots or canes were collected from different heights on every tenth plant for later microscopic examination in the laboratory.

After collection, plant parts were immediately covered by moist paper towel, sealed in plastic bags and kept cool in cool boxes for transfer to the laboratory. In the laboratory the plant material was stored in a fridge (+4°C) for up to two months, until it was examined for mites with a stereo microscope, usually at 40x magnification. Presence of eriophyoid mites, niches in which the mites occurred, morphology of symptomatic tissue, presence of eggs, immatures and colonies and relative sizes of these, were recorded. The eriophyoid mites were collected into a sorbitol-isopropyl alcohol medium (Keifer 1975a) using a minuten pin (de Lillo *et al*. 2010).

Specimens identification

Specimens for morphological identification were slide mounted using the modified version of the methods and media according to Keifer (1975a) (de Lillo *et al*. 2010). Slide-mounted specimens were studied and identified with a Zeiss Axioskop compound microscope with phase contrast and DIC, using 10 x eyepieces and applicable 100 x oil immersion objectives. More than 100 specimens were identified from each cultivar sampled and all samples comprised all instars and both sexes. The genus *Acalitus* was identified using the key to world eriophyoid genera by Amrine *et al*. (2003). The species was identified by comparing the specimen morphology with published descriptions of *A. vaccinii* by Keifer (1939) and Baker and Neunzig (1970). They were also compared to the 17 known *Acalitus* spp. in Africa (Meyer 1990), and other *Acalitus* spp. known from Ericaceae (*A. ledi* Keifer, 1965 and *A. santaluciae* Keifer, 1966) (2016 J.W. Amrine Jr and E. de Lillo, unpublished personal electronic database of world eriophyoid species, unreferenced). These *Acalitus* spp. were a subsample of the more than 90 valid *Acalitus* spp. worldwide (2016 J.W. Amrine Jr and E. de Lillo, unpublished personal electronic database of world eriophyoid species, unreferenced).

All slide-mounted specimens were deposited as voucher specimens in the National Collection of Arachnida – Mites (NCA–Mites) housed by the Agricultural Research Council – Plant Protection Research Institute (ARC-PPRI), Pretoria, South Africa.

Botanical nomenclature

Names of plants, including those in the introduction, are according to Online GRIN Taxonomy (1987–2015). For those not included in this database, Online Plant List (2013) and Online Plants of Southern Africa (2012) were used – in order of preference. Presentation of plant cultivar names follows the International code of nomenclature for cultivated plants (ICNCP) (Brickell *et al*. 2009). Cultivars were identified according to information received from the blueberry farmer, originally obtained from the producers.

Results

Identification, first report and current status of *Acalitus vaccinii* in South Africa

Specimens collected from the blueberry samples were positively identified as *A. vaccinii*. Identification of *A. vaccinii* was unambiguous, based on its prodorsal shield ornamentation in combination with a single row of longitudinal cuticular ridges on the female genital coverflap (Keifer 1939, 1941, 1975b). The shield ornamentation consists of two, usually obscure, curved admedian lines between the scapular setae on the proximal part of the shield, a few granules grouped on the outer side of the scapular tubercles and a zone of granules lateral of the shield more or less surrounding a possible eye-like area (modified from Keifer 1939). These characteristics clearly differentiate the species from *Acalitus* spp. found in Africa and the other two *Acalitus* spp. known on Ericaceae in North America.

The remainder of the qualitative characteristics in the specimens broadly matched the published descriptions of *A. vaccinii* by Keifer (1939), although two significant differences were noted. Firstly, setae *h1* (accessory setae) were clearly present in all life stages, whereas they had previously been described absent in both adults (Keifer 1939) and immatures (Baker and Neunzig 1970). Secondly, the presence and distribution of microtubercles on the opisthosoma of immature specimens differed significantly from their description by Baker and Neunzig (1970). A supplementary description of the species will be valuable and is in preparation.

This constitutes the first record of this pest in South Africa, and the first record outside of its putative native range in North America. *Acalitus vaccinii* was first found on a farm between Amsterdam and Lothair, Mpumalanga Province, where blueberries had been cultivated since *ca.* 2000. Gall symptoms were first observed in 2012 (2014 personal communication with blueberry farmer, unreferenced) on a rabbiteye cultivar, *V. virgatum* Aiton. 'Centurion'. Blueberries on this farm were studied to provide some information on the field biology of this mite in South Africa. The South African Department of Agriculture, Forestry and Fisheries under-took a follow-up survey, in which *A. vaccinii* was found to be also present on blueberry plantings in Lydenburg and Dullstroom in the same province. It was not found in other provinces or on other hosts (South African Department of Agriculture, Forestry and Fisheries

Table 1 Details of blueberry plantings and percentage symptoms caused by the blueberry bud mite, *Acalitus vaccinii*, in 2014 on a farm between Lothair and Amsterdam, Mpumalanga Province, South Africa, where the mite pest was found the first time; * estimated by visual inspection.

Block number	GPS	Cultivars	Age of planting (years)	Extent of planting (hectare)		Collecting date	Estimated percentage flower buds and amount of resultant growth galled*
1	S26º 27.273' E30º 36.098'	*V. corymbosum* 'Ivanhoe'	14	0.5	inter-planted with 'Spartan'	12-nov-14	50
		V. corymbosum 'Spartan'	14	0.5	inter-planted with 'Ivanhoe'	12-nov-14	70
		V. virgatum 'Centurion'	14	1.5	solid planting, with a few 'Bluecrop'	12-nov-14	90
		V. corymbosum 'Bluecrop'	6	few plants	inter-planted with 'Centurion'	-	unknown
2	S26º 27.303' E30º 36.339'	*V. corymbosum* 'Elliott'	14	4	solid planting	12-nov-14	30
		V. corymbosum 'Berkeley'	14	1.5	inter-planted with 'Spartan'	16-july-15	80
		V. corymbosum 'Bluecrop'	6	few plants	among 'Spartan' & 'Berkeley' plants	16-july-15	70
		V. corymbosum 'Spartan'	14	1.5	inter-planted with 'Berkeley'	12-nov-14	70

2016;2017 personal communication with Davina Saccaggi, unreferenced). The presence of *A. vaccinii* in Mpumalanga, South Africa was reported on the International Plant Protection Convention's website on 3 June 2016 (South African Department of Agriculture, Forestry and Fisheries 2016).

Field observations, eriophyoid infestations and symptomology

Eriophyoid mites were the only phytophagous organisms found on the collected symptomatic plant material, and they were identified as *A. vaccinii,* strongly indicating that the symptoms were caused by the mite infestations. The mites were present on virtually all plants of all six blueberry cultivars on the farm (Table 1), but symptoms and extrapolated infestation levels per cultivar varied. Visual percentage of buds galled in combination with severity of damage of galling (how many healthy berries and/or flowers were present) per cultivar is presented in Table 1. Similar to most other gall-living eriophyoid mites, *A. vaccinii* has a vermiform body (Figure 1A-C). The mites are translucent to whitish and light cream-brown and eggs are typical rounded eriophyoid eggs (Figure 1B). On 12 November 2014 (early summer), mites in colonies of various sizes, some relatively large (Figure 1A), with all life stages and eggs were living in the galls. The galls had largely not deteriorated or dried out. Vegetative growth and new vegetative buds had just started developing. Single mites or very small colonies were also found in some young vegetative buds and other vegetative plant micro-niches (e.g. space between leaf pedicle and stem). On 16 July 2015 (mid-winter) the plants were in endodormancy, with no leaves, flowers or berries present. Large and viable mite colonies with all life stages and eggs were living and reproducing inside investigated dormant fruit buds (Table 1). Tissue of the infested buds were already altered by the mites.

The galls caused by *A. vaccinii* on the various cultivars differed morphologically, e.g. between those on 'Centurion' (Figure 1D) and 'Berkeley' (Figure 1E). The 'Centurion' flower bud bracts were entirely thickened and the bracts formed a tightly closed flower gall (Figure 1D). The flower bud gall bracts in 'Berkeley' had callus-like tissue over the entire bract; the bases of the bracts being thicker than the apical parts resulting in a more open rosette-like, "leafy" structure (Figure 1E).

Discussion

The levels of symptoms and extrapolated infestation and resultant damage caused by the blueberry bud mite, *A. vaccinii* in South Africa at the study site near Amsterdam, ranging from 30-90% (see Table 1), clearly indicates that the mite could be an economically important pest on susceptible blueberry cultivars under suitable climatic conditions in South Africa.

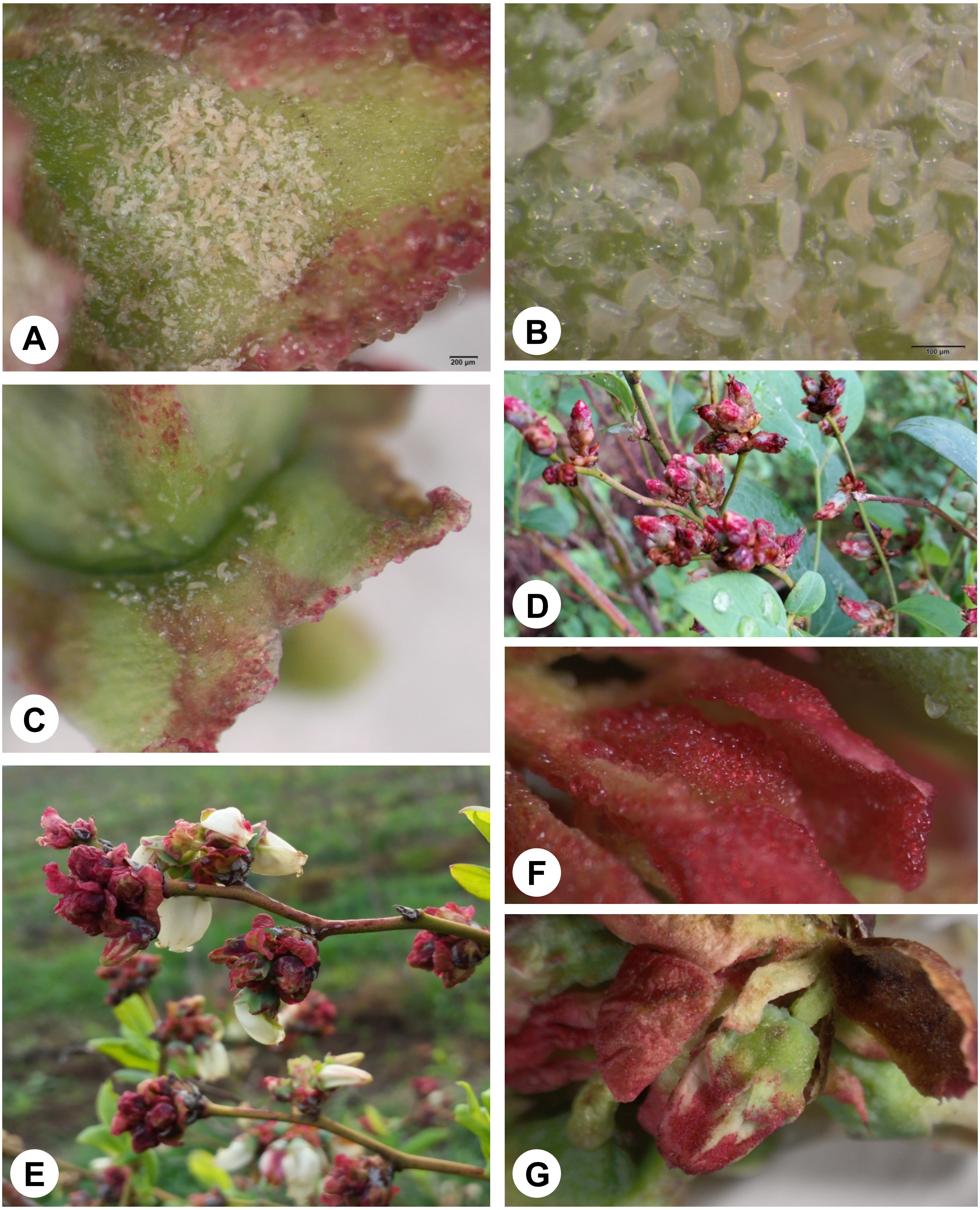

Figure 1 *Acalitus vaccinii* (Keifer, 1939) in South Africa: A – colony at the base of a symptomatic flower bud bract of *Vaccinium corymbosum* 'Berkeley'; B – enlarged part of the colony shown in Figure 1A; C – relatively small colony between corolla and calyx of *V. corymbosum* 'Elliott' flower with callus-like tissue caused by the mites. Symptoms caused by *A. vaccinii* in South Africa: D – flower galls on *V. virgatum* 'Centurion' which are more compact than those on *V. corymbosum* 'Berkeley' in Figure 1E; E – rosette-like flower galls on *V. corymbosum* 'Berkeley'; F – hypertrophic red "roughened" callus-like tissue of a flower gall on *V. corymbosum* 'Ivanhoe'; G – red callus-like tissue on outside of corolla of *V. corymbosum* 'Elliott' flower.

Symptoms, infestation levels and infested cultivars

The symptoms observed on cultivated blueberries in this study are similar to those noted by other authors in North America. Mainly Fulton (1940), Keifer (1941) and Baker and Neunzig (1970) studied the biology of *A. vaccinii*. The mite largely lives in the flower buds, causing the affected cells to become hypertrophic (Baker and Neunzig1970), forming callus-like tissue (Figure 1F), and causing abnormalities in the buds, flowers and fruit (Figure 1G; Fulton 1940; Keifer 1941; Baker and Neunzig 1970). Infested flower buds usually develop into typical, reddish, rosette-like galls (Figure 1D, E; Keifer 1941; Baker and Neunzig 1970; Keifer *et al.* 1982). Symptomatic cells eventually become necrotic, and heavily infested flower buds may be blasted (buds wither and die) (Baker and Neunzig 1970). Flowering and fruit development from affected buds may be inhibited or halted (Fulton 1940; Keifer 1941; Baker and Neunzig 1970; Isaacs and Gajek 2003; Isaacs *et al.* 2010). The exact morphology of symptoms varies among blueberry species and cultivars (Isaacs *et al.* 2010). Isaacs and Gajek (2003) found severity of symptoms was not correlated with the number of mites present in different blueberry cultivars.

In the USA, *A. vaccinii* is usually more common and abundant on early-season than late ripening blueberry cultivars (Neunzig and Sorensen 1976). This was also found in the current study, where the early-season rabbiteye 'Centurion' had higher mite infestation and symptoms than the mid- and late-season northern highbush blueberry cultivars. Another explanation may be that the higher infestations on 'Centurion' were simply due to the fact that it was the first cultivar infested and mite numbers built up for a longer period than on the other cultivars.

In this study, *A. vaccinii* was found on *Vaccinium corymbosum* and *V. virgatum,* which are known to be susceptible to the mite in North America (Keifer1941; Isaacs and Gajek 2003). However, with the exception of 'Bluecrop' and 'Elliott' which were surveyed and found infested with *A. vaccinii*, but not extensively damaged by the mites (Isaacs and Gajek 2003), none of the individual cultivars examined in the present study have been surveyed or were mentioned in the literature consulted to be particularly susceptible to *A. vaccinii* in North America (Isaacs and Gajek 2003; Isaacs *et al.* 2010).This may be due to these cultivars (e.g. 'Centurion') not being commonly grown commercially in North America (Meyer and Prinsloo 2003).

Considering the high level of infestation found at the study site during 2014–15, the severity of mite infestation and symptoms must have escalated considerably and spread rapidly since their initial detection in 2012. This apparently rapid spread and escalation could be due to various factors. Arguably, the most important factor is climate. In the Mpumalanga Eastern Highveld escarpment, where the mite was found, winters are relatively mild (between 1 – 15°C) in comparison to the mite's natural range. Mild winters could contribute considerably to continual population growth and rapid spread of the mite. In the case of particularly 'Centurion' and 'Ivanhoe', the plantings were dense, with plants growing into each other, conceivably facilitating quick local spread. Once *A. vaccinii* was detected, the farmer sprayed three kinds of non-systemic pesticides with relatively long residual action (respectively with active ingredients bifenazate, bromopropylate and spirodiclofen) at different times during the 2013–14 and 2014–15 seasons in an attempt to control the mites. These were probably not effective against *A. vaccinii*, for several possible reasons, because the large numbers of mites found during the survey were living and actively breeding and there were no sign of any significant number of dead *A. vaccinii* even shortly after spraying. However, the pesticides may plausibly have killed predatory mites which might have previously control the *A. vaccinii* populations to some extent. It is also possible that the rate of spread was just a perception of the farmer, and that in fact the blueberries may have been infested long before he noticed the first symptoms, allowing a slow build-up of mite populations to the rapid growth observed in the last two years.

Introduction to South Africa

The introduction of *A. vaccinii* to South Africa again illustrate that eriophyoid mites are good candidates to become adventive species and can easily be distributed in world trade (Navia *et al*. 2010). It is difficult to detect them on imported plant material, because they are extremely small (Navia *et al*. 2010) and might be hidden in small plant micro-spaces. They also have a capacity to survive adverse conditions, have parthenogenetic reproduction, and are dispersed by wind (Navia *et al*. 2007; de Lillo and Skoracka 2010). *Acalitus vaccinii* may have been introduced to South Africa as a contaminant on imported *Vaccinium* plant material for propagation or on fresh blueberries for consumption. However, due to the relative chances of transport and establishment from propagation material vs. fresh fruit, the former is the more likely route of entry. Blueberry propagation material is legally imported to South Africa as tissue culture seedlings, either *in vitro* or hardened off, then grown under strict quarantine conditions until release to the importer (2015 e-mail from Davina Saccaggi, unreferenced). Brazelton (2013) is of opinion that it is extremely difficult to introduce plant material to South Africa due to legal and phytosanitary barriers. Due to this rigorous import system, the possibility that *A. vaccinii* was introduced via legally imported propagation material is slim, although not impossible.

Potential impact on blueberry farming in South Africa

In South Africa, blueberry plantings begun in the early 1990s. It is still considered a new, understudied (Bredenhand *et al*. 2010) and minor fruit crop (Brazelton 2013), which is particularly exposed to alien pests. The industry largely produces export quality fresh blueberries for Europe (Meyer and Prinsloo 2003). Blueberries will likely become a more important crop in South Africa, because relatively large areas are suitable for blueberry farming (Meyer and Prinsloo 2003) and here and internationally the blueberry industry has experienced a period of extensive and rapid growth — planted area, production, value and demand — and this growth is accelerating (Brazelton 2013).

Acalitus vaccinii is currently considered as one of the first serious and economically important arthropod pests to infest blueberries in South Africa. In 2015 Barnes *et al*. (2015) reported 15 insect pests of the orders Hemiptera, Coleoptera, Lepidoptera and Thysanoptera known on blueberry in South Africa, but none were considered especially damaging. This coincides with the farmer in the present study declaring that he had not experienced any economically important pest or disease problems before the arrival of *A. vaccinii*.

At the study site *A. vaccinii* appears to have had a considerable influence on yield. The total yield of blueberry fruit on the farm reduced from about 50 tonnes in the 2011–12 season, just prior to the detection of the mites, to about 10 tonnes in the 2014–15 season (2014 personal records of blueberry farmer, unreferenced). No other obvious reasons for the yield reduction were noted, and no farming practices were changed. However, some factors, e.g. possible presence of pathogens or nematodes in the soil, were not investigated (2014 personal communication with blueberry farmer, unreferenced).

The potential threat to blueberries in South Africa varies in the susceptibility of different cultivars to *A. vaccinii*. Northern highbush blueberry cultivars, which are most susceptible (Neunzig and Sorensen 1976; Neunzig and Galletta 1977), are not suitable for the South African climate due to their high winter chilling requirements (Meyer and Prinsloo 2003). Thus, these cultivars are not widely and commonly planted in South Africa. Most commercial producers in this country are situated in the Western Cape Province and plant relatively recently introduced southern highbush cultivars such as 'Bluecrisp', 'Emerald', 'Jewel', 'Snowchaser' and 'Star' (Müller 2011; Swart 2015). Of these *A. vaccinii* can be damaging on 'Bluecrisp' (Lyrene 1999) and Weibelzahl and Liburd (2009) found large populations on 'Star'. Some rabbiteye cultivars are planted on a small scale in the Western Cape.

The South-Western Cape has a Mediterranean-type climate with winters much warmer than in the Mpumalanga Eastern Highveld (Kruger 2004) where *A. vaccinii* is currently found.

These mild winter temperatures may increase the pest status of the mite should it be introduced there.

The preliminary knowledge on the symptoms, infestation levels, niches where mites were found, cultivars infested, and potential impact of *A. vaccinii* under South African conditions gathered in this study will assist with the development of optimal, integrated control programs. No pesticide is registered for the control of this mite on blueberries under South African conditions (Agri-Intel 2017). Cultural control methods, especially pruning (Weibelzahl and Liburd 2009), might be a control option.

Biological control of *A. vaccinii* has hardly been studied, and it is probably not yet an option in South Africa. Nothing is known about the predators associated with *A. vaccinii* in South Africa. In the USA predatory mites from various families, including Ascidae, Phytoseiidae, Cheyletidae and possibly Tydeidae, Cecidomyiidae larvae (Diptera) and thrips (Thysanoptera), have been found associated with *A. vaccinii* (Baker and Neunzig 1970; Isaacs and Gajek 2003). None of the predators occurred naturally in large enough numbers or had enough control impact, to provide effective control, especially when *A. vaccinii* infestations were high (Baker and Neunzig 1970; Isaacs and Gajek 2003).

Hirsutella thompsonii F.E. Fisher, a fungus pathogenic on various Acari (Samson *et al*. 1980), infests *A. vaccinii* in North America (Baker and Neunzig 1968; Weibelzahl and Liburd 2009) and might contribute towards the control of this mite in summer, especially under warmer, wetter conditions (Baker and Neunzig 1970). Weibelzahl and Liburd (2009) regarded *H. thompsonii* to be a key biological control agent regulating *A. vaccinii*, and suggested control management should consider its role when selecting fungicides. *Hirsutella thompsonii* has not been recorded from South Africa (2017 e-mail from Dr. Riana Jacobs-Venter, unreferenced).

Threat to native flora

Acalitus vaccinii is oligophagous and Eriophyoidea are generally very host specific (Oldfield 1996). It is unlikely that *A. vaccinii* has a wider host range than blueberry *Vaccinium* spp. (subgenus *Vaccinium*, section *Cyanococcus*) and the very closely related *G. baccata* (Floyd 2002) on which it has been found. In South Africa, the family Ericaceae is represented by over 950 species, almost exclusively in the genus *Erica* L., many of which are endemic and make up the largest portion of the Cape Floristic Region (Goldblatt 1997). Only one *Vaccinium* sp., *V. exul* Bolus (African blueberry) (subgenus *Vaccinium*, section *Cinctosandra*), is native to South Africa (Online Plants of Southern Africa 2012). One additional *Vaccinium* sp., *V. stanleyi* Schweinf, occurs in Uganda, and these are the only two *Vaccinium* spp. indigenous to continental Africa (Online Plants of Southern Africa 2012; Bester and Burrows 2015). In South Africa,*Vaccinium exul* is not considered a threatened species, but its natural habitat and vegetation type are considered vulnerable and of conservation importance (Bester and Burrows 2015). The natural distribution of *V. exul* corresponds with areas with suitable climate (low winter temperatures at high altitudes) for the production of commercial blueberries in the Eastern Highveld, Mpumalanga (Meyer and Prinsloo 2003; Bester and Burrows 2015). Although it is possible that *A. vaccinii* may infest *V. exul*, the likelihood is small since it is in a different section of *Vaccinium*. In general, *A. vaccinii* is unlikely to pose a threat to South Africa's indigenous flora, in particular to the diverse *Erica* spp. of the Cape Floristic Region.

In conclusion, *Acalitus vaccinii* has been found at isolated locations (Amsterdam, Lydenburg and Dullstroom areas) in the Mpumalanga Province in South Africa (South African Department of Agriculture, Forestry and Fisheries 2016). Its containment may be difficult, as it can be dispersed by wind (de Lillo and Skoracka 2010). The degree of damage associated with the first occurrence of *A. vaccinii* in South Africa, however, indicates that it will require active monitoring on cultivated blueberries. Apart from possibly *V. exul*, it is unlikely to infest indigenous vegetation, and thus poses little threat to South Africa's indigenous plant diversity or allowing indigenous plants to act as a source of new infestations.

The route of introduction to South Africa is unknown. This highlights the importance of phytosanitary border controls across all possible routes of entry, including propagation material, fresh fruit and travellers who may carry plant material illegally into South Africa (Saccaggi *et al.* 2016). Further, studies on the biology and ecology of *A. vaccinii* in South Africa are needed, so that an effective management program can be developed should the mite become a more widespread pest.

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