Application to import *Acaciothrips ebneri* (Thysanoptera: Phlaeothripidae) for the biological control of prickly acacia, *Vachellia nilotica* ssp. *indica*

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1. INFORMATION ON THE TARGET WEED

1.1. Taxonomy

Scientific name:	*Vachellia nilotica* (L.f.) P.J.H. Hurter & Mabb.
	sub-species *indica* (Benth.) Kyal. & Boatwr
Genus:	*Vachellia* Wright & Arn.
Tribe:	Acacieae
Subfamily:	Mimosoideae
Family:	Fabaceae
Order:	Fabales
Subclass:	Rosidae
Common name:	Prickly acacia

Morphological and molecular studies have demonstrated that *Acacia s. l.* is polyphyletic and the genus has been split into five genera (*Acacia*, *Vachellia*, *Senegalia*, *Acaciella* and *Mariosousa). Acacia (sensu stricta)* has been retypified so that the majority of species within Acacia *s.l.* (i.e. *Acacia* subg. *Phyllodineae)* retain this name (Table 1; see Maslin et al. 2003, Miller & Seigler 2012). Species within *Acacia* subg. *Acacia* (including prickly acacia) have been transferred to the genus *Vachellia* Wight & Arn.

Within the species *nilotica* there are nine recognised subspecies considered to be morphologically and ecologically distinct (Table 2; Brenan 1983). Biochemical and molecular studies suggests that *V. nilotica* populations in Queensland are the subspecies *indica.*

Table 1: Generic and infrageneric names for *Acacia sens. lat.* following decision at the 17th International Botanical Congress (IBC) to endorse and ratify the recommendations of the Committee for Spermatophyta and the General Committee of IAPT to accept the Orchard & Maslin (2003) proposal to retypify *Acacia* with a new type (http://www.worldwidewattle.com/infogallery/ nameissue/).

Pre-IBC names[1]	Post-IBC names [2]	Australia (native)	Worldwide
Acacia			
Subgenus *Acacia*	*Vachellia*	9	162
Subgenus *Aculeiferum*			
Section Spiciflorae	*Senegalia*	2	197
Section Filicineae	*Acaciella*	0	15
Acacia coulteri group	*Mariosousa*	0	13
Subgenus *Phyllodineae*	*Acacia*	1058	1070

[1]*Acacia* treated as a single genus (*Acacia sens. lat*.), with *A. nilotica* as the type.
[2]*Acacia sens. lat*. treated as multiple genera with *A. penninervis* as the type for *Acacia* and *V. farnesiana as* the type for *Vachellia*.

1.2. Native range

Vachellia nilotica has an extensive natural distribution and is endemic to much of Africa and the Indian subcontinent (Ross 1979; Brenan 1983). It is a savannah species growing in tropical and subtropical semi-arid areas where rainfall is distinctly seasonal. Its centre of origin is thought to be the Ethiopian region. Subspecies *indica* is native to India and Pakistan (Hannan-Jones 1999; Wardill et al. 2005).

Throughout most of its natural range *V. nilotica* is considered a highly beneficial plant. In countries such as India and Sudan, it is grown in plantations and insects attacking it are considered pests. The tree produces gum arabic, timber, firewood, and fodder for domestic animals and is a host for lac insects.

Table 2: Subspecies of *V. nilotica* and their distributions (after Dhileepan 2009).

Subspecies	Native range	Introduced range
Ssp. *adstringens* (Schumach. & Thonn.) Kyal. & Boatwr.	Africa (Algeria, Cameroon, Chad, Egypt, Gambia, Mali,l Nigeria, Senegal, Sudan and Somalia)	Iran, Libya, West Indies, India and Pakistan
Ssp. *cupressiformis* (J.L.Stewart) Ali & Faruqi	Indian subcontinent (India and Pakistan	Nil
Ssp. *hemispherica* Ali & Furuqi	Pakistan	Nil
Ssp. *indica* (Benth.) Kyal. & Boatwr.	Indian subcontinent (India and Pakistan); Asia (Yemen, Oman, and Myanmar)	Angola, Australia, Ethiopia, Indonesia, Iran, Iraq, Nepal, New Caledonia, Somalia, Tanzania, and Vietnam
Ssp. *kraussiana* (Benth.) Kyal. & Boatwr.	Africa (Angola, Botswana, Malawi, Mozambique, Namibia, South Africa-Natal & Transvaal, Zambia, Zimbabwe, Swaziland, and Tanzania)	Ethiopia, Yemen, and Oman
Ssp. *leiocarpa* (Brenan) Kyal. & Boatwr.	East Africa (Kenya, Somalia, Ethiopia, and Tanzania)	Nil
Ssp. *nilotica* (L.) P.J.H.Hurter & Mabb.	Africa (Cameroon, Chad, Egypt, Ethiopia, Sudan, Mali, Nigeria, Niger, Senegal, and Sudan); Asia (Iran, Iraq, Oman, Saudi Arabia, and Yemen)	Tanzania and Zanzibar
Ssp. *subalato* (Vatke) Kyal. & Boatwr.	East Africa (Sudan, Ethiopia, Uganda, Kenya, and Tanzania)	India, Pakistan, and Sri Lanka
Ssp. *tomentosa* (Benth.) Kyal. & Boatwr.	Africa (Senegal, Mali, Ivory Coast, Ghana, Niger, Nigeria, Sudan, and Ethiopia)	India

1.3. Australian and overseas distribution

The major infestation of prickly acacia covers 6 million hectares and 2000 km of bore drains of the Mitchell grass downs of western Queensland (Mackey 1997; Spies & March 2004). Scattered populations also occur in the coastal regions of Queensland, the Northern Territory and Western Australia (Spies & March 2004). However, *V. nilotica* has the potential to infest a far greater area than it currently occupies, including most of Queensland, the Northern Territory and northern Western Australia (Figure 1; Kriticos et al. 2003).

Vachellia nilotica is also considered a weed in parts of Indonesia (Tarmuzi 2009). In South Africa a group of endemic *Vachellia* congeners, including *V. nilotica*, have become invasive and are causing rangeland degradation (Holm et al. 1979).

1.4. Related species

The genus *Vachellia* is of Afro-Asian origin. There are 12 species found in Australia of which nine are endemic (*V. bidwillii, V. clarksoniana, V. ditricha, V. douglasica, V. pachyphloia, V. pallidifolia, V. sutherlandii, V. suberosa,* and *V. valida*) and two (*V. nilotica* and *V. farnesiana*) are naturalised (Kodela and Wilson 2006; Maslin 2009). *Vachellia erioloba* (E.Mey.) P.J.H.Hurter is present in Australia but has not yet naturalised (Anonymous 2011a). *Vachellia karroo* (Hayne) Banfi & Galasso has become invasive in Australia, though all known populations have been eradicated (Anonymous 2011b). Many of the native *Vachellia* species are roughly sympatric with the present distribution of prickly acacia in Australia. *Senegalia* is represented in Australia by two rare endemic species and two naturalised species (Maslin 2012), and *Acaciella* is represented in Australia by only two naturalised species. *Acacia s. s.* contains over 1000 species and most of these are Australian.

Recent molecular work suggests that *Vachellia* is nested with tribe Mimoseae (Bouchenak-Khelladi et al. 2010). As such *Vachellia nilotica* is now believed to be more closely related to species within Mimoseae than it is to the majority of Australian acacia species (*Acacia s.s*). *Vachellia* is also more closely related to *Senegalia, Acaciella* and *Mariosousa* (all formally within *Acacia s.l*.) than *Acacia s.s.* which forms a clade with the Ingeae tribe. Mimoseae contains four genera native to Australia (*Neptunia, Dichrostachys, Entada* and *Adenanthera*), with 12 species and four naturalised genera (*Prosopis, Mimosa, Leucaena* and *Desmanthus*). The tribe Ingeae is represented in Australia by eight genera including 20 native species and three naturalised species. The Fabaceae is represented in Australia by c. 1500 species in 136 genera (Crisp 2009). There are also many agriculturally important exotic species grown in Australia (Stanley & Ross 1983) . The Caesalpinaceae is a relatively small family. Of the 150 genera world wide, 22 (of which three are endemic and six naturalised) are found in Australia represented by 127 species (Ross 1998).

1.5. Approval as a target species for biological control

Vachellia nilotica was approved as a target species for biological control prior to 1981 with the then Queensland Department of Lands as the proposing organisation.

Biological control of *V. nilotica* was initiated in the early 1980s. Two insects from Pakistan, three insects from Kenya and one insect from South Africa have been introduced as biological agents into Australia (Dhileepan 2009). Only two species, a seed-feeding bruchid (*Bruchidius sahlbergi)* from Pakistan and a leaf-feeding geometrid (*Chiasmia assimilis)* from Kenya and South Africa have become established. So far, the impact of *B. sahlbergi* on prickly acacia has been insignificant. The leaf-feeding geometrid *C. assimilis* became established in a few of the coastal sites in northern Queensland, but not in the Mitchell grass downs. As a result, the need for effective biological control agents continues to be a priority in the Mitchell grass downs, where the introduced agents have neither established nor been effective.

1.6. Pest status

Vachellia nilotica was declared a noxious weed in Queensland in 1957, and is now a Weed of National Significance (WONS) in Australia. It is a declared species in all Australian states and territories (Anonymous 2011c). *A*long with rubbervine (*Cryptostegia grandiflora*) and giant sensitive weed (*Mimosa pigra*), prickly acacia is considered to be one of the three most serious weeds in northern Australia.

Vachellia nilotica was introduced into Queensland from India in the late 1890s as an ornamental tree (Bolton

1989). During the 1920s and 1930s it was promoted as a shade and fodder tree for sheep in western Queensland. Today, *V. nilotica* costs primary producers $9m per year due to decreasing pasture production and hindering the mustering of livestock (Dhileepan 2009). It also facilitates a shift in botanical composition from native perennial grasses to ephemeral forbs and annual grasses (Carter et al. 1989). In the Mitchell grass downs, *V. nilotica* poses a threat to nearly 25 rare and threatened animal species, including the endangered carnivorous marsupial Julia Creek dunnart (*Sminthopsis douglasi* Archer), and two endangered plant communities, by displacing grasslands (Spies & March, 2004).

Vachellia nilotica has the potential to establish across the majority of northern Australia (Figure 1).

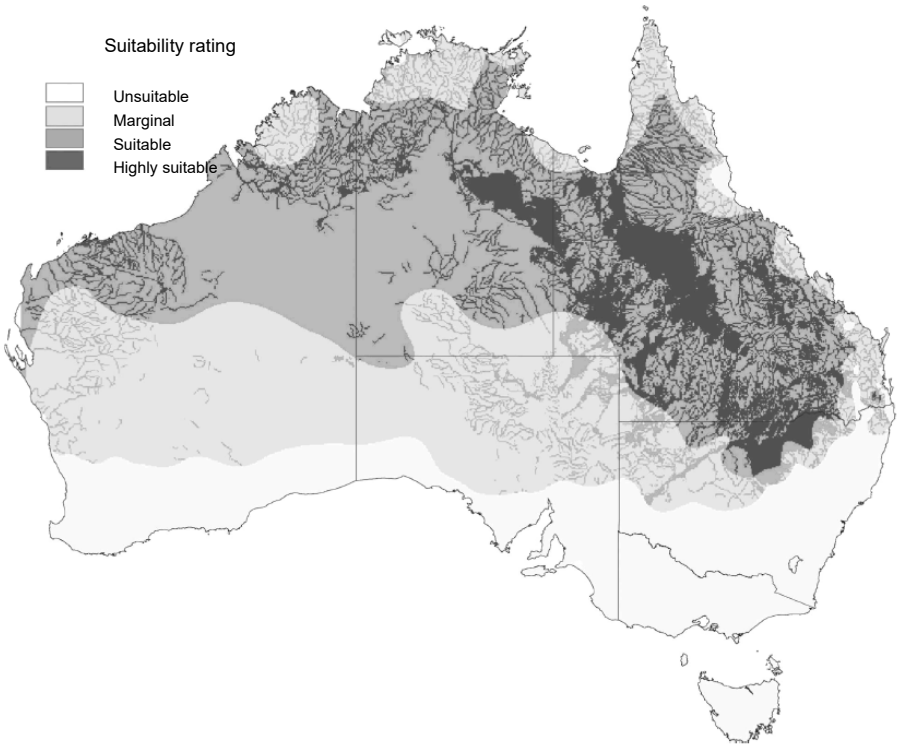

Figure 1: Potential distribution range of *Vachellia nilotica* ssp. *indica* in Australia (Dhileepan 2009).

2. INFORMATION ON THE CONTROL AGENT

2.1. Taxonomy

Species: *ebneri* (Karny)
Genus: *Acaciothrips* Priesner, 1965
Subfamily: Phlaeothripinae
Family: Phlaeothripidae
Order: Thysanoptera
Class: Insecta

The insect was identified by thrips expert Dr Laurence Mound (CSIRO).

2.2. Biology

Little is known about the biology of *Acaciothrips ebneri*. It is a galling thrips that attacks the growing shoot tips of *Vachellia nilotica* ssp. *indica*. Adults are relatively large (most thrips are less than 1 mm; Figure 2) and are the only life stage capable of dispersing (either by walking or wind). Eggs, larvae and pupae all remain within the gall.

Figure 2: Life stages of *Acaciothrips ebneri.*

2.3. Native range

Acaciothrips ebneri was collected from *V. nilotica* ssp. *indica* plants in Ethiopia. The species has also been recorded in Egypt, Senegal and Nigeria (Bournier 1994; CSIRO 2009). *Acaciothrips ebneri* has only been collected from prickly acacia.

2.4. Related species

Acaciothrips is a monotypic genus, with *A. ebneri*, the only species. The subfamily Phlaeothripinae contains 370 genera and 2800 species (CSIRO 2009). There are 109 Phlaeothripinae genera in Australia and 465 species (ABRS 2013). This is a diverse group and includes fungivores, insectivores as well as herbivores. *Liothrips urichi* Karny and *Amynothrips andersoni* O'Neil, two species released as weed biological control agents, belong to this subfamily.

A detailed list of Phlaeothripinae species found in Australia and their hosts can be found at http://www.environment.gov.au/biodiversity/abrs/online-resources/fauna/afd/taxa/Phlaeothripinae/hosts. There are believed to be more than 250 species of thrips specialising on *Acacia* species in Australia (McLeish et al. 2013; Mound 2014). *Acacia* thrips appear to be a monophyletic group that has radiated and diversified on phyllodinous Acacia species in the sections Plurinerves and Juliflorae, as well as Phyllodineae; they are not found on any other plants. *Acacia* thrips include domicile builders, kleptoparasites (gall-stealers), gall-inducers and opportunistic species that invade abandoned galls, domiciles etc. Most Acacia host species support representatives from each of these groups.

There are only two known associations between thrips and *Acacia s.l.* outside of Australia. The galling of *V. nilotica* by *Acaciothrips ebneri* is one of these (Mound 2014).

2.5. Proposed source of agent

Acaciothrips ebneri will be collected in the field in Ethiopia and shipped on prickly acacia foliage to Australia to establish a colony in the QC3 quarantine facility at the Ecosciences Precinct, Boggo Road, Dutton Park.

2.6. Mode of action

Thrips have sucking mouthparts. *Acaciothrips ebneri* feed on the growing shoot tips of *V. nilotica,* inducing galls and retarding growth (Figure 3).

Figure 3: Galling damage to *V. nilotica* ssp. *indica* shoot tips caused by *Acaciothrips ebneri.*

2.7. Potential for control

It is anticipated that *Acaciothrips ebneri* will contribute to the control of prickly acacia, particularly on the Mitchell grass downs where the major infestation occurs.

2.8. Non-target organisms at risk from the agent

In its native range, *Acaciothrips ebneri* has only been collected from prickly acacia. Researchers at Agricultural Research Council's Plant Health and Protection Institute (PPRI) in South Africa have been unable to establish the thrips on *V. nilotica* ssp. *kraussiana*, which suggests that insect may be host specific to subspecies level. Proposed host specificity testing under quarantine conditions in Australia will further demonstrate the host range of the insect and thus any non-target organisms at risk.

2.9. Possible interactions with existing control agents

Only two of the six biological control agents released against *V. nilotica* in Australia have established. Widely established, *B. sahlbergi* is a seed borer and is therefore unlikely to interact with *Acaciothrips ebneri*. The leaf-feeding geometrid *C. assimilis* has established only in coastal areas, and not in the Mitchell grass downs where the major infestation occurs. Hence, potential interactions with *Acaciothrips ebneri* are expected to minimal.

2.10. Host specificity testing program

The insect will be subjected to comprehensive host specificity testing in the quarantine facilities in the QC3 quarantine facility at the Ecosciences Precinct, Boggo Road Dutton Park. Test species will be selected based on their phylogenetic relationship to *V. nilotica*, with an emphasis on endemic species and species of economic importance. Representatives from most sections in *Acacia s.l.* will be included, as will representatives from the family Fabaceae.

2.11. Progress of testing program

A colony of the *Acaciothrips ebneri* thrips has been established on Australian prickly acacia at the PPRI in South Africa. Researchers have been unable to establish the thrips on *V. nilotica* ssp. *kraussiana*, which suggests that insect may be host specific to subspecies level.

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