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White ball acacia

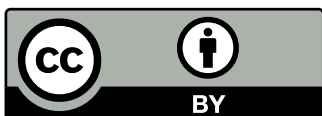
Acaciella angustissima

(syn. *Acacia angustissima*, *Acacia boliviana*)



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Photo: Sheldon Navie

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Summary

Acaciella angustissima (white ball acacia) is a highly variable perennial shrub native to subtropical and tropical America. Three varieties of this species are recognised (i.e. var. *angustissima*, var. *filicioides* and var. *texensis*), all of which were planted at various trial sites in Queensland in the 1970s and 1980s to investigate their potential as forage legumes. However, these trials concluded that *A. angustissima* was of limited value as cattle feed and that its weed potential probably outweighed any potential benefits.

Currently, *A. angustissima* exists as isolated naturalised specimens scattered at a handful of sites in Queensland, generally in close proximity to experimental plots where it has been planted. All sites are currently subject to an eradication program funded by the Queensland Primary Industries and Fisheries and the Meat and Livestock Association. A long-term commitment is required to detect isolated specimens and to exhaust long-lived seed banks in the soil.

This study was unable to find clear evidence that *A. angustissima* was a *major* weed elsewhere in the world. However, there is little doubt that it has weed risk, since it is documented to form thickets along roadsides and within rangelands within its native range and elsewhere. Ecologically, it has a number of attributes that confer weed risk: a history of successful naturalisation outside its native range, high fecundity, long-lived (hard coated) seeds and a propensity to quickly colonise gaps within open woodland and dry scrub.

Climatically, *A. angustissima* appears well adapted to Queensland's seasonally dry tropics as well as parts of the subtropics, primarily in coastal areas where rainfall is 800–3000 mm per annum, but with one variety (var. *texensis*) extending into much drier areas. If the very small numbers of specimens that currently exist in Queensland are allowed to spread, this species has clear potential to become a widespread and abundant pest over substantial areas of rangeland and deciduous vine scrubs in the dry tropics extending south into subtropical areas.

Important note: please send any additional information, or advice on errors, to the authors.

Identity and taxonomy

Species	<i>Acaciella angustissima</i> (Mill.) Britton & Rose
Synonyms	<i>Acacia angustissima</i> (Mill.) Kuntze, <i>Mimosa angustissima</i> Mill., <i>Mimosa ptericina</i> Poir., <i>Senegalia angustissima</i> (Mill.) Pedley
Common names	fern acacia, prairie acacia, prairie wattle, white ball acacia, white-ball acacia, whiteball acacia, carboncillo [Spanish], chilicap [Spanish], guajillo blanco [Spanish], guajito [Spanish], guapinico [Spanish], huajillo [Spanish], timbe [Spanish], timbre [Spanish]

Family: *Mimosaceae*. This family is sometimes included within the *Leguminosae* or regarded as a subfamily in the *Fabaceae* (i.e. *Mimosoideae*).

Subordinate taxa

- *Acaciella angustissima* var. *angustissima*
- *Acaciella angustissima* var. *filicioides* (Cav.) L. Rico
- *Acaciella angustissima* var. *texensis* (Nutt. ex Torrey & A. Gray) L. Rico

A number of additional synonyms and common names relate to only one of these subordinate taxa. They are listed in the following table.

Variety	Synonyms	Common names
var. <i>angustissima</i>	<i>Acacia angulosa</i> Bertol., <i>Acacia angustissima</i> subsp. <i>smithii</i> (Britton & Rose) Wiggins, <i>Acacia angustissima</i> var. <i>smithii</i> (Britton & Rose) L. Rico, <i>Acacia angustissima</i> var. <i>suffrutescens</i> (Rose) Isely, <i>Acacia boliviana</i> Rusby, <i>Acacia delicata</i> (Britton & Rose) Bullock, <i>Acacia elegans</i> M. Martens & Galeotti, <i>Acacia hirta</i> Torrey & A. Gray var. <i>suffrutescens</i> (Rose) Kearney & Peebles, <i>Acacia insignis</i> M. Martens & Galeotti, <i>Acacia pittieriana</i> Standl., <i>Acacia suffrutescens</i> Rose, <i>Acaciella angulosa</i> (Bertol.) Britton & Rose, <i>Acaciella breviracemosa</i> Britton & Rose, <i>Acaciella ciliata</i> Britton & Rose, <i>Acaciella costaricensis</i> Britton & Rose, <i>Acaciella delicata</i> Britton & Rose, <i>Acaciella ferrisiae</i> Britton & Rose, <i>Acaciella rensonii</i> Britton & Rose, <i>Acaciella santanderensis</i> Britton & Killip, <i>Acaciella smithii</i> Britton & Rose, <i>Acaciella suffrutescens</i> (Rose) Britton & Rose, <i>Acaciella talpana</i> Britton & Rose	Bolivian wattle
var. <i>filicioides</i>	<i>Acacia filicina</i> Willd., <i>Acacia filicioides</i> (Cav.) Trel., <i>Acacia hirsuta</i> Schldl., <i>Acacia stipellata</i> Schldl., <i>Acaciella filicioides</i> (Cav.) Britton & Rose, <i>Acaciella hirsuta</i> (Schldl.) Britton & Rose, <i>Acaciella holtonii</i> Britton & Killip, <i>Acaciella martensis</i> Britton & Killip, <i>Mimosa filicioides</i> Cav., <i>Senegalia hirsuta</i> (Schldl.) Pittier, <i>Senegalia popayana</i> Britton & Killip	
var. <i>texensis</i>	<i>Acacia angustissima</i> var. <i>chisosiana</i> Isely, <i>Acacia angustissima</i> var. <i>cuspidata</i> (Schldl.) Benson, <i>Acacia angustissima</i> var. <i>oaxacana</i> B.L. Turner, <i>Acacia angustissima</i> var. <i>texensis</i> (Nutt. ex Torrey & A. Gray) Isely, <i>Acacia cuspidata</i> Schldl., <i>Acacia filicioides</i> (Cav.) Trel. var. <i>texensis</i> (Nutt. ex Torrey & A. Gray) Small, <i>Acacia hirta</i> Torrey & A. Gray, <i>Acacia texensis</i> Nutt. ex Torrey & A. Gray, <i>Acaciella hirta</i> (Torrey & A. Gray) Britton & Rose, <i>Acaciella texensis</i> (Nutt. ex Torrey & A. Gray) Britton & Rose	Chisos prairie acacia

This species was first described as *Mimosa angustissima* in 1768. It was transferred to the genus *Acacia* by Kuntze in 1896 and until recently was known by the scientific name *Acacia angustissima*. Britton and Rose (1928) proposed moving it to the new genus *Acaciella*, but this did not gain acceptance for long. However, in a recent taxonomic review by Rico Arce and Bachman (2006), the genus *Acaciella* was reinstated. Therefore, *Acacia angustissima* should now be referred to as *Acaciella angustissima*.

The genus *Acaciella* is of neotropical origin, with a centre of diversity along the Pacific coast of Mexico, and actually shares more morphological features with the genus *Piptadenia* than *Acacia* (Rico Arce and Bachman 2006). Rico Arce and Bachman (2006) described 15 species of *Acaciella* in considerable detail, and provided line drawings of the leaves, flowers and seeds of most species. They separated *A. angustissima* into three varieties (i.e. var. *angustissima*, var. *filicioides* and var. *texensis*), based largely on the number of pinnae the leaves possessed and on the degree of hairiness of the stems and leaves.

Les Pedley, a highly respected plant taxonomist based at the Queensland Herbarium who has considerable experience with the genus *Acacia* and its relatives, regards the three varieties of *A. angustissima* to be separate species (Les Pedley pers. comm. 2008). The Queensland Herbarium has accepted his opinion, and specimens in their collection and database were very recently reassigned to either *A. angustissima*, *A. filicioides* or *A. texensis* (EPA, 2009).

Because this change has yet to become widely accepted, and all three taxa are so closely related, *A. angustissima* is treated as a single variable species in this risk assessment.

Taxonomic uncertainty

Because *A. angustissima* displays a high degree of morphological variability over its natural range and consists of several reasonably distinct varieties or a complex of several closely related species, there has been considerable confusion over its identity. This has led to a large number of alternative names or synonyms being applied to it.

For many years, *Acaciella angustissima* plants in Australia were generally known by the name *Acacia boliviana* (e.g. in Csurhes and Edwards, 1998; Maslin, 2001 and Henderson, 2002). The name *Acaciella angustissima* has only come into common use following the division of the genus *Acacia* into several genera, and the recent reinstatement of the genus *Acaciella* by Rico Arce and Bachman (2006).

Adding to the confusion, other closely related species such as *Acaciella villosa* (syn. *Acacia villosa*) and *Acaciella glauca* (syn. *Acacia glauca*) have a similar habit, environmental adaptation and productivity to *Acaciella angustissima*, and these three species are often confused with each other.

In fact, when *Acaciella glauca* was introduced into Queensland for trial purposes it was confused with *Acaciella angustissima*, and called by the name *Acacia angustissima*. Therefore, older references to the name *Acacia angustissima* in the Australian literature actually pertain to *Acaciella glauca*. Even some taxonomic publications have used the name *Acacia angustissima* when referring to plants that we now know to be *Acaciella glauca* (e.g. Maslin, 2001; Henderson, 2002).

Description

As previously noted, *A. angustissima* is morphologically highly variable. For example, the branchlets can vary from being almost glabrous to being covered with short appressed hairs. Leaf size, venation of the leaflets and flower size are also variable. The following description is of the typical form of the species (i.e. *A. angustissima* var. *angustissima*), which is most common in Queensland. It is based largely on the description in Rico Arce and Bachman (2006):

A thornless shrub or small tree usually growing 2–7 m tall with a single short trunk. However, it may very rarely reach up to 12 m in height. Its younger stems are hairless or finely hairy and are usually somewhat striate (Figure 1).

The leaves are bipinnate, 10–21 cm long, and usually have 10–17 pairs of pinnae (Figure 2). They are borne on stalks 1.2–3.5 cm long that are sparsely strigulose. The pinnae are 2.5–5 cm long and each bears 20–40 pairs of leaflets. These relatively narrow leaflets are small (2.4–5 mm long and 0.5–2 mm wide) with pointed tips and entire margins (Figure 3). Stipules are inconspicuous (2–2.5 mm long).



Figure 1. Striate younger stem and finely hairy leaf stalks of *Acaciella angustissima* var. *angustissima* (Photo: Sheldon Navie).



Figure 2. Bipinnate leaves of *Acaciella angustissima* var. *angustissima* (Photo: Sheldon Navie).



Figure 3. Close-up of narrow leaflets with pointed tips (Photo: Sheldon Navie).

The whitish flower clusters are globular or ellipsoidal in shape (1–1.5 cm across) and are actually short head-like racemes. They are borne on short peduncles (1–1.5 cm long) and arranged in axillary fascicles, which may sometimes be arranged into larger panicle-like inflorescences (Figure 4).



Figure 4. Flower clusters of *Acaciella angustissima* (Photo: Chris Gardiner).

The flat, thin-walled, papery, pods are oblong in shape (3–9 cm long and 6–15 mm wide) with straight or sinuate margins. They are initially green (Figure 5), but turn coffee-brown when ripe (Figure 6). These glabrous pods are acute at the base and apex, with a stipe 7–12 mm long and a beak 2–7 mm long.



Figure 5. Immature fruit of *Acaciella angustissima* (Photo: Sheldon Navie).



Figure 6. Mature fruit of *Acaciella angustissima* (Photo: Sheldon Navie).

Each pod contains 8–12 circular seeds 2.5–3.2 mm across (Figure 7). These seeds are arranged transversely in the pod and are clearly separated from each other. Seed production is prolific. Seed weight is 90 000–100 000 seeds/kg (Cook et al. 2005).



Figure 7. Close-up of the seeds of *Acaciella angustissima* (Photo: Sheldon Navie).



Figure 8. *Acaciella angustissima* var. *filicioides* has hairy stems and leaves with many pinnae (Photo: Chris Gardiner).

The two other varieties of this species have the following morphological differences:

Acaciella angustissima var. *filicioides* plants have twigs, petioles and leaf rachises that are densely or sparsely hispid or pilose-pubescent, with hairs that are usually yellowish. Their leaves are also usually larger with 18–32 pairs of pinnae (Figure 8).

Acaciella angustissima var. *texensis* plants are usually glabrous or glabrescent. Their leaves are also usually smaller with less than six pairs of pinnae.

Native range and worldwide distribution

Collectively, the three varieties of *A. angustissima* are native to a large area of tropical and sub-tropical America (Figure 9):

A. angustissima var. *angustissima* is widespread from the southern United States, south through Mexico and Central America to Venezuela, Colombia, Peru, Ecuador, Bolivia and northern Argentina.

A. angustissima var. *filicioides* is native to the southern United States, south through Mexico and Central America to Venezuela, Colombia and Bolivia.

A. angustissima var. *texensis* is native to the southern United States (Arizona, Texas and New Mexico) and Mexico (south to Oaxaca and Puebla).



Figure 9. Global distribution of *Acaciella angustissima* (the yellow dots in North, Central and South America indicate the extent of its native range) (GBIF, 2008).

Acaciella angustissima has also been introduced to Brazil, the Dominican Republic, India, Pakistan, Thailand, Indonesia, the Philippines, Australia and Papua New Guinea (ILDIS, 2005; Rico Arce and Bachman, 2006).

Distribution in Australia

Acaciella angustissima has only been recorded in Queensland (Figure 10). This study was unable to find any reference to it being planted in other states.

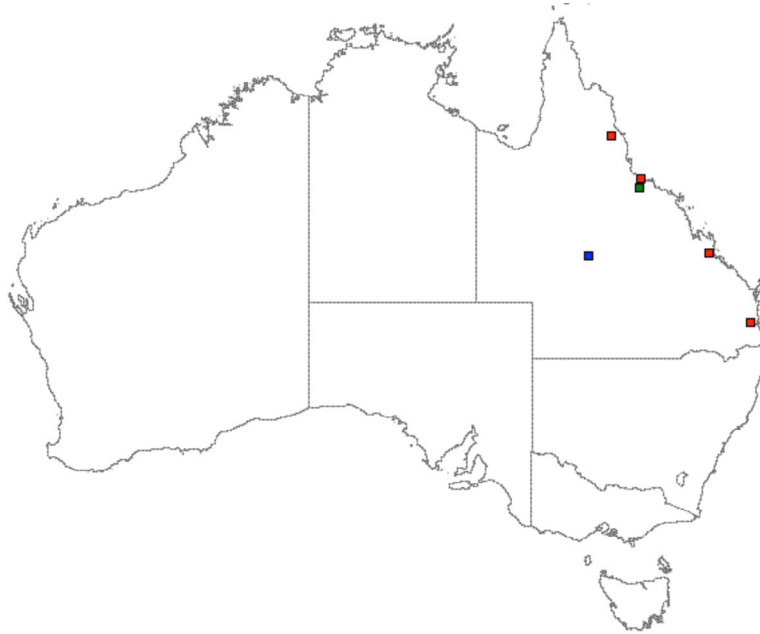


Figure 10. Distribution of *Acaciella angustissima* in Australia according to herbarium records (■ = var. *angustissima*, ■ = var. *filicioides* and ■ = var. *texensis*).

Acaciella angustissima var. *angustissima* is naturalised at several isolated locations in eastern Queensland (i.e. at Walkamin Research Station near Mareeba, in Townsville and Rockhampton, and at Indooroopilly in Brisbane).

Acaciella angustissima var. *filicioides* is doubtfully naturalised near old trial sites at Lansdown Research Station south of Townsville. It has also been cultivated at Brian Pastures Research Station, near Gayndah.

Acaciella angustissima var. *texensis* is doubtfully naturalised near old trial sites at Rosebank Research Station near Longreach.

History of introduction in Queensland

A number of accessions of *A. angustissima* were planted at 27 sites in Queensland from 1975 until 1991 to evaluate its value as a new forage plant (QPastures Database 2008). For example, according to McSweeney et al. (2005), 'fifteen accessions of *A. angustissima* or closely related species (recorded as *A. angustissima*, *A. boliviana* and *A. villosa*) were planted in a dry tropical environment at CSIRO Lansdown Research Station, Townsville'. This material was sourced from Guatemala, Honduras, Mexico, El Salvador, Belize, Costa Rica, Bolivia and Indonesia. Separate research trails were also undertaken at Utchee Creek and Silkwood in northern Queensland (Bray et al. 1997), at the University of Queensland Research Farm at Mount Cotton (Maasdorp and Gutteridge, 1986) and elsewhere (all sites, accession numbers and planting dates are recorded in the QPastures Database).

Herbarium records also indicate that *A. angustissima* var. *angustissima* material originating from La Pasuela, in Bolivia, was being cultivated at Walkamin Research Station near Mareeba in northern Queensland in 1975 and 1979 (EPA, 2009). A specimen was collected from naturalised plants growing in an open *Corymbia* forest at this location in December 2005. Therefore it is persisting in, or has spread from, these old trial sites.

Seed collected from this Walkamin Research Station site, or somewhere else in the Mareeba area, was planted in a garden at Indooroopilly in suburban Brisbane. This cultivated plant was noted to be in flower when material was collected from it in 1984 (EPA, 2009). By 1994, it was noted that *A. angustissima* was spontaneously regenerating from seed at this location and had spread to neighbouring properties. In the following year naturalised plants were recorded growing on the nearby bank of Witton Creek. Further specimens were also collected from fruiting plants at this location in 2006 (EPA, 2009). At least one adult plant was also being cultivated in the Mount Coot-tha Botanic Gardens in Brisbane in 2006 (S. Navie, pers. obs.).

Additional material has been collected from naturalised plants at Rockhampton and Townsville in 2006 and 2007. The Rockhampton collection was made behind the local DPI (now QPIF) office and was possibly in or near an old DPI pasture evaluation site. The Townsville collection was made along Campus Creek, near a drain running from the CSIRO research facility located adjacent to James Cook University.

Preferred climate

Acaciella angustissima prefers tropical climates but can persist in warmer sub-tropical areas. It is best adapted to seasonally dry areas within these climate zones. For example, in eastern Indonesia (which is outside its native range), this species can readily survive an eight-month dry season. Cook et al. (2005) stated that within its native range, annual rainfall varies from 800–3000 mm and mean temperatures range from 25–30 °C. However, these authors included a number of closely related species in their assessment. In addition, it is unclear whether their assessment included *A. angustissima* var. *texensis*, which inhabits considerably drier areas in Texas with as low as 400 mm rainfall per annum.

When considered collectively, it may be reasonable to conclude that the three varieties of this species could inhabit seasonally dry tropical areas with an annual rainfall between 400 and 3000 mm, with perhaps 800–1500 mm being optimal.

Acaciella angustissima grows naturally from near sea level to 2800 m. It can also tolerate cold climates once established, including occasional temperatures below freezing (Cook et al. 2005).

Ecology and preferred habitat

Acaciella angustissima prefers free-draining, infertile, acidic soils in its native range (including black and red acid soils). However, it has been cultivated on a wide range of soils, including vertisols of slightly alkaline pH. It responds well to fertiliser when grown on acidic infertile soils (Cook et al. 2005).

Within its native range, *A. angustissima* var. *angustissima* grows naturally in mixed *Quercus* (oak) and *Pinus* (pine) forest as well as secondary low deciduous forest and dry scrub (Rico Arce and Bachman, 2006). Similarly, *A. angustissima* var. *filicioides* grows naturally mainly in *Pinus-Quercus* forest and less often in seasonally dry forest and transitional vegetation between the two. It has also been recorded in dry scrub, *Pinus-Juniperus* forest, grassland and secondary succession in humid rainforest in Venezuela (Rico Arce and Bachman, 2006). In contrast, *A. angustissima* var. *texensis* grows mainly in dry thorny scrub, but does extend into seasonally dry forest, mixed *Quercus-Pinus* forest, secondary *Quercus* forest and grassland (Rico Arce and Bachman, 2006).

Field observations of this species in disturbed coastal riparian habitats in south-eastern Queensland (i.e. subtropical climates) and disturbed coastal open dry woodlands in northern Queensland (i.e. tropical climates) tend to support a conclusion that it is able to invade disturbed sites in open forests, dry scrubs (including deciduous scrubs) and certain riparian habitats.

Reproduction and dispersal

Flowering occurs throughout the year in its natural range (Cook et al. 2005; Rico Arce and Bachman, 2006). Some accessions can also produce new shoots through root suckering.

Acaciella angustissima usually produces large numbers of seeds. However, at lowland sites (20 m above sea level) in Papua New Guinea, it has been observed to flower but does not produce any seeds, whereas at higher elevation (1650 m) it seeded prolifically. Like most species of *Acacia*, recruitment tends to occur most readily when competition from other plants is low (Cook et al. 2005).

Seeds are hard-coated and can survive for many years when buried in soil (Cook et al. 2005).

History as a weed overseas

This study was unable to find clear evidence that *A. angustissima* was a *major* weed elsewhere in the world. However, various authors have noted that it can escape cultivation and form (naturalised) thickets along roadsides and within rangelands both within its native range and elsewhere. For example, Rico Arce and Bachman (2006) commented that even within its native range it tended to be invasive (weedy) within low deciduous forest. Also, Lowry et al. (1992) noted that it has naturalised in south-east Asia, particularly in Indonesia (where it is called *Acacia villosa*).

Impact

Current impact in Queensland

Until recently, *A. angustissima* existed as isolated naturalised specimens scattered at several locations around the state (i.e. at Walkamin, Townsville, Lansdown, Rockhampton, Longreach and Brisbane). These naturalised specimens were usually in close proximity to sites where it was tested as a potential forage legume (Figure 11). However, a few populations have originated from specimens that had been planted in gardens (Figure 12).



Figure 11. *Acaciella angustissima* var. *filicioides* persisting in an old CSIRO shrub legume trial paddock at Lansdown in northern Queensland (Photo: Chris Gardiner).

All known sites were subject to successful eradication efforts by the Queensland Department of Primary Industries and Fisheries (now part of Department of Employment, Economic Development and Innovation), co-sponsored by the Meat and Livestock Association (MLA). However, ongoing work is required to exhaust soil seed banks.

Prior to control, however, *A. angustissima* had started to spread from cultivation and invade nearby riparian habitats and disturbed sites in seasonally dry coastal tropical woodlands.



Figure 12. *Acaciella angustissima* var. *angustissima* growing along Witton Creek in Indooroopilly in 2006 (Photo: Sheldon Navie).

Potential impact in Queensland

Cook et al. (2005) noted that ‘the ability to tolerate repeated coppicing, in combination with its prolific seed production, rapid growth and low palatability to ruminant livestock has enabled *A. angustissima* to become a weed in its native range and in exotic locations, forming thickets along roadsides and on free-draining soils in rangelands. Extreme caution should be exercised in introducing *A. angustissima* to exotic environments’. Furthermore, it ‘will spread under grazing if not regularly controlled’.

Ecologically, *A. angustissima* has a number of attributes that confer weed risk: a history of successful naturalisation outside its native range, high fecundity, long-lived (hard coated) seeds and a propensity to quickly colonise gaps within open woodland and dry scrub.

Climatically, the various forms of *A. angustissima* are adapted to a broad range of climates from the seasonally dry tropics to cooler subtropical areas (where rainfall ranges from 400–3000 mm per annum). A prediction of this species’ potential range is provided in Figure 13.

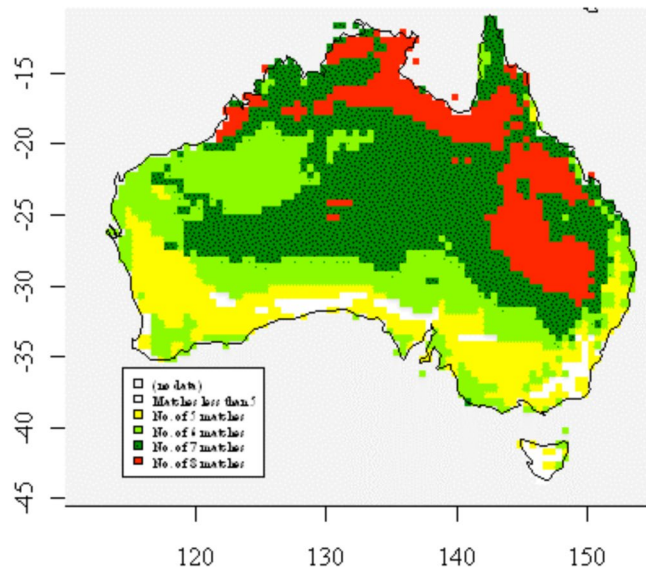


Figure 13. Potential range of *Acaciella angustissima* in Australia, as predicted by CLIMATE modelling software (red areas indicate very suitable climate, dark green suitable, light green and yellow areas are marginally suitable, and white are unsuitable).

Based on an assessment of its climatic, edaphic and habitat preferences, it is reasonable to predict that *A. angustissima* has the potential to become a widespread and abundant invasive pest over much of north Queensland's dry tropical woodlands and riparian areas, extending to sub-coastal and coastal southern Queensland. Within this climatic envelope, it is predicted to become most abundant on well-drained acidic, infertile soils. Where conditions are suitable, it has the potential to form dense thickets that could exclude more desirable pasture plants and native vegetation. Its propensity to form a long-lived soil seed bank means that any attempts at eradication will be prolonged.

Uses

A. angustissima is used as a forage shrub for grazing cattle. It is highly tolerant of repeated defoliation and its palatability varies from 'low' to 'moderate' (Cook et al. 2005). However, it contains toxic compounds such as low molecular weight phenolic compounds (i.e. polyphenolics such as condensed tannins) and possibly non-protein amino acids that have an anti-nutritional effect in ruminants (Smith et al. 2003; Cook et al. 2005). Other authors note that it is toxic to Ethiopian Highland sheep (Odenyo et al. 1997), Bogor sheep and Kupang goats (Smith et al. 2003). Polyphenolics are widespread secondary metabolites in plants and are thought to be an important defence against herbivory (Smith et al. 2003).

Control

In its native habitat, *A. angustissima* is eaten by the larvae of an acacia skipper butterfly (*Cogia hippalus*) and the larva of two species of moths (*Sphingicampa blanchardi* and *S. raspa*) (Cook et al. 2005).

Once mature, it tolerates annual burning (Cook et al. 2005).

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