Department of
Primary Industries and
Regional Development

GOVERNMENT OF
WESTERN AUSTRALIA

Environmental weed risk assessment

Blue agave, tequila agave (*Agave tequilana*)

Agave tequilana, commonly called blue agave or tequila agave, is a succulent native to the states of Jalisco, Colima, Nayarit and Aguascalientes in Mexico. In its native range blue tequila predominantly grows at high altitudes (>1,500m) on iron-rich, fertile soils of volcanic origin (Chambers and Holtum 2010). The 'Jalisco' region where *A. tequilana* has traditionally been grown has a distinctive wet (summer) and dry season (winter) with average annual rainfall of 800-900mm. Growing at high altitudes the night temperatures are usually markedly lower (10°C) than day temperatures.

Like all *Agave* species, *A. tequilana* has the capacity to assimilate CO_2 during the day using C_3 photosynthetic pathway and also the capacity to assimilate CO_2 at night using Crassulacean acid metabolism (CAM). The CAM pathway gives the plants a three- to five-fold higher water-use efficiency (WUE) than C_3 or C_4 plants under comparable conditions because stomata open at night when tissue temperatures average 10–12°C lower than during the day, and close during the day when temperatures are high (Chambers and Holtum 2010).

Part of the *Asparagaceae* family, like other Agave species, it grows as a large rosette of thick, fleshy leaves which can reach 2m in height. Each plant is monocarpic meaning that each rosette dies after flowering and fruiting. When about five years old, a large 'mast' (stem) up to 5m in height, grows from the centre of the plant and bears a large number of tubular, yellow flowers. Within its native range, blue agave is pollinated by a local native bat (*Leptonycteris nivalis*) and produces several thousand seeds per plant.

Blue agave is an important economic product of Mexico as the base ingredient of the distilled alcoholic drink, tequila. It has also been evaluated in Queensland as a potential biofuel feedstock (Chambers and Holtum 2010; Holtum et al. 2011; Subedi et al. 2017). A challenge with commercial production is the requirement for vegetative propagation and the long lead time from planting until harvesting can start (Hoban 2022).

Following the protocol in Moore et al. (2022) there was no evidence of *A. tequilana* being a weed in similar environments, or that it would persist without management (see below).

Is the species a weed in similar environments in Australia or overseas?

There are 12 species of Agave listed as weeds worldwide. Five taxa are known from Western Australia (WA).

Agave americana (century plant) was formerly separated into 3 varieties which have been recorded as naturalised – *A. americana* var *americana*; *A. americana* var *americana* var. *marginata* and *A. americana* var *expansa*. However, the varieties are no longer separated in Florabase.

This species is the most commonly recorded species with records from the Pilbara to the Nullarbor. There are sporadic records of: *A. angustifolia*; *A. attenuata*; *A. sisalana* and *A. colorata*/*potatorum* complex. The later complex has scattered records from abandoned stations and in the goldfields but have not yet been found in flower to

confirm an identification (G. Keighery personal observation). All known populations of these taxa are found around abandoned settlements, road and railway verges, farm or station homesteads, slowly spreading via offshoots from the original plantings as ornamentals.

The largest populations recorded of naturalised Agave in WA are:

- the large stand of *A. sisalana* on Rottnest (imported for sisal production), now eradicated (Keighery 1986, 1988); and
- a large population of *Agave angustifolia* forming almost a monoculture covering a hillslope above Sir James Mitchell Park in South Perth.

Both of these species were apparently present in these areas for over 100 years.

No *Agave* species appear to invade undisturbed bushland, and removal by mechanical means is the most common management action. It appears that chemical control has been undertaken on some offshore islands and coastal sites in eastern Australia where the species, normally *A. americana*, has been long established and has actively invaded disturbed bushland.

There are no known records of *Agave tequilana* as a weed worldwide despite a long history of cultivation chiefly as an ornamental in many countries, which supports the finding reported in Csurhes (2016). *Agave tequilana* has been grown as an ornamental for over 150 years in Australia, and there are several unnamed variegated forms widely grown (Spencer 2005). In Australia, there are no known records of the species naturalising or even persisting outside of cultivation.

However, the species is closely related to the more widespread and highly variable *A. angustifolia* (Gentry 1982). This species grows over a large geographic range and on many soil types. Young plants of both species are difficult to differentiate (Irish and Irish 2000) and the species could potentially hybridise making identification of populations difficult. These species should not be grown together. *Agave tequilana* can probably persist and spread in favourable sites similarly to this species, but it's very narrow climatic and edaphic range compared to *Agave angustifolia* would considerably lessen this risk.

Most *Agave* species set little seed in Australia as they are missing the bat pollinators from their native environment. Plants are generally clones that appear to show low levels of self-fertility, that spread via offshoots, or bulbils produced in the inflorescence. All are relatively slow growing and require a long period between planting and local spread. *Agave tequilana* is cultivated using offsets as little to no seed is produced. To ensure uniformity of the crop selected clones are grown for production of tequila. In commercial plantations, the inflorescence buds are generally removed as it increases the rate of growth of the plant stem which is the portion harvested to produce tequila. This would also reduce the chance of spread from plantations as no inflorescence bulbils would be produced.

Weed lists

National-international:

- Not listed in Weeds of Australia (398 weed species) https://weeds.org.au/weeds-profiles/

- Not listed in Weeds of Australia website Fact sheet Index (lucidcentral.org), although other species in the *Agave* genus are listed (*Agave americana*, *A. angustifolia*, *A. sisalana*).
- In the Global Compendium of Weeds, there are no records of *Agave tequilana* being listed as a weed or naturalised anywhere in the world (Randall 2017).
- In the Introduced flora of Australia, there are no records of *Agave tequilana* being listed as a weed (Randall 2007).

Western Australia:

- Not listed in Western weeds. A guide to the weeds of Western Australia (Hussey et al. 2007)
- Not listed in 'The naturalized vascular plants of Western Australia 1: Checklist, environmental weeds, and distribution in IBRA regions'. Other agave species: namely *Agave americana* var. *americana* (Century Plant), *A. americana* var. *picta* and *A. sisalana* (Sisal) are listed (Keighery and Longman 2004).
- Not listed in Environmental weeds of Western Australia (Keighery 1991).

Note: there were no records for *Agave tequilana* in Australia on 'The Australasian Virtual Herbarium'

Is the species likely to persist in the environment without management?

Blue agave is native to high altitude areas in the Mexican states of Jalisco, Colima, Nayarit and Aguascalientes with a summer dominant rainfall of 800-900mm per annum (Chambers and Holtum 2010). The optimum temperature is 26°C, but blue agave can tolerate high maximum temperatures of 50°C for limited periods (Chambers and Holtum 2010). It is reported to be found growing on fertile, volcanic soils by Chambers and Holtum (2010), while Csurhes (2016) reports it grows on sandy soils.

Blue agave is reported to be a weak competitor with weeds during the establishment phase. In Mexico, abandoned *Agave* plantations tend to be rapidly recolonized by other species and reach diversity values similar to undisturbed natural habitats (Gonzáles-Iturbe et al. 2002).

A climate match between its native distribution in Mexico (Jalisco) and Australia based on climate only identifies a very small niche area in the north Kimberley where *Agave tequilana* could potentially grow without management (Figure 1). However, as seen in Australia, other Agave rarely produce viable seed and the density declines without being actively managed in their native Mexico. Given these factors a rating of 'Negligible to low' is appropriate for the Kimberley.

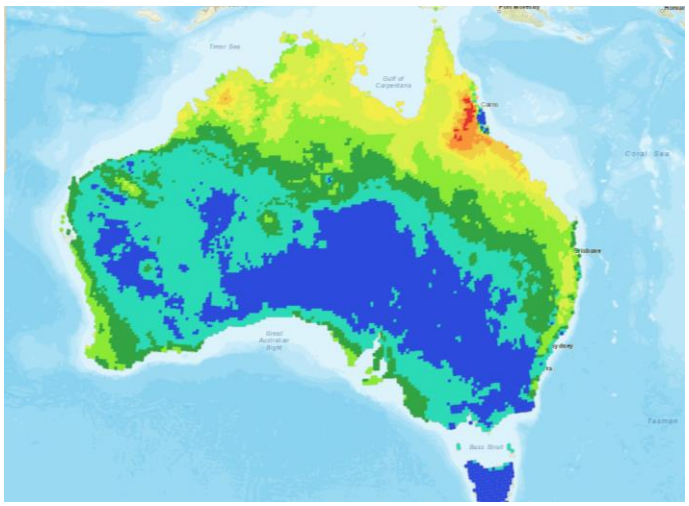

Figure 1. A climate match between the Mexican state of Jalisco and Australia using 'Climatch (v.2.0)'.

Environmental weed risk assessment

Assessed using the 'Environmental weed risk assessment protocol for growing non-indigenous plants in the Western Australian rangelands' (Moore et al. 2022)

Region	Filter A	Filter B	Weed Risk Assessment rating
	Is the species a weed in similar environments in Australia or overseas?	Is the species likely to persist in the environment without management*?	
Kimberley	No	No**	**Negligible to low*** **
Pilbara	No	No	**Negligible to low*** **
Gascoyne – Goldfields	No	No	**Negligible to low*** **
Agricultural area	No	No	**Negligible to low*** **

*Without management means no fertiliser, Rhizobia, irrigation, grazing management or control of competition from other species

**Refer to Figure 1

***For all approved plantings, there should be a condition that on cessation of cultivation all plants are removed and destroyed.

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Important disclaimer