Department of
Primary Industries and
Regional Development

GOVERNMENT OF
WESTERN AUSTRALIA

Environmental weed risk assessment

Cowpea (*Vigna unguiculata*)

Synonyms: *Vigna sinensis, V. anaustifoliolat, Dolichos unguiculata*

Family: Fabaceae

Common name: Cowpea, black eyed pea

Cultivars: Include Ebony, Red Caloona, Meringa, Calypso, Black stallion

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Species summary:

Vigna unguiculata (cowpea) originates from West Africa (Cook et al. 2020) with an additional centre of genetic diversity in Southern India (Krishna 2014). Ba et al. (2004) found that domesticated cowpea showed a high genetic variability. Combined with high morphological diversity this has resulted in a complex taxonomy which has been reviewed and reported by many authors. Krishna (2014) divides cowpea *Vigna unguiculata* into four sub species (*cylindrica* – Catjang bean; *dekindtiana* – black eyed bean; *psesquipedalis* – Yardlong bean and *unguiculata* – Southern peas). The commercially available varieties are var. *unguiculata.*

Cowpea is an annual, herbaceous twining and trailing legume with a coarse main stem and large, ovate-shaped leaves. Depending on the cultivar, the growth habit can vary from prostrate to climbing, or suberect, with stands growing to a height of 50-100cm. The optimum temperature for cowpea growth is around 30°C and it is best adapted to areas with an annual rainfall from 500–1,500mm, although it has a wide range 300–4,100mm. However, in high rainfall environments the incidence of fungal diseases increases (FAO EcoCrop Database; Cook et al. 2020).

Cowpea is fast growing and suitable for multiple uses including grazing, hay/silage, grain, or green manure (Cook et al. 2020). They are mainly grown for seed but both seeds and vegetative parts can be eaten by humans and animals. Cowpea is grown widely in Africa, Asia and the Americas as a grain legume, vegetable and fodder crop (Ehlers and Hall 1997). In Queensland, it has been grown as a green manure in rotation with sugarcane, as forage, hay, silage and as a grain crop (Cook et al. 2020).

The use of cowpea in northern Western Australia (WA) has been limited but it has mostly been grown as a forage option and occasionally as a companion species with forage sorghum.

Figure 1. The distribution of Cowpea (*Vigna unguiculata*) in Australia from the Australasian Virtual Herbarium (https://avh.ala.org.au/)

Section 1: Invasiveness

1. Does the species have a documented environmental weed history?

a) Is an environmental weed in Australia

b) Is an environmental weed overseas

c) Species not known to be an environmental weed but there are environmental weed species in the genus

d) Genus has no known environmental weeds

Vigna unguiculata is not listed in Weeds of Australia (398 weed species) https://weeds.org.au/weeds-profiles/ , nor on the Weeds of Australia website Fact sheet Index (lucidcentral.org). In the Global Compendium of Weeds, cowpea is listed as an agricultural weed, casual alien, naturalised, weed (Randall 2017).

Vigna unguiculata is not listed in 'Western Weeds' (Hussey et al. 2007), or Environmental weeds of Western Australia (Keighery 1991) or the Naturalized vascular plants of Western Australia (Keighery et al. 2004), or the Western Australia Herbarium (1988).

Hussey et al. (2007) note that mung bean (*V. radiata*), which originates from India, has become naturalised in disturbed areas of the Kimberley and that *V. trilobata*, originating from Asia, has spread from cultivated areas to naturalise along roadsides and drains around Kununurra. In addition, there are over 40 species from the genus Vigna listed in the Global compendium of weeds (Randall 2017). This includes all four subspecies of Cowpea (*Vigna unguiculata*). However, there are no references to this species as an environmental weed.

Other species within the *Vigna* genus are reported to be environmental weeds including: *Vigna adenantha*, *V. radiata*, *V. hosei*, and *V. mungo* (Randall 2017).

2. What is the ability of the species to successfully establish and compete with other plants, especially amongst intact native vegetation?

a) High - species can establish and displace intact native vegetation

b) Moderate - species can establish amongst intact native vegetation, but may not displace the native vegetation

c) Low - species can only establish where there is little or no competition or in areas where the native vegetation is in poor condition or has been disturbed

d) Very low - species can only successfully establish in vegetation which has been highly disturbed (e.g. roadsides, degraded or cleared areas)

e) Don’t know

Cowpea is unlikely to compete with native vegetation unless it is in poor condition or disturbed. In an agriculture context, cowpea may be grown as a single species crop, often for seed, but it may also be grown with other crops in a companion planting. As an annual legume, cowpea may not compete with perennial species and little seedling regeneration was reported in the second year from trials in southern Queensland (Cook et al. 2020).

3. Grazing tolerance and palatability

a) Very high - Unpalatable (or toxic), rarely grazed

b) High - Will persist under heavy continuous grazing due to plant structure (like rhizomatous grasses) or has limited palatability

c) Moderate - Tolerant of grazing as, usually, only young growth (annuals) or young re-growth (perennials) is grazed, for example after fire or early in wet season; or plants are occasionally browsed

d) Low - Readily grazed during the wet season with some preferential grazing, during the dry season some plants are grazed while others are left ungrazed

e) Very low - Comparatively good feed quality and preferentially grazed at all growth stages; or has low tolerance to grazing and plants are easily killed. Plant numbers decline over successive years if overgrazed.

f) Don’t know

Cowpea is very palatable, and some varieties do not recover well if grazed before flowering. However, the wide diversity in cowpea results in some variation across accessions in the response to grazing with some regrowing well after defoliation. The recommendation is for light grazing, removing only leaves, to protect the plant frame (Cook et al. 2020).

4. What is the species’ ability to persist as a long-term sward or stand without management?

a) Plant numbers increase substantially with successive reproductive cycles to form a near monoculture over a significant area

b) Plant numbers remain at a steady level, persisting as a significant component of a mixed sward/stand

c) Plant numbers decline slowly over successive years so that it becomes a minor component of the vegetation

d) Plant numbers decline rapidly over successive years so that only occasional plants can be found

e) Don’t know

Cultivated cowpea accessions are usually soft-seeded annuals and therefore do not persist as a long-term stand without management. In trials of one accession in Queensland, despite good seed yields in the first year (6t/ha) there was little seedling regeneration in the second year across a number of sites (Cook et al. 2020).

5. Is the plant likely to spread or rapidly colonise a site?

a) High risk – plants with a history of spreading rapidly with many plants successfully establishing under favourable conditions >200m from the sown area within 5 years for herbaceous perennials or 10 years for woody perennials

b) Medium risk – some plants will spread outside the planted area and successfully establish under favourable conditions >100m from the sown area within 5 years for herbaceous perennials or 10 years for woody perennials

c) Low – No or minimal spread of sown species. Outside the planted area a few plants will spread and successfully establish within 100m of the planted area under favourable conditions within 5 years for herbaceous perennials or 10 years for woody perennials

d) No spread of sown species more than 10m outside the planted area within 5 years for herbaceous perennials or 10 years for woody perennials

e) Don't know

Commercial cowpeas are soft seeded annual legumes and have little potential for survival in the soil. Hard-seeded perennial subspecies may have some potential to spread but have not been evaluated as forages to any extent (Cook et al. 2020).

In Australia, cowpea has been grown as a seed crop or for forage. Although there are reports of occasional escapees there is little information to indicate establishment outside disturbed or prepared ground, without management or in native ecosystems. Most commercial cowpeas are annual and soft seeded so there is no significant hard seed to distribute or form a soil seedbank.

6. Will the species establish and reproduce in low-nutrient Australian soils without the addition of fertiliser or inoculant?

a) Establishment, growth and seed production uninhibited in low-nutrient soils

b) Establishment, growth and seed production reduced in low-nutrient soils

c) Establishment, growth and seed production severely diminished in low-nutrient soils

d) Establishment, growth and reproduction not likely in low-nutrient soils without soil additives

e) Don't know

Cowpea is tolerant of a wide range of soil textures from sands to heavy, well-drained clays. It is also adapted to a wide range of pH and can tolerate very acid soils (pH 4).

Cowpea can establish and grow in soils with low fertility, but responses have been recorded to P, K and S as well as molybdenum on low fertility soils (Cook et al. 2020). Although inoculation with a selected cowpea strain of Rhizobium inoculum is an advantage, cowpea nodulates freely with native rhizobia. Johnson (1970) found that in low fertility soils in Rhodesia, Africa cowpea responded to the addition of phosphorus and potash.

7.1 How likely is long-distance dispersal (>100m) by flying animals (birds, bats)?

a) Common

b) Occasional

c) Unlikely

d) Don't know

Cowpea seed size is very variable (5,000-12,000 seeds/kg) but relatively large (4 to 8mm long, 3 to 4mm broad. No information was found for dispersal or seed viability after ingestion by birds or bats.

7.2 How likely is long-distance dispersal (>100m) by stock, native and/or feral animals?

a) Common

b) Occasional

c) Unlikely

d) Don't know

Although cowpea seeds have no adaptations for attachment to hair, fur or hooves, seed may be dispersed after being eaten. Samansiri and Weerakoon (2008) report that cowpea seed can survive passage through an Asian elephant and remain viable, so a proportion of seed may survive ingestion by stock, feral or native animals in Australia.

7.3 How likely is long-distance dispersal (>100m) by water?

a) Common

b) Occasional

c) Unlikely

d) Don't know

Cowpea is moderately tolerant of drought but does not tolerate waterlogging. It is susceptible to fungal diseases which are favoured by excessive soil moisture (Cook et al. 2020). Cowpea is not reported as growing along waterways and seed has no adaptations to float or survive inundation.

7.4 How likely is long-distance dispersal (>100 m) by wind?

a) Common

b) Occasional

c) Unlikely

d) Don't know

Seed have no adaptations for wind dispersal and although variable in size, are generally too large for wind dispersal (Cook et al. 2020).

8.1 How likely is long-distance dispersal (>100m) accidentally by people and vehicles?

a) Common

b) Occasional

c) Unlikely

d) Don't know

Cultivated cowpea seed are large and have no adaptations for attachment to clothing or vehicles. Incorporation and attachment in mud is possible although cowpea is more often grown in well-drained soils.

8.2 How likely is long-distance dispersal (>100 m) as fodder or accidentally in contaminated produce?

a) Common

b) Occasional

c) Unlikely

d) Don't know

As cowpea is often grown as a grain crop, fodder crop cut for hay or silage or in other cropping situations cowpea seed may be dispersed as a contaminant of other agricultural produce.

9.1 What is the species' minimum generation time?

a) ≤1 year

b) 2-3 years

c) >3 years or never

d) Don't know

Cowpea is mostly a self-fertilising, quantitative short-day plant, but there are also day-neutral cultivars. The different cultivated cowpea accessions can show wide variation in reproductive development with some flowering 30 days after sowing and ready for harvest of dry seeds 25 days later. Other accessions may take more than 90 days to flower and 210-240 days to mature (Cook et al. 2020).

9.2 What is the species' average seed set in a favourable season?

a) Prolific seed production high (e.g. >1000 m^{-2}/year for woody species, >5000 m^{-2}/year for herbaceous species)

b) Moderate – low seed production

c) None (or seed is sterile)

d) Don't know

The variation within the species is reflected in the morphology of the pods and seeds. Pods vary in length with 6-15 seeds/pod. Seeds are also variable in size (5,000-12,000 seeds/kg), shape, and variously coloured (including mottled, white, brown, maroon, cream and green) (Cook et al. 2020). There is a large variation in seed production depending on the cultivar or landrace (Cook et al. 2020). Grain production of 250-4,000kg/ha has been reported (max. of 4,800 seeds per square metre).

9.3 What is the species' seed persistence in the soil seedbank?

a) >5 years

b) 2-5 years

c) <2 years

d) Don't know

The commercially available cowpea varieties are soft-seeded annuals with rapid germination in suitable conditions. As a result the seed has little potential for survival in the soil (Cook et al. 2020). However, *V. unguiculata* subsp. *dekindtiana* usually has a higher proportion of hard seed and may show a greater ability to persist as a soil seedbank and germinating in subsequent seasons. This also provides the potential to develop new varieties with an increased level of hard seededness and persistence.

Wild cowpea accessions have smaller pods and seeds and a higher hard seed level (Lush and Evens 1981).

9.4 Can the species reproduce vegetatively?

a) Yes – rapid vegetative reproduction

b) Yes – slow

c) No

d) Don't know

Cowpea is an annual species showing no ability for vegetative reproduction.

Section 2: Impacts

1. Could the species reduce the biodiversity value of a natural ecosystem, either by reducing the amount of biodiversity present (diversity and abundance of native species), or degrading the visual appearance?

a) The species could significantly reduce biodiversity such that areas infested become low priorities for nature conservation and/or nature-based tourism

b) The species could have some effect on biodiversity and reduce its value for conservation and/or tourism

c) The species would have marginal effects on biodiversity but is visually obvious and could degrade the natural appearance of the landscape

d) The species would not affect biodiversity or the appearance of natural ecosystems

e) Don't know

Although cowpea has been reported as escaping from cultivation and may become naturalised in suitable conditions (Randall 2017) there is no information to suggest that this species invades native ecosystems. If present the species could trail or scramble over other vegetation altering the appearance of the vegetation.

2. Does the species have a history of, or potential to reduce the establishment of other plant species?

a) The species can significantly inhibit the establishment of other plants (e.g. regenerating native vegetation) by preventing germination and/or killing seedlings, and/or the species forms a monoculture over a large area

b) The species can inhibit the establishment of other plants and can become dominant.

c) The species can cause some minor displacement by inhibiting establishment but will not become dominant.

d) The species does not inhibit the establishment of other plants.

e) Don't know

No information found of cowpea invading native ecosystems. Cowpea is reported as a weed of following crops or as a crop or garden escape. It may become naturalised in suitable conditions and could climb over adjacent vegetation but as an annual this is unlikely to be a significant affect.

3. Could the species alter the structure of any native ecosystems at risk of invasion from this species by adding a new strata level?

a) Will add a new strata level, and could reach medium to high density

b) Will add a new strata level, but at low density

c) Will not add a new strata level

d) Don't know

Although cowpea could become naturalised in suitable conditions and could climb over adjacent vegetation, as an annual, this is unlikely to have a significant affect.

4. Could or does the species restrict the physical movement of people, animals, and/or water?

a) Species infestations could become impenetrable throughout the year, preventing the physical movement of people, animals and/or water

b) Species infestations could significantly slow the physical movement of people, animals and/or water throughout the year

c) Species infestations could slow the physical movement of people, animals and/or water at certain times of the year or provide a minor obstruction throughout the year.

d) Species infestations have no effect on physical movement

e) Don't know

Cowpea is herbaceous small shrub or trailing vine, growing 15-80 cm high (Cook et al. 2020) and is unlikely to restrict the physical movement of people, animals, or water.

5. Does the species have, or show the potential to modify the existing behaviour and alter the fire regime?

a) High - major effect on frequency and/or fire intensity. May greatly increasing the dry season fuel load

b) Moderate effect on frequency or fire intensity

c) Minor or no effect

d) Don't know

Cowpea is commonly a trailing and scrambling annual vine and can grow over other vegetation in some conditions. However, in non-cultivated situations there are no reports of high yields of flammable material being produced. The plant itself is not tolerant of fire (Cook et al. 2020) and does not regenerate after fire.

6.1 Is the species toxic to animals, have spines or burrs, or host other pests or diseases that could impact on native fauna and flora?

a) Yes – plant poisonous or other adverse factors present

b) No – plant is not poisonous, does not produce burrs or spines or harbour pests or diseases

Cowpea is not toxic to ruminants but the presence of trypsin inhibitors and some tannin in may affect some monogastrics. Heat treatment can reduce trypsin inhibitors in the seeds.

(Cook et al. 2020). Cowpea forms groups with high variability and susceptibility to a wide range of pests and diseases including fungal infections, cowpea aphid (Aphis craccivora), cowpea aphid borne mosaic virus (CABVM), bacterial blight (Xanthomonas campestris) and root nematodes (Ehlers and Hall 1997).

6.2 Could the species provide food and shelter for pest animals?

a) Yes – could provide more shelter or greater nutritional value than the native vegetation

b) No – could provide similar or less shelter or nutritional value than the native vegetation

c) Don't know

The nutritious seed and foliage could provide a food source for pest animals.

7.1 Does the species have, or show the potential to have, a major effect on nutrient levels in intact native vegetation?

a) Will significantly increase soil nutrient levels

b) Will significantly decrease soil nutrient levels

c) Will have minimal effect on soil nutrient levels

d) Don't know

In Australia cowpea nodulates freely with native rhizobia. It is reported to have a high potential as a green manure when it can either be incorporated into the soil or spread on the soil surface. Within 8-10 weeks after sowing cowpea, it can provide the equivalent of 80 kg/ha N to a subsequent crop. In trials, maize grain yields, associated with the use of cowpea as green manure, were doubled compared to unfertilised control treatments. Estimates of fixed nitrogen from cowpea often range from about 50 to more than 100kg/ha (Anon. 2013).

7.2 Could the species reduce water quality or cause silting of waterways?

a) Could significantly reduce water quality or cause silting or alteration of flow of waterways

b) May have some effect on water quality or silting of waterways in some ecosystems

c) Minor or no effect on water quality

d) Don't know

Cowpea does not grow preferentially along waterways and is not tolerant of waterlogging or prolonged inundation by flooding. It therefore unlikely to affect water quality water flow and no information was found to suggest this.

7.3 Does the species have, or show the potential to have, a major effect on the soil water table below intact native vegetation?

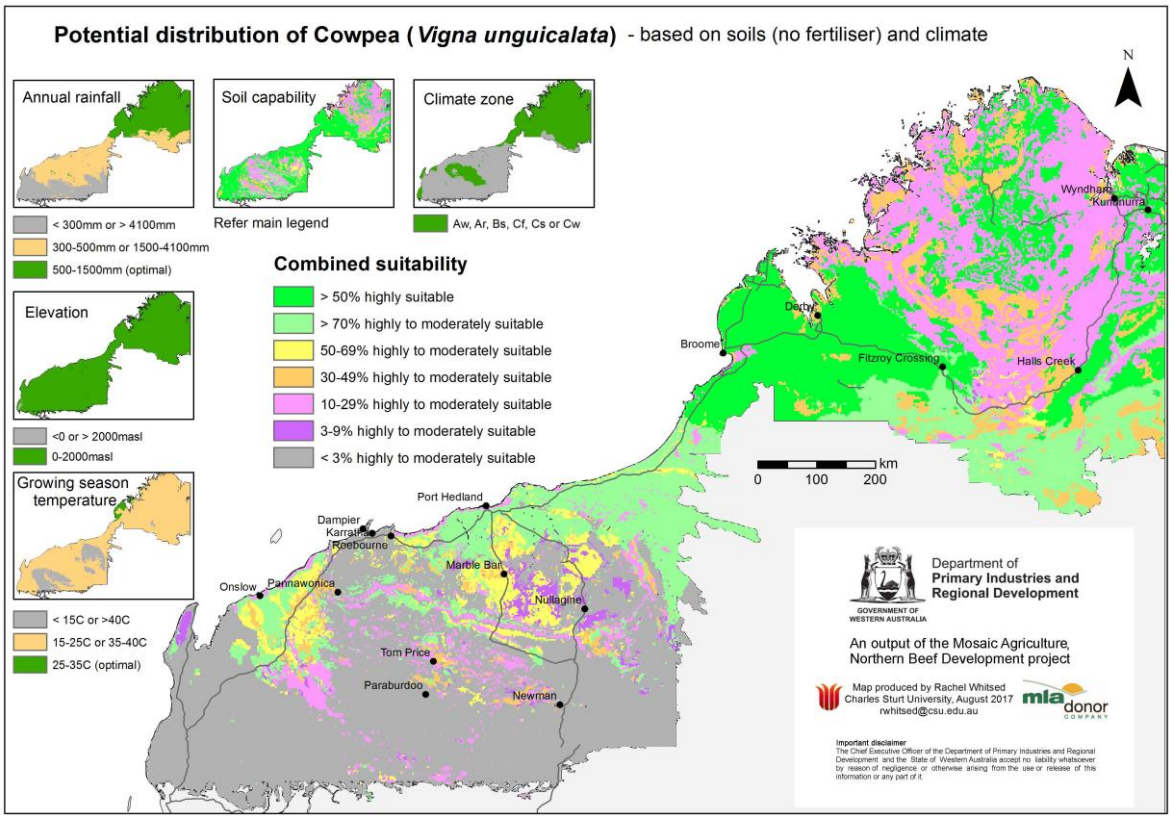
a) Will significantly lower the water table and/or reduce groundwater recharge to the water table.

b) Will have little or no impact on hydrology

c) Don't know

The wide genetic and morphological variety found across the species is reflected in a range of drought tolerance Cowpeas have a deep tap root with many spreading lateral roots that help stabilise the soil and extract soil water (Cook et al. 2020). This root structure helps the plant extract soil moisture and achieve a level of drought tolerance but no information was found to suggest that cowpea significantly lower water levels unless grown as a significant component of the vegetation.

Potential distribution



Region	Area of suitable soils and climate	Potential distribution score
Kimberley	16.8Mha	8.0
Pilbara (>300mm)	6.8Mha	7.0
Pilbara (<300mm)	0	0.5
Gascoyne – Goldfields	0	0.5

Overall weed risk assessment

The overall weed risk assessment (WRA) is calculated from Equation 1.

Equation1: Invasiveness (0-10) x Impacts (0-10) x Potential Distribution (0-10) = Weed risk score (0-1000)

Invasiveness score = 2.9; Impacts score = 2.5

Region	WRA calculation*	Overall score	WRA rating
Kimberley	2.9 x 2.5 x 8.0	**58.0**	**Medium**
Pilbara (>300mm)	2.9 x 2.5 x 7.0	**50.8**	**Medium**
Pilbara (<300mm)	2.9 x 2.5 x 0.5	**3.6**	**Negligible-low**
Gascoyne – Goldfields	2.9 x 2.5 x 0.5	**3.6**	**Negligible-low**

***** Invasiveness (0-10) x Impacts (0-10) x Potential Distribution (0-10) = Weed risk score (0-1000)

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Important disclaimer