2022

Megathyrsus maximus - environmental weed risk assessment 2022

Department of Primary Industries and Regional Development, Western Australia

Department of
Primary Industries and Regional Development

GOVERNMENT OF WESTERN AUSTRALIA

Environmental weed risk assessment

Panic grass (*Megathyrsus maximus*)

Family: Poaceae

Synonyms: *Panicum maximum*, *Panicum maximum* var. *trichoglume*

Common names: Panic grass, green panic, Guinea grass

Varieties in Australia – short types (panic grass) include: Petrie (green panic), Gatton panic, and Megamax049™; and Medium to tall types (Guinea grasses) including: Megamax059™, G2, Tanzania, Mombaça, Makueni, Coloniao and Hamil grass

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Species summary:

Panic grass (*Megathyrsus maximus)* is a warm season (C4), perennial grass which is widely used in South America, Japan, India, and sub-tropical Queensland and more recently in the northern agricultural region of Western Australia. It is a productive forage grass for pasture, green-forage, hay and silage. The panic grasses are shade tolerant and often found around tree lines in their native environment (tropical and sub-tropical Africa) where the soil fertility is higher.

Panic grass is a tufted, highly palatable leafy bunch grass, occasionally with short rhizomes, with foliage to 1.5m (short-medium types), but the Guinea grasses can reach up to 3-4m (Cook et al*.* 2005). They are moderately drought tolerant (varies with genotype) and can respond rapidly to rainfall. Most genotypes are intolerant of waterlogging or flooding.

The taxonomy of *Megathyrsus maximus* has been examined on several occasions and the species and a number of sub-specific taxa assigned to several different genera (*Panicum, Urochloa*) until Simon and Jacobs (2003) provided the current use. The species is very variable with a number of variations and sub taxa described and many varieties developed for a range of agricultural systems. Two distinct types are often identified; these being the short types mainly from sub-tropical origins which are generally <1.5m when flowering; and medium to tall types, commonly called Guinea grasses which are usually 1.5 to 4m when flowering and predominantly from tropical origins (Cook et al*.* 2005).

In Australia panic grass has been grown widely sown as a pasture species in Queensland and is now reported as naturalised in some areas and a weed of roadsides and disturbed sites and some agricultural crops. In Western Australia it is being sown on sandy soils in the Northern Agricultural Region and South Coast with a minimum rainfall of 400mm/annum (DAFWA 2006; Moore et al. 2014). There is interest in growing panic grass for stand and graze systems under irrigation in northern Western Australia.

The Western Australian Herbarium (1998–) describes panic grass as alien to WA and reports that in northern WA it is present in Interim Biogeographical Regions of Australia (IBRA) regions including: Dampierland, Northern Kimberley and Victoria Bonaparte. Hussey et al. (2007) note panic grass as found outside agricultural use at several disturbed sites in the Kimberley and also in Perth and Albany.

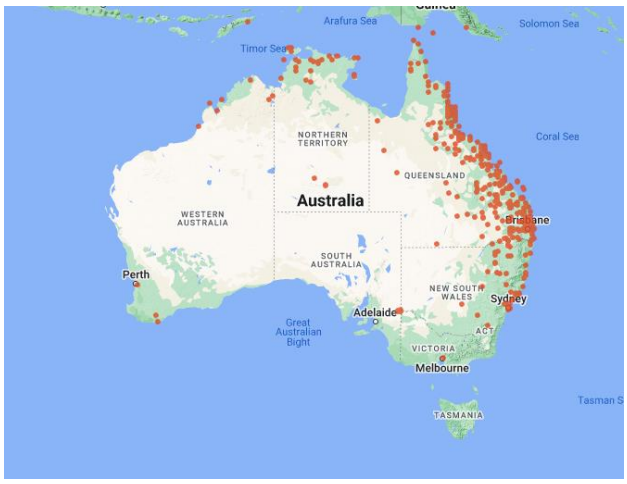


Figure 1 The distribution of panic grass (*Megathyrsus maximus*) in Australia from the Australasian Virtual Herbarium (https://avh.ala.org.au/)

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

Panic grass is reported as a serious weed in tropical and sub-tropical crops and wastelands in other parts of the world (Cook et al. 2005; PIER 2010). Guinea grass can suppress or displace local plants on fertile soils in pastures and can survive to become dominant after a fire (Global Invasive Species Database 2017). It is a naturalised non-indigenous species in Tropical America and as it survives and recovers rapidly after fire it can prevent succession back to native forest (D'Antonio and Vitousek 1992).

Randall (2017) in the Global Compendium of Weeds notes that panic grass is reported as naturalised in several parts of Australia and also considered invasive in some areas including parts of the wet tropics. Guinea grass is regarded as an environmental weed in Queensland, the Northern Territory and north-eastern New South Wales (Anon 2017).

In Queensland and NT it is "managed for conservation" (www.deh.gov.au - Community involvement in off-reserve and on-reserve management of environmental weeds - 1997)). In Ipswich, is managed as a low priority species (Ipswich city council). Is a weed in Queensland that out-competes native plants and alters fire regimes (Tropical Savannah CRC) and a weed of roadsides and disturbed sites in WA (impacts not noted) (Hussey et al. 2007).

Cook et al. (2005) reports it is a major weed in sugar-cane fields, due to its ability to grow under shaded conditions. It is also and a common and widespread weed of crops, orchards, vineyards, disturbed sites, roadsides, railways, footpaths, parks and gardens, bushland and riparian vegetation (Cook et al. 2005; Anon 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

Panic grass is well adapted to tropical and sub-tropical environments and in central and South America its introduction has been implicated in altering native habitats (D'Antonio and Vitousek 1992). Responses to soil and climate vary with genotype, but in general seedlings are comparatively slow to establish and full weed control is required during the establishment phase of sown panic grass pastures (Nichols et al. 2012; Moore et al. 2013). The optimum temperature range for growth is between 30-36°C, with negligible growth below 15°C/10°C (Sweeney and Hopkinson 1975). In Mediterranean environments panic grass (short types) can be successfully grown in areas with an annual rainfall >400mm (Moore et al. 2006), but in summer rainfall sub-tropical or tropical regions the minimum rainfall is >750mm for the short types and >1,000mm for the medium to tall types (Cook et al. 2005).

The Tropical Forage Database (Cook et al. 2005) suggests that spread is minimal or slow under grazed conditions, but that panic grass is an effective coloniser in ungrazed areas especially where there has been some form of disturbance. They also report that panic grass spreads along watercourses and ungrazed roadsides, and has been listed as a weed in many countries.

3. Grazing tolerance and palatability

a) Unpalatable (or toxic), rarely grazed

b) Will persist under heavy continuous grazing due to plant structure or has limited palatability

c) Tolerant of grazing as, in general, only young growth (annuals) or young re-growth (perennials) is grazed or plants are only occasionally browsed

d) Readily grazed during the wet season with some preferential grazing, during the dry season

e) Preferentially grazed at all growth stages; or has low tolerance to grazing and plants are easily killed. Plant numbers decline over successive years.

f) Don't know

Panic grass is a palatable species that is often preferentially grazed in mixed swards being readily eaten by all stock (Cook et al. 2005). In New South Wales Gatton panic is grown to provide feed over spring, summer and autumn (McDonald 2003). Once established and well anchored plants will tolerate rotational grazing all year round, but not heavy, continuous grazing without management (Cook et al. 2005, Global Invasive Species Database, Moore et al. 2006).

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

When well managed with some form of rotational grazing and with regular fertiliser applications individual panic grass plants can be long-lived (>10 years). Under favourable seasonal conditions seedling recruitment can occur to a re-invigorate a sward, but the seedlings are comparatively slow growing and very susceptible to competition and grazing when establishing. Panic grass is also shade tolerant and moderately drought tolerant.

However, panic grass is often preferentially grazed including by native animals and could be eaten out if grazing pressure is high or decline in number if soil fertility falls. In northern WA the low soil fertility of the soils will constrain spread and without ongoing management (controlled grazing, fertiliser) stands are likely to decline.

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

b) Medium risk – some plants will spread outside the planted area and successfully establish under favourable conditions

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.

d) No spread of sown species more than 1m outside the planted area

e) Don't know

Propagation is by seed, as generally there is no vegetative reproduction. Wind disperses seed short distances. Individual plants can tiller profusely, but the tillers must be manually planted to spread this way (www.fao.org). Panic grass spreads slowly by seed and needs fertile soils to become dominant (Global Invasive Species Database). Seedlings germinate readily near the parent plant under favourable seasonal conditions providing there is bare ground and little competition.

Panic grass is reported as naturalised (Randall 2017) in some parts of Australia and is found in several disturbed sites in the Kimberley (Hussey *et al.* 2007). It is reported as a weed of the environment and of agricultural systems. It can survive fires to become dominant after a fire (Global Invasive Species Database 2017, D'Antonio and Vitousek 1992, Cook et al. 2005). Tropical forages Database (Cook et al. 2005) report that it is a very effective coloniser in ungrazed or disturbed areas.

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

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

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

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

d) Establishment, growth and reproduction unlikely in low-nutrient soils without soil additives

e) Don't know

Most references say panic grass is a high fertility species (FAO; Tropical Forages- Cook et al. 2005; Moore et al. 2006; Global Invasive Species Database) e.g. fertiliser − add 20-40kg/ha P and 50kg/ha N on infertile soils when sowing (Cook *et al.* 2005). Additional N is required to prevent invasion by less desirable species and to maintain healthy stands (Cook et al. 2005). Other species become established once the initial pulse of soil fertility has declined (D'Antonio and Vitousek 1992). Panic grass does grow in fairly infertile sands in the northern agricultural region of WA (Moore et al. 2014), but requires higher fertility for optimum growth. An extensive root system provides moderate drought tolerance, but panic grass is intolerant of waterlogging.

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

a) Common

b) Occasional

c) Unlikely

d) Don't know

The seed has no structures to adhere to feet or feathers. Panic grass seed is eaten by birds, but there is no information that viable seed can excreted and be spread in this way. Not stated if seeds are digested, excreted or used for nesting material (PIER 2010; Oudtshoorn 1999). The seeds are very small (florets 2.5-5mm, seeds 0.25mm, approx. 1.7-2.2 million seeds/ha). A study of dispersal of grass species in Botswana found no evidence of animal or bird dispersal of this species. The inflorescence dropped their seeds when touched by small seed-eating birds, but no transport was observed (Ernst *et al*. 1992).

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

The very small seed (0.25mm) has no structures to adhere to fur or hair. However, in suitable conditions the seed might be carried in mud on hooves or the feet of grazing animals. A study in Botswana found no evidence of spread by animals (Ernst *et al.* 1992). Dispersal may be possible since the seeds are small, and may lodge in hair or feet, but there was no data found to support this.

In a controlled experiment panic grass seed was placed directly into the rumens of cattle, but only 0.6% seeds of the fed seeds were excreted in the faeces and germinated (Gardener et al. 1993).

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

a) Common

b) Occasional

c) Unlikely

d) Don't know

Seed could be moved by surface water and could germinate once deposited, but there is no information that this forms a significant dispersal pathway. Water is not described as a dispersal agent by PIER, but is by Smith (2002). There are no specific adaptations for water dispersal and panic grass does not tolerate waterlogging, but it does grow along riverbanks (Cook et al. 2005). There are reports of it becoming established following flooding due to disturbance of the riverbank (Enviroweeds list server).

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

a) Common

b) Occasional

c) Unlikely

d) Don't know

The seed is very small (1.2 million/kg, Moore et al. 2006) and seed is readily shed from the seed head as it matures. The species is wind dispersed, but only short distances (Global Invasive Species Database, Anon 2017). A study from Botswana savannas showed seed dispersed a maximum of 8m at a wind velocity of 10m/s of tall *M. maximus* (1.4m), and only 3.4m for short panic grass plants 0.6m tall (Ernst et al. 1992).

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

a) Common

b) Occasional

c) Unlikely

d) Don't know

Seed could occasionally stick to vehicles in mud, particularly in pastures where vehicles would be used regularly. The species is naturalised in some parts of Australia including roadsides and could be spread via roadwork machinery, like road-graders. Smith (2002) considers this a likely means of dispersal.

8.2 How likely is long-distance dispersal (>100m) accidentally through the movement of produce or materials for infrastructure?

a) Common

b) Occasional

c) Unlikely

d) Don't know

Spread of the very small seed is reported in contaminated agricultural produce and movement of soil or gravel (Anon 2017). Smith (2002) record hay as a dispersal agent in the Northern Territory, although panic grass is not commonly cut for fodder production. PIER (2010) suggest it is likely because the seed is small, but the risk is reduced because panic grass seed is readily shed from maturing panicles.

9.1 What is the species' minimum generation time?

a) 1 year

b) 2-3 years

c) >3 years to never

d) Don't know

Under favourable conditions with good soil fertility and little competition, seedlings can establish and then grow rapidly to produce seed in the first year, but more usually in the second year.

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

a) High

b) Low

c) None

d) Don't know

Seeds profusely but seeds may be of low germination and do not survive long (Global Invasive Species Database 2017). Stone (2007) suggests that a medium estimate would be 12,000 seeds per m^2. Seed yields of 50-200kg/ha are reported in commercial seed crops depending on the method of seed harvesting (Cook et al. 2005).

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

Seeds freely, but seeds may be of low germination and do not survive long (Global Invasive Species Database 2017). Not noted as persistent in the soil, panic grass seed has a high level of post-harvest seed dormancy for 6-9 months (Moore pers.com), but seed viability under natural conditions is short-lived (www.hort.purdue; G. Calvert - Enviroweeds list server).

9.4 Can the species' reproduce vegetatively?

a) Yes – rapid

b) Yes – slow

c) No

d) Don't know

No vegetative reproduction (FAO; PIER 2010). Panic grass is a variable species and some genotypes are described as having short rhizomes, but the commercial varieties are tufted bunch grasses, so the general answer is No.

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 or would have little effect on the biodiversity or the appearance of natural ecosystems

e) Don't know

Panic grass could adversely affect biodiversity but this is likely only to be the case in riparian zones with fertile soils, but due to the importance of these areas in the WA Rangelands (answer (b) has been selected.

Panic grass is not expected to invade native bushland at high density in northern WA due to the inherently low soil fertility and the grasses being much more palatable than the native vegetation. Therefore, at a low density, the species will not significantly reduce biodiversity in these regions. It could have some visual impact, being a multi-tillered bunch grasses with some Guinea grasses reaching over 2-3m in height, so the medium to tall panic grass plants could be conspicuous where naturalised or invading. The short panic grasses would be less conspicuous because they are a similar height to the native grass under-storey.

The tall variety has the potential to out-compete native vegetation (John Hosking – source Stone 2007), and in grasslands on fertile soils (Global Invasive species database 2017) - most likely in tropical or subtropical regions where the grass is not killed by winter frosts. Is a weed in Queensland, where it can also change fire regime (tropical savannahs). Visual and biodiversity impacts are high in Queensland where open and lightly shaded areas are invaded, and large fire loads created. Larger streams are also invaded, and seeds germinate following disturbance such as flooding.

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 out-competing seedlings, and/or the species forms a monoculture over a large area

b) The species can inhibit the establishment of other plants and may 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

Panic grass can form monocultures in an experimental plot under irrigation with good management, but is unlikely to do so in native vegetation in northern Australia. The results from the field nursery trials show that panic grass is only moderately competitive with many panic grass plots being invaded by native plants and/or more vigorous exotic grasses over time (G. Moore unpublished data). It is considered a sub-climax species in arid conditions – second phase in succession and a climax grass in nutrient, moisture rich conditions (Guide to grasses in South Africa).

However, established panic grass plants can rapidly re-sprout after fire and can become dominant and prevent the re-establishment of native species (Global Invasive Species Database, PIER 2010; D'Antonio and Vitousek 1992).

3. Could the species alter the structure of 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

Panic grass varieties are multi-tillered and some varieties can reach 2-3m in height so that plants could be conspicuous, but likely to be at a low density. The increased fuel load and rapid regeneration of plants after fire could alter the structure of some native ecosystems particularly on areas of fertile soil along creek-lines and in low lying moisture gaining sites not subject to waterlogging. The 'short' panic grasses would not add a new strata as most vegetation systems in northern WA have a perennial grass layer of similar height.

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

Panic grass varieties do not have spines, burrs or thorns to restrict movement. Some varieties of panic grass can form tussocks to 3m with optimum growth and could become dense stands

in the tropical north of Australia. However there is little information suggesting the development of dense monocultures that would significantly restrict physical movement in Rangeland areas with infertile soils and highly seasonal rainfall.

5. Does the species have, or show the potential to have, a major effect on fire regime?

a) Major effect on frequency and/or fire intensity

b) Moderate effect on frequency or fire intensity

c) No effect

d) Don't know

A build-up of material if the plants are not grazed or harvested can significantly add to the fuel load encouraging a hot fire which may be detrimental to native species. The plants shade tolerance and drought tolerance may also add to the fuel load as growth continues in shade and in a drying climate. The underground rhizome means the panic grass plants can often survive fire and re-grow more rapidly than native species, becoming a dominant species after fire (Global Invasive Species Database 2017). Panic grass can have a deleterious impact on fire regimes and native vegetation (Grice and Slater 1996).

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

Panic grasses do not have spines, burrs or thorns to impact native flora or fauna and are usually highly palatable and often preferentially grazed. However, panic grass can contain saponins, although a survey of commercial paddocks showed only 3 samples out of ~100 panic grass samples above the threshold (Moore unpublished data). At high levels saponins can cause secondary photosensitisation in ruminants.

Panic grasses also can have low to moderate levels of oxalate which can result in 'big head' in horses and occasionally nephrosis and hypocalcaemia in ruminants (Moore *et al.* 2006; Jones and Ford 1972). The ratio of total oxalate to calcium may also mean that the calcium is unavailable to non-ruminant grazers causing big head in horses.

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

a) Yes – more than the native vegetation provides

b) No – similar or less shelter than the native vegetation

c) Don't know

In certain situations panic grass can provide more food or shelter than the native vegetation, for example – fertile soils in riparian zones where moisture is non-limiting.

In general, food sources for native fauna would not be out-competed and reduced. Some birds may eat the seed and therefore provide a new food source (PIER 2010). Panic grass is unlikely to provide greater food or shelter than what is currently available to native and feral animals in natural vegetation. Any increase in feed is likely to be a short-term effect as it is more palatable than the native grasses and any uncontrolled preferential grazing would negatively impact on growth and probably persistence.

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

Panic grass varieties have been selected to grow on a range of soils, but most prefer medium-textured, well drained soils. However, they are a high fertility species and require fertile soils for optimum growth and as a result may deplete soil fertility in a native ecosystem if not managed.

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

Panic grass is reported to grow in riparian areas (Global Invasive Species Database 2017) and some varieties are tolerant of short-term flooding by moving water (Anon 2016), although panic grass is generally considered intolerant of waterlogging (Moore et al. 2006; Cook et al. 2005). May have some effect on water quality or flow in high rainfall environments.

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

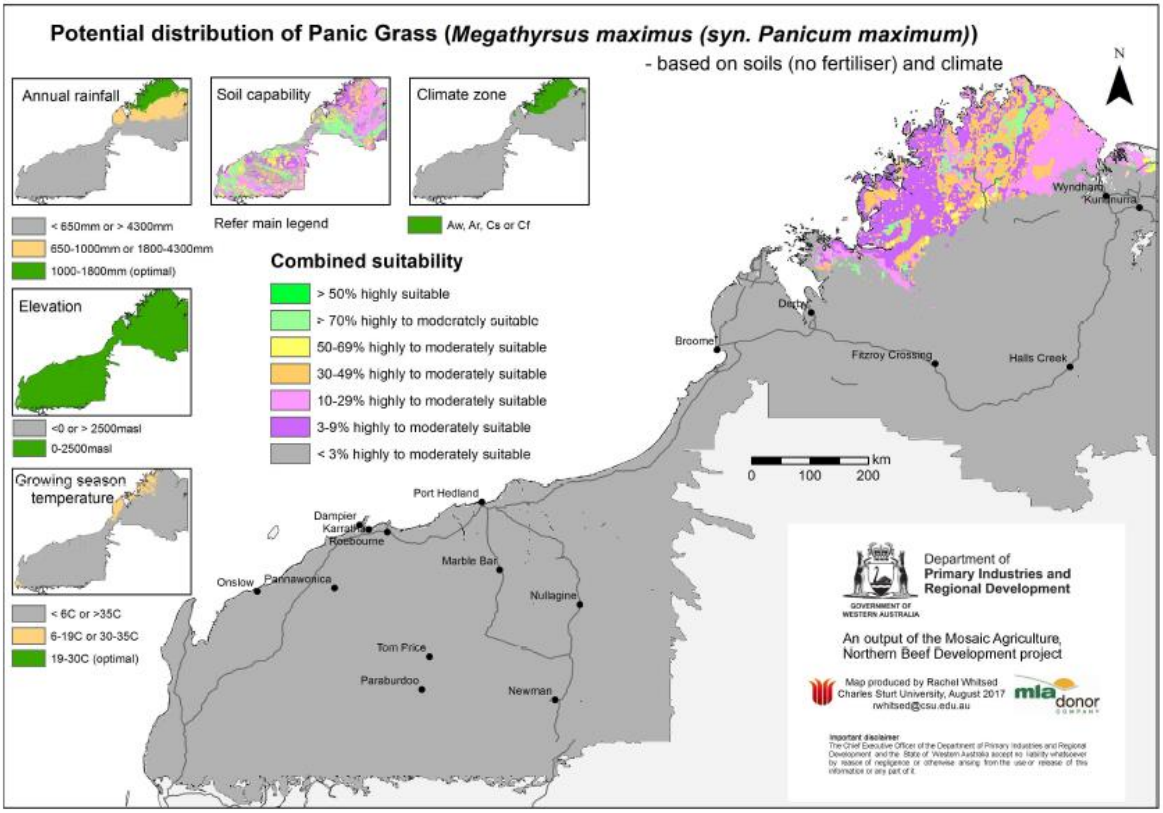
a) Yes – can significantly lower the watertable and/or reduce groundwater recharge to the watertable

b) No – will have little or no impact on hydrology

c) Don't know

Once established, panic plants may have a mat of roots, but these do not penetrate deeper than most of the native vegetation in the rangelands and are unlikely to deplete the watertable more than the native vegetation.

Potential distribution



Region	Area of suitable soils and climate	Potential distribution score
Kimberley (>650mm AAR)	1.7Mha	4.0
Kimberley (<650mm AAR)	0	0.5
Pilbara	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)

Region	WRA calculation*	Overall score	WRA rating
Kimberley (>650mm AAR)	5.0 x 6.0 x 4.0	**120.0**	**High**
Kimberley (<650mm AAR)	5.0 x 6.0 x 0.5	**15.0**	**Negligible to low**
Pilbara	5.0 x 6.0 x 0.5	**15.0**	**Negligible to low**
Gascoyne – Goldfields	5.0 x 6.0 x 0.5	**15.0**	**Negligible to low**

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

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Important disclaimer