



Grader Grass management guide

Grader grass (*Themeda quadrivalvis*)

Problem

Grader grass is an undesirable species in grazing and conservation areas of Australia. It can invade both native and improved pastures and, due to its low palatability, greatly reduce animal productivity if it becomes the dominant species. It can also significantly reduce biodiversity in conservation areas by replacing native ground covers. Grader grass is an opportunistic invader which when established competes strongly with existing and establishing perennial grass tussocks, particularly in over grazed and degraded pastures and disturbed areas.

Because it is generally ungrazed grader grass can generate large fuel loads increasing the risk of wild fires. In the tropical savannas this potentially increases the frequency and intensity of dry season fires resulting in increased tree death and loss of species. These impacts on

ecosystems are often long-term or irreversible.

The Weed

Grader grass is an erect tufted grass that grows to more than 2m in height. As the plant matures it turns a

distinctive orange-red or golden colour. It has robust, cane-like stems with long complex seed heads. The height and robustness of grader grass plants is rainfall and fertility dependent and during a poor wet season plants can

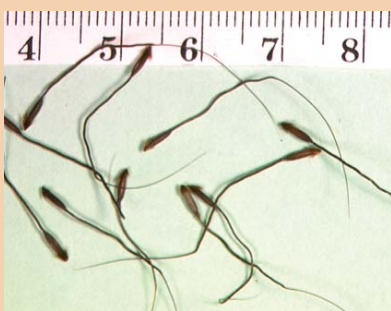


Top: Mature grader grass (2m high) April 2008 following a good wet season.
Bottom: Mature grader grass (0.5m high) April 2007 following a poor wet season.
Photos: Wayne Vogler, Qld DPI&F.



grow as little as 40cm high. Typically land managers could expect to see grader grass plants growing to 1 – 1.5m in an average wet season. In the seasonally dry tropics grader grass usually behaves as an annual although it may also survive as a short-lived perennial under moist conditions where frost does not occur.

The grass is able to grow rapidly, sometimes reaching more than 2m in height



Grader grass seed.
Photo: Wayne Vogler, QLD DPI&F.

within 6-8 weeks and yielding more than 5000 kg/ha after one growing season. Seed heads generally appear between February and June in Australia but may occur

outside of this period depending on climatic conditions such as timing and duration of rainfall. Seed heads can appear within 5-6 weeks of germination, with mature seed being present after 10 weeks.

Grader grass is a prolific seeder with as many as 1000 seeds being produced in one seed head under ideal conditions. Soil seed banks can contain up to 20 000 seeds per square metre under dense infestations following the growing season. These seed banks can decline rapidly. Within 15 to 18 months, the viability of seed at or near the soil surface is almost zero. However, 30% of seed buried at 5cm or seed in well grassed areas remains viable after 18 months. Disturbance (such as grading fire breaks or tracks) can expose this seed to favourable conditions for germination causing areas that appear free of grader grass to become reinfested.

This rapid decline in the soil

seed bank indicates that grader grass relies on frequent seed input rather than persistent soil seed banks for long-term survival. It also indicates that management of the seed bank (reducing seed input and seedling establishment) is critical to the long term success of grader grass management.

Fresh grader grass seed tends to be dormant, i.e. seed is healthy but not inclined to germinate even in ideal conditions. The dormancy of grader grass seed declines from 60% at two months after maturity to less than 10% at eight months after maturity. In tropical Australia this ensures that high levels of germinable seed are available when the first rains of the wet season occur between October and January.

In northern Australia, mass germination and emergence (up to 90% of the viable seed bank) follow within 3-4 days of sufficient rainfall. This is faster than most common grasses in this region enabling grader grass to compete effectively and establish before other germinating seeds emerge from the soil.

Seed can germinate throughout the year as long as temperature, light and moisture conditions are suitable. Seeds germinate best under high light conditions at temperatures between 20 and 30°C. Seed will germinate in darkness (buried) and at temperatures outside this range if sufficient moisture is present. Smoke does not appear to stimulate germination.



Mass Grader Grass seedling emergence following a single rainfall event in Dec 2006.
Photo: Wayne Vogler, QLD DPI&F



Top left: Grader grass seed head (*Themeda quadrivalvis*) - spikelets are 4-7mm long. Top right: Kangaroo grass (*Themeda triandra*) - spikelets are 8-14mm long. Bottom left: Grader grass seed head. Bottom right: Kangaroo grass seed head.

Photos: Wayne Vogler, QLD DPI&F.

Look-a-like Grasses

Grader grass is similar in appearance to the native perennial kangaroo grass (*Themeda triandra*). Kangaroo grass is generally smaller (usually growing to about 1m in height) and has a brown rather than golden appearance when mature. The two species are most reliably distinguished by the size of the spikelets and the nature of the hairs on their seed heads. Grader grass has smaller spikelets (4-7mm long) and conspicuous, tubercle-based hairs (distinct, bulbous-based bristles) on the seed head, while kangaroo grass spikelets are 8-14mm long and are either hairless or with fine hairs and only a slightly bulbous base.

Where it Grows

Geographical distribution

Grader grass is native to India, but also occurs

nowadays in Thailand, Indonesia, Papua New Guinea, China, the Middle East and tropical America. It has also been recorded in California, Florida, Kansas and Louisiana, USA. In Australia, grader grass was first recorded in North Queensland in the early 1900s and has since spread to most of Queensland's east coast, New South Wales, the north of the Northern Territory and Western Australia. Grader grass continues to spread and has not reached the limit of its climatic range.

Climate

Grader grass is well adapted to the seasonally dry tropics but will grow anywhere that has a warm moist growing season. In its native range in India, grader grass grows best in areas receiving between 500 and 1250mm of rainfall annually, although it grows in areas receiving as little as 375mm. Grader grass can also grow where average annual rainfall is up

to 3200mm if soils are well drained. This adaptation to a wide range of moisture regimes is evident in its current Australian distribution where average annual rainfall ranges from about 450mm in inland regions to more than 2000mm on the north-eastern tropical coast.

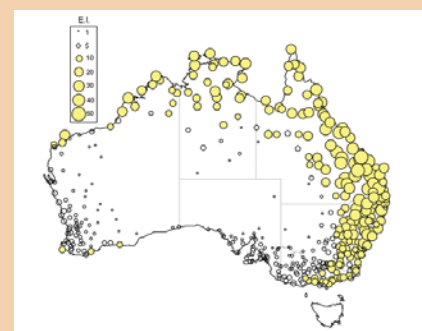
Soil and disturbance

Grader grass will grow on any soil type but grows particularly well on cracking clay soils. These soils hold moisture well and their cracking nature allows grader grass seeds to easily bury themselves at a shallow depth, ideal for germination and emergence.

Grader grass prefers disturbed areas such as drainage lines, fire breaks, tracks and roadsides, degraded and/or heavily grazed pastures, frequently burnt areas, slashed areas and around cattle camps and watering points. These areas provide entry points



Current distribution of grader grass (*Themeda quadrivalvis*) in Australia, as determined from database records of the species (Source: Queensland, New South Wales, and Northern Territory Herbariums, and Australian Virtual Herbarium: <http://www.chah.gov.au/avh>).



Potential distribution of grader grass (*Themeda quadrivalvis*) in Australia based on modelling with CLIMEX software. The size of each dot corresponds to the Ecoclimatic Index (EI) value for that location, representing the suitability of the climate for the persistence of grader grass. Areas with EI values of less than 10 (shown as unfilled circles) are considered only marginally suitable, while those over 30 represent a very favourable climate.

Source: Keir, A.F. and Vogler, W.D. 2006. A review of current knowledge of the weedy species *Themeda quadrivalvis* (grader grass). *Tropical Grasslands* 40: 193-201.

for invasion into the wider landscape. Minimisation of disturbance will reduce the risk of grader grass invasion.

How it is Spread

Grader grass seeds are not adapted for dispersal by wind or water. Most seeds will fall within a few metres of the parent plant, although fast flowing water within gullies, creeks and rivers can move seed considerable distances.

Most long distance seed transport is by humans and animals. Seed may be on fur or clothing, in soil moved by graders, mud stuck to animals or machinery, plant material on slashers, or as a contaminant in pasture seed or hay. Weed seed hygiene protocols will need to be implemented to minimise the risk of seed spread.

Management

Any management strategy for annual weeds must suppress seedling establishment and stop seeding to minimise repeated seed input into the system.

Denuding the soil encourages grader grass germination and establishment, while maintaining competitive grasses and other ground cover species reduces grader grass density. Therefore, where grader grass is present, management practices that expose soil, such as overgrazing, burning, soil disturbance, short slashing or using non-specific herbicides, should be minimised. Where grader

Weed Hygiene – An effective way of reducing weed seed spread

With any movement of livestock, fodder, vehicles or machinery both within and between properties, there is a risk of spreading weed seed from infested to clean areas. Since grader grass seed is not easily dispersed by natural means, good hygiene practices, such as driving on weed-free tracks only, cleaning vehicles and machinery and ensuring hay, pasture seed and stock are uncontaminated before moving will significantly reduce the risk of grader grass spread. The development and implementation of a property weed hygiene plan will assist land managers to manage their weed issues and prevent new introductions.

Key points for inclusion in a weed hygiene plan:

- Ensure contaminated vehicles are cleaned before coming on to your property or moving from weed-infested to weed free areas. Put extra effort in controlling weeds growing in areas likely to be driven such as roads and tracks. Don't drive through known weed infestations unless absolutely necessary and at times when no seed is present on the plants. Always clean the vehicle, inside, outside and underneath, as soon as possible afterwards.



Photo: John Clarkson, Qld Parks and Wildlife.

- Livestock carry seed in their gut and on their coats. If stock are moved from infested to weed free areas, confine them for up to five days in an area that can be monitored and easily treated. This will allow most weed seed to pass through and fall from the coats of the animal. This is particularly important when the background of new livestock is unknown.
- Buy hay and certified pasture seed from reputable producers. This reduces the risk of contamination with weed seeds. Monitor sites where hay has been fed for any weed germination.

grass is not present, keeping disturbance to a minimum will reduce the risk of grader grass establishing.

Pasture management

Land in good condition, dominated by vigorous perennial pastures, will provide maximum competition and minimise the area of exposed soil.

Wet season spelling and avoiding over grazing will assist in maintaining pastures in good condition. This will help prevent invasion by suppressing grader grass seed germination. In contrast, where grader grass is present, exposing the soil surface by burning, slashing and over grazing before the wet season encourages germination of grader grass. Grader grass biomass in native pastures in the Mt Surprise area (north Queensland) decreased from 70% to 20% following two years of spelling, indicating the benefits of increasing competition and minimising disturbance in managing grader grass.

Careful pasture management to maintain adequate cover is especially important in areas of low rainfall due to the generally sparse vegetation. Managing vegetation cover during times of drought is also important so that when rainfall occurs grader grass seedling establishment is suppressed.

Grasses such as the exotic Indian couch (Indian blue grass - *Bothriochloa pertusa*) are known to compete strongly with grader grass and may be

useful in managing grader grass under certain conditions. However Indian couch is a lower quality grass and can out-compete other perennial native grasses. It can also form monocultures which reduce biodiversity and lower grazing animal productivity.

Grazing

Cattle will graze young grader grass plants. The quality (crude protein and digestibility) of these plants is generally above that of young native grasses and some introduced grasses. However, as grader grass matures and becomes stalky, the quality declines. Mature plants are generally unpalatable to livestock though the quality is similar

to that of other mature grasses.

A grazing strategy of heavy short duration (crash) grazing of young palatable grader grass infestations will reduce the overall height of grader grass when it matures. Other perennial grasses may then be more competitive throughout the growing season. Some graziers have used mature grader grass as roughage when feeding supplements during the dry season. However, though these grazing strategies may offer some production/economic benefit in situations where other management or control options are not economic or feasible, they should be used with caution. The removal of cover suits

Grader Grass quality compared to other native and exotic grasses in the Mt Surprise area of Northern Queensland on red basalt soils 2006-2007.

Species	Crude protein % of whole plant			
	Early Wet Season: Pre Stem	Mid Wet Season: Pre Seed	End Wet Season: Mature	Late Dry Season
Pitted blue grass	9.8	8.6	4	0.9
Black spear grass	8.9	4.8	2.5	1.9
Aristida species	6.9	7.6	4.5	2.3
Grader grass	12.4	6.4	3.4	1.4
Kangaroo grass	9.1	6.9	3	2.5
Indian couch	10.1	7.6	3.4	1.4
Urochloa	13.4	9	4.6	0.2
Qld blue grass	5.9	6.1	2.4	1.7
Digestible dry matter % of whole plant				
Pitted blue grass	54.9	49.3	45	46.4
Black spear grass	54.4	44	48	49.3
Aristida species	49.6	49.1	50.3	47.3
Grader grass	58	48.2	54.5	44.3
Kangaroo grass	56.4	46	49.7	46.3
Indian couch	52.7	55.2	50.1	45.2
Urochloa	62.3	46.2	50.2	49.8
Qld blue grass	57.7	48	48.7	46.4

Pre stem: fresh green shoots with minimal stem elongation.

Pre seed: stems elongated no seed head visible. Mature: plants in full seed

Source: Wayne Vogler, QLD DPI&F.

grader grass germination and establishment. Thus an existing grader grass problem may be exacerbated.

Fire

In northern Australia, property management often includes the use of fire as one tool for maintaining pasture species composition and quality, controlling woody weeds and reducing future fire hazards. Fire however removes vegetative cover providing an ideal environment for the

establishment of grader grass seedlings. Frequent burning of pastures with grader grass present will significantly increase the grader grass component.

Where fire is used for land management purposes, burning grader grass infested areas should be avoided if possible or at least limited to no more than once every five years. Any increase in the grader grass population due to the fire can then be suppressed by good pasture management following the fire.

Following burning, pastures should not be grazed until they have recovered and preferably seeded. This will help pastures remain healthy and provide high levels of competition with any grader grass seedlings. Future grazing should be managed to maintain a competitive pasture with high levels of vegetation cover.

Slashing

Slashing to prevent seed set is often a useful control method for annual plants. Slashing at full flowering prior to seed set eliminates seed production. However, timing such a cut before seed is produced is difficult to achieve in practice due to weather considerations, access and the short treatment window of approximately 1-2 weeks following seed head appearance. Slashed plants can produce new seed heads if significant soil moisture is present at slashing or if rainfall occurs soon after slashing. Slashing is a control option for small infestations that are easily accessible but is not practical for large infestations.

Chemical control

Herbicides currently registered for control of grader grass in pastures, along roadsides and fire breaks and around infrastructure are limited to glyphosate and paraquat. An agronomist/product labels should be consulted for recommended application rates for their situation.

Control, using herbicide, of established grader grass



Top: Native pasture spelled for two wet seasons resulting in significantly lower grader grass biomass. Bottom: Native pasture heavily infested with grader grass following frequent burning. Photos: Wayne Vogler, QLD DPI&F.

infestations must be employed before seed set in order to prevent re-establishment the following year. Glyphosate gives effective control. However, as it is non-selective, its use should be limited to areas where grader grass is the only remaining grass, areas being prepared for the sowing of alternative pasture species or along roadsides, fire breaks and other high disturbance areas. If sown pastures are to be established, seed should be sown soon after such spraying to enable it to compete with the next crop of grader grass seedlings. Glyphosate can be applied as an overall spray using a boom spray, as a spot-spray or with a rope-wick applicator if grader grass is growing at least 25cm above the pasture height.

Paraquat has also been used successfully on both seedlings and mature plants. In pastures, paraquat will damage both grader grass and other species, but perennial grasses will usually have enough root reserves to regenerate. Plants should be sprayed while still young (<30cm high) for best results. Larger plants will require higher rates of paraquat, may require repeated sprayings and they should be sprayed within one week of seed head appearance to avoid viable seed production. Grader grass biomass in native pastures in the Mt Surprise area (north Queensland) decreased from 70% to 20% following two consecutive years of applying Gramoxone (paraquat) prior to seed set. Users of paraquat need to

ensure that the correct protective equipment is used when handling and applying it to ensure there is little risk to personal safety.

Isolated Infestations

Controlling small isolated infestations must be a priority for land managers. A concerted effort to control these infestations is the most effective way of stopping further spread and the establishment of large infestations. This is especially important along transport corridors and

property roads and tracks as these areas provide ready points from which invasion can occur.

For isolated outbreaks or small infestations, implement spot spraying, hand pulling or other manual control methods before grader grass sets seed. Follow-up inspections and control for several years are critical to achieving success. Minimise disturbance and allow competition from other pasture species to help prevent reinfestation.



Top: Native pasture sprayed annually for two years with paraquat prior to seed set resulting in reduced grader grass biomass. Bottom: Native pasture cut before stem elongation to simulate one crash graze in two consecutive years resulting in continued heavy grader grass infestation.

Photos: Wayne Vogler, QLD DPI&F.



Large Infestations

Reducing the grader grass population in large, dense infestations and gaining some production / biodiversity benefits is a real challenge. The limited management options available are largely determined by external factors (e.g. terrain, accessibility, resources). A long term commitment is needed for the management of these infestations with the expectation of slow reductions in the grader grass population.

Herbicide control of large, dense infestations is often not cost effective or practical due to limited accessibility (trees, terrain), limited potential productivity increases or limited resource availability. In these cases, strategies such as pasture spelling and moderate grazing pressure will minimise soil disturbance and enhance existing

pasture competitiveness. These strategies maintain high levels of ground cover assisting in the suppression of grader grass seedling emergence and provide strong competition for any established plants.

A program of long term spelling (no disturbance for a minimum of 2 years) on a rotational basis across these large infestations may provide a way of regaining some grazing animal production while slowly reducing grader grass populations to manageable levels. Using weed hygiene strategies will also limit spread.

Where land values and/or potential production/ economic gains are significant, active management of grader grass using herbicides should be considered. Herbicides can reduce populations to a level where good pasture management

practice will keep populations at a low level or be a precursor to the establishment of improved pasture species or other land development.

Follow-up

Whatever management approach is taken the need for follow-up is critical in the success of any weed management process. Without the commitment to follow-up control any weed management project will ultimately end in failure and waste valuable resources. However with persistence and careful management the impact of grader grass can be reduced to manageable levels.

Acknowledgements:

Wayne Vogler, Senior Weed Scientist, Biosecurity Qld, DPI&F, Tropical Weeds Research Centre.

Thanks to QPWS, NRW Fire Management Unit North Region, Alan Smith formerly Etheridge Shire Council and S & K Keough for providing in-kind funding.



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