Grader grass (*Themeda quadrivalvis*): changing savannah ecosystems

Wayne D. Vogler and Nikki A. Owen
Biosecurity Queensland, Department of Primary Industries and Fisheries, Tropical Weeds Research Centre, PO Box 187, Charters Towers, Queensland 4820, Australia
Email: wayne.vogler@dpi.qld.gov.au

Summary Grader grass (*Themeda quadrivalvis*) is an invasive exotic high biomass grass that is increasing its distribution in northern Australia. It is of concern because of its unpalatable nature and potential to dominate ecosystems in which it grows, thereby decreasing grazing animal production, degrading conservation areas and increasing fire intensity and hazard.

A study to determine aspects of the biology of grader grass, including its response to fire, has been established in north Queensland. At one of the field sites (Lynwater Station) the initial biomass of the grass layer consisted of 70% grader grass. It also produced 80% of the seed input into this ecosystem during the first growing season of this study (2006–2007). These factors, in combination with a large viable seed bank and rapid germination at the start of the wet season, demonstrate the potential of grader grass to dominate and degrade the savannah ecosystems of northern Australia.

Keywords Grader grass, *Themeda quadrivalvis*, weed, invasive, fire, biology, tropical, savannah.

INTRODUCTION

Grader grass (*Themeda quadrivalvis* (L.) Kuntze) is an invasive exotic grass that is increasing its distribution in northern Australia. It is an annual native to India, where it grows well in high rainfall monsoonal climates. In Australia, grader grass typically grows well in higher rainfall areas of the savannahs and coastal regions of northern Australia. It has also been recorded in cooler climates near Sydney, New South Wales and the semi-arid 400 mm rainfall areas of western Queensland.

Grader grass is a high biomass grass of concern in northern Australia due to its potential to change the biodiversity of the landscape where it grows. It is unpalatable and is capable of forming dense monocultures that decrease grazing animal production, degrade conservation areas and increase fire intensity and hazard. Grader grass is declared in the Northern Territory (Miller 2003) and in several Shires in North Queensland.

A study to determine aspects of the biology of grader grass, including response to fire, has been established on Lynwater Station, approximately 120 km south-west of Mt Garnet (18.48893889°S, 144.50630128°E) in North Queensland. This paper describes some of the initial results from biology studies being undertaken as part of a larger long term project to develop improved management strategies for this species.

MATERIALS AND METHODS

A randomised complete block experiment to test the response of grader grass to fire and various cutting and herbicide treatments was established in a dense grader grass infestation on Lynwater Station during September 2006. Twelve treatments replicated three times were applied in 15 × 15 m plots separated by 10 m slashed breaks during the period following site establishment. As part of the establishment process the botanical composition of the vegetation in the grass layer was assessed in 40 50 × 50 cm quadrats in each plot using the BOTANAL method (Tothill *et al.* 1992).

Initial grader grass seed banks were assessed in each plot by systematically collecting and bulking 60 5 cm diameter × 5 cm deep soil cores prior to treatment application. Samples were taken in September 2006 to allow sufficient time for seeds to drop to the ground from parent plants, but prior to commencement of the wet season. The number of viable grader grass seeds in the seed bank was determined by spreading the soil collected from each plot to no more than 2 cm deep in five 31 × 29 cm germination trays and watering twice daily for three six week periods. At the end of each wet period, emerged seedlings were counted and removed and the soil was dried and stirred prior to re-wetting (Orr *et al.* 1996). Following the completion of the third period of germination, any remaining grader grass seed was extracted from the soil from five randomly selected germination trays. This seed was then viability tested using tetrazolium (Moore 1985) to determine the effectiveness of the method used for determining the viable seed bank of grader grass.

Seedling emergence in all field plots was recorded in early December 2006, one week following the first significant storm rainfall of the wet season. Grader grass seedlings were counted in two randomly located 50 × 50 cm quadrats in each plot.

Seed production in undisturbed grader grass infested areas was also determined during the 2006–2007 growing season by randomly placing ten 22 cm diameter seed traps in each control plot. The seed traps were emptied monthly, with the number of grader grass and non-grader grass seeds counted. The implications of these initial findings are discussed.

RESULTS

The average grass layer biomass across all plots was 3588 kg ha^{-1}, while grader grass biomass across all plots averaged 2541 kg ha^{-1}, equating to 70% of the total biomass of the grass layer. Black spear grass made up 10% of the total biomass with the remaining 20% consisting of more than 10 minor grass and herbaceous species.

The germination method used to estimate the viable soil seed bank of grader grass proved to be effective, with only 2% of the viable seed bank remaining ungerminated when the trial was completed. The initial viable soil seed bank of grader grass across all plots averaged 6700 seeds m^{-2}, with no seedlings of other species recorded, whether due to dormancy or simply a lack of significant numbers of seed.

Mass grader grass seedling emergence occurred within 3–4 days following a 50 mm rainfall event in early December 2006. This gave the landscape a lawn-like appearance between existing perennial grass tussocks. Estimated grader grass seedling emergence across all plots averaged 6100 seedlings m^{-2}, which was 91% of the viable seed bank. Grader grass seed production in the control plots during the 2006–2007 growing season was 12,000 seeds m^{-2}, with seed production of all other seeds being 2800 seeds m^{-2}.

DISCUSSION

These preliminary results demonstrate the potential of grader grass to dominate the grass layer in Australian savannah ecosystems. The high biomass of grader grass produced annually, combined with its unpalatable nature, indicate its potential to out-compete other more palatable perennial grasses in an ecosystem used for grazing animal production. It also indicates the potential for increased frequency and intensity of fire in an ecosystem where wildfires are common, thereby potentially adversely impacting on the native flora and fauna.

The rapid germination and emergence reported is consistent with that observed by McIvor and Howden (2000), where grader grass germinated faster than 18 other common species in the rangelands of North Queensland. This rapid mass germination at the start of the wet season is consistent with that reported by Parsons and Cuthbertson (2001) and provides extreme competition for establishing native grass seedlings. It is likely that this, combined with the more than 80% of seed input into this ecosystem by grader grass, will suppress the emergence and establishment of native grass seedlings, thereby reducing the regenerative ability and resilience of the native species in these savannah ecosystems.

It is likely therefore that once established, grader grass could dominate and significantly change the species composition, production potential and impact of fire on these ecosystems.

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