Longevity of blady grass (*Imperata cylindrica*) seeds

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Summary Blady grass (*Imperata cylindrica* (L.) P.Beauv.) is considered one of the 10 worst weeds globally. It has the ability to reproduce by seeds and by rhizomes, making management more difficult than if reproduction was through one method alone. Once established, it is a strong competitor for resources such as nutrients, water and light. The objective of this research was to determine the longevity of blady grass seeds in order to improve weed management. Seeds were purchased from a commercial seed supplier in May 2017, having been collected from an area near Coonabarabran in Western New South Wales (NSW) in 2015 and subsequently stored by the seed company at 10°C and 50% relative humidity. After purchase, seeds were stored at room temperature (~12–22°C) at the University of New England in Armidale, NSW. Germination testing on 16 June 2017 indicated a germination percentage of 89%. Seeds were then subsequently germinated under the same conditions on 7 November 2017 and the germination percentage had declined to 37%. This rapid decrease in germination rate during the nearly five months of storage at room temperature indicates that blady grass seed may be very short lived under field conditions in temperate areas of Australia as has been found elsewhere in the world and that sexual reproduction may play a less significant role in dispersal and establishment than plant rhizomes.

Keywords Rhizomes, germination, weed management.

INTRODUCTION

Blady grass (*Imperata cylindrica* (L.) P.Beauv.) is a problematic perennial weed which causes serious risks for cropping systems and uncultivated areas in more than 73 countries (MacDonald 2004, Mahdi 2012, Estrada and Flory 2015) across the tropics and sub-tropics and on all continents except Antarctica (MacDonald 2004). In many places it threatens both biodiversity and ecosystem structure (MacDonald 2004, Daneshgar and Jose 2009). Blady grass occurs in all Australian states (Richardson *et al*. 2011), and grows in a wide range of soils, particularly in poor soils with low pH (e.g. 4.7), low fertility and low organic matter (Wang 2008, Richardson *et al.* 2011). Blady grass reproduces sexually by seeds and vegetatively by a complex network of rhizomes that makes management difficult (Shilling 1997, Chikoye *et al.* 2002, MacDonald 2004, Wang 2008, Omezine and Skiri-Harzalla 2009). Individual plants of blady grass can produce new rhizomes with a yearly length ranging from 1.5–12 m, which is a significant factor for long term survival and for dispersal over short and long distances. The latter may occur due to movement of contaminated soil, equipment and machinery from a blady grass patch to a new location (Tominaga 2003, Omezine and Skiri-Harzalla 2009).

Rhizomes start development in blady grass between the third and fourth leaf stage and have the ability to conserve water, nutrients and resist breakage, disruption, drought and heat from fire (Holm *et al.* 1977, Tominaga 2003). Rhizomes are long, white, tough and scaly with prominent nodes and short internodes and have sharp apical ends that are able to penetrate the roots of neighbouring plants (Senkosi 2014, Zaccaro 2016). A single plant can produce over 3000 seeds, which are small, light and attached to a plume of silky white hairs that help them to travel by wind, animals and equipment over long distances (MacDonald 2004, Zaccaro 2016). Viable seeds are produced only by cross pollination and are reported to lose their viability in less than 12 months (Chikoye *et al.* 2002, Zaccaro 2016). Seeds have germination rates as high as 95% after harvest which means that they have no dormancy period (Chikoye *et al.* 2002). Blady grass invasions generally start when the seeds reach a new site and, after establishment, blady grass spreads asexually by rhizome development (Tominaga 2003). Flowering is highly variable depending on the region and environment and occurs in response to stress or human disturbance such as desiccation, burning, overgrazing, repeated slashing, mowing, frost or the addition of nitrogen (Chikoye *et al.* 2002, MacDonald 2004). There is limited information in both Australia and Iraq about the longevity of seeds of blady grass under different environmental conditions and so the aim of this study was to investigate the longevity under laboratory storage conditions.

MATERIALS AND METHODS

Two germination experiments were carried out in a controlled temperature room (25°C) under constant light (average light intensity was 36.6 µmol) at the University of New England in Armidale, New South Wales (NSW), Australia (latitude 30.515 S and longitude 151.665 E).

On each occasion 25 seeds were placed in each of four Petri-dishes lined with filter-paper and kept moist with rainwater. The seeds were purchased from the Nindethana Seed Service in Albany, Western Australia 6331, Australia and all seeds had been collected from one location near Coonabarabran in Western NSW in 2015.

The two germination tests were started on the 16 of June and 7 of November 2017 and lasted for 18 and 15 days respectively. During the intervening five months, the seeds were stored at room temperature (~12–22°C) in a laboratory.

Data analysis The experiments had a Completely Randomized Design. Non-linear regression was used to analyse cumulative germination for *I. cylindrica* over time. A Michaelis-Menten function was used,

$$y = (a \times x) / (b + x)$$

where y = cumulative germination, x = time (days), a = upper asymptote and b = time at the mid-point (a/2) (Thornley and Johnson 1990). Confidence bands were used to indicate the variability at the widths of one and two standard errors.

RESULTS

Most seeds of blady grass germinated in the first 4 days from the initiation of the first germination test (Figure 1). The germination percentage reached 29% on the first day of the test.

In the second test, there was no germination of seeds recorded in the first three days and most seeds of blady grass germinated from the 3rd to the 6th days (Figure 1).

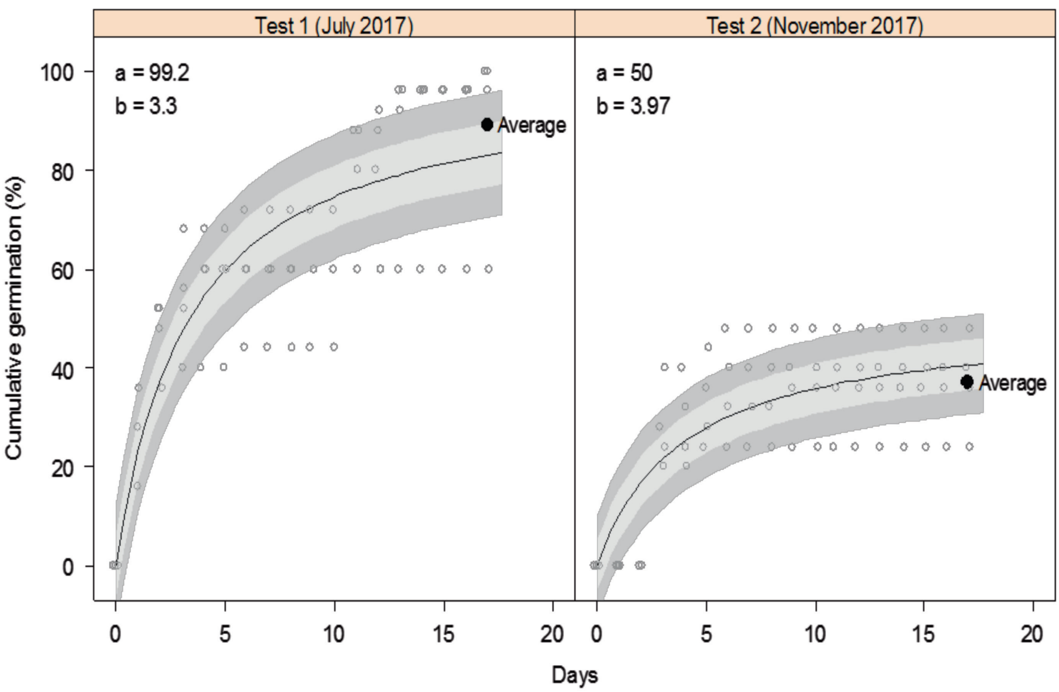

Figure 1. Cumulative germination of *Imperata cylindrica* (blady grass) over time for two test runs. Note: circles = raw data, solid line = fitted non-linear regression (Michaelis-Menten function), grey bands = 1 and 2 standard errors, a = upper asymptote, and b = mid-point in time.

The maximum cumulative germination was significantly different for the two tests (P=0.003), with averages of 89% and 37% for the first and second tests respectively (Figure 1). Non-linear regression confirmed that the maximum potential level of germination was significantly lower in the second test (a = 53% compared with 99% in the first test) and also indicated that the speed of germination was lower in the second test (b = 3.97 days compared with 3.30 days in the first test).

DISCUSSION

The seeds of blady grass initially had a high level of viability a few days after receipt from the supplier, germinating readily from the first day and reaching 89% germination after 16 days. However, after five months of storage at room temperature seed germination was down to 37%, having lost 52% viability. Shilling (1997) found similar results, and also that fresh seeds had no dormancy mechanism. Dickens and Moore (1974) also found that germination percentage decreased when seeds were stored at room temperatures. When the seeds were stored in cold conditions their viable period was extended. The seed company had stored their seed stocks in a cold room at 10°C and 50% relative humidity.

Dickens and Moore (1974) found that blady grass seed germinated at temperatures ranging from 25–35°C and that the optimal temperature was 25–30°C (Wilcut *et al.* 1988). Florescent light was used during the germination period in both germination tests and light had been previously shown to increase both the total germination and speed of germination (Dickens and Moore 1974). The rainwater used to water the Petri dishes in both germination tests had a pH of 6.0 and was considered suitable for germination and growth of blady grass (Bryson *et al.* 2010). Previous research also showed that seeds germinated and survived better in moist conditions than when seeds were overtopped with water (King and Grace 2000a, 2000b).

Despite their small size, light weight and ability to disperse by wind over long distances, seeds appear to have less of a role in the dispersal and invasion process than rhizomes (Estrada *et al.* 2016). Our results indicate that blady grass seeds are likely to be short lived under field conditions in temperate Australia.

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