# Is there a link between dieback in Mitchell grass across central-west Queensland and sown-pastures through eastern Queensland?

Stuart Buck[1], Nicholas Brazier[2], and David Phelps[3]

[1] Department of Agriculture and Fisheries, 25 Yeppoon Rd, Parkhurst, QLD 4701
stuart.buck@daf.qld.gov.au
[2] Department of Agriculture and Fisheries, 25 Yeppoon Rd, Parkhurst, QLD 4701
[3] Department of Agriculture and Fisheries, 10357 Landsborough Highway, Longreach, QLD 4730

**Abstract.**

In botanical communities such as trees, shrubs and grasses, the term 'dieback' has been used to describe unthrifty growth and premature death of plants. Depending on the plant community, multiple reasons for dieback have been reported. These include pathogenic diseases or organisms such as fungi and insects, soil compaction from vehicles, or abiotic stressors such as severe and prolonged water deficits. Dieback of native Mitchell grass pastures in central-west Queensland was first observed during the early 2000s. Research soon after indicated extended periods of below average rainfall in conjunction with high evaporation was the cause. No biotic stressors were reported at that time, nor since.

Dieback in sown pastures across eastern Queensland and Northern New South Wales, referred to as pasture dieback, has been observed since around 2015. While research into causes continues, the culprit is likely to be pathogenic organism(s), as opposed to environmental or managerial stressors. It's highly unlikely a direct causal link exists between dieback in Mitchell grasses across central-west Queensland and sown pastures in eastern Queensland. However, the solutions for both situations have similarities; pasture management practices utilised before, during and after dieback can influence the occurrence and recovery thereafter.

## Introduction

In botanical communities such as trees, shrubs and grasses, the term *dieback* has been used to describe unthrifty growth and premature death of plants. Dieback generally refers to the outcome of specific or multiple plant pathogenic organisms or diseases that cause death of above ground plant parts including leaves, stems and reproductive structures. However, dieback may or may not lead to the death of the entire plant including the root system. In Australia dieback is reported in a broad range of plant communities, some of which include: native (Phelps *et al.* 2007) and sown pastures (Makiela and Harrower 2008; Buck 2017); hardwood trees (Jurskis 2005); temperate legumes (Foster *et al.* 2017); mangroves (Accad *et al.* 2019); prickly acacia (Haque *et al.* 2012); and pandanus trees (Smith 1998).

Pathogenic organisms, i.e. biotic stressors such as fungi or insects, are purported as the cause of dieback for most of these examples. For others, environmental or abiotic stressors (typically heat and/or moisture stress) are stated as the main reason for plant death. It's evident that in all cases, environmental stressors, especially heat and moisture extremes, are either precursor triggers or on-going factors that contribute to poor plant health and eventual death.

This paper discusses if there is any link between dieback in Mitchell grass (*Astrebla sp.*) pastures across central-west Queensland and sown pastures (various sp.) in eastern Queensland by describing and contrasting the two situations. Both pasture systems are highly valued due to the number of livestock supported and the amount of animal product (meat and fibre) produced. The economic outcomes generated by these pasture systems

underpin many rural and regional communities and ultimately flow to support the Queensland and national economy.

## Dieback in Queensland pastures

*Mitchell grass pastures in central-west Queensland*
Mitchell grasses are long lived, productive, drought hardy native pasture species. They are adapted to the heavy cracking clay soils in central-west and north-west Queensland where rainfall is highly variable and droughts frequent. Mitchell grasses rely on a deep root system and an ability to enter a dormancy phase to survive prolonged dry periods (Phelps *et al.* 2007). They can respond quickly to complete the lifecycle once sufficient moisture is available. While Mitchell grass pastures are very adapted to the arid / semi-arid environments of Queensland, dieback and death of tussocks have occurred multiple times in recorded history (Phelps *et al.* 2007). The most recent significant event occurred during the millennium drought (early to late 2000's) and caused a considerable loss of grazing value across millions of hectares. Dieback in Mitchell grasses is characterised by a progressive or sudden death of tillers. Leaves are shed and stems turn grey / black. Stock avoid grazing the remaining plant material. While tillers end up dying, this doesn't necessarily mean the plant has fully succumbed. Crowns, rhizomes and roots can still remain alive which provides the ability of affected plants to recover (Phelps *et al.* 2007).

The major factors of dieback in Mitchell grass pastures are prolonged dry weather combined with high evaporation (Phelps *et al.* 2007). No pathogenic organisms, such as diseases or insects, are reported during multiple studies over the last 20 years or so (Phelps *et al* 2007; Phelps and Houston 2014). This research also suggests the duration of soil moisture levels below wilting point (soil water level below when plants cannot extract) is a critical factor for plant recovery, as is when drought relieving rains occur – early summer storms that can provide relieving moisture promote recovery compared to rainfall during cooler times of the year e.g. winter.

Management solutions for dieback in Mitchell grasses largely revolve around grazing management (Phelps and Houston 2014). First, pastures in good land condition with healthy plants prior to droughts have a greater ability to survive long dry periods and respond quickly once relieving rains occur. Grazing practices during the drought period, and once the drought has broken, are highly critical. Lowering pasture utilisation by destocking during the drought assists to maintain plant structure and ground cover. Continuing low pasture utilisation once the drought breaks until plants have refreshed and set seed is the next critical step. Soil-seed banks can be depleted in stands affected by dieback therefore pasture recovery can be accentuated by nurturing the remaining plants rather than relying on new plants to establish. Observations also indicate prolonged continued grazing pressure, even at low utilisation, can have a negative impact. Wet season spelling, high utilisation for a short period during the dry season, and strategic use of fire, can all have beneficial impacts (Phelps and Houston 2014).

*Sown pastures in eastern Queensland*
Improved pasture species are commonly sown across productive landscapes of eastern Queensland to boost livestock productivity. Generally, pastures are sown to grasses only, however tropical legumes such as leucaena (*Leucaena leucocephala subsp. glabrata*), desmanthus (*Desmanthus sp*.) and stylos (*Stylosanthes sp*.) are sometimes incorporated (Peck *et al.* 2011). While improving productivity, sown pastures need to be managed to ensure these improvements are maintained. Over time, biomass yield and quality of grass-only sown pastures can decline due to a condition called pasture rundown (which is the gradual tie-up of plant available nutrient supply, namely nitrogen, in organic matter) (Graham

*et al.* 1981; Peck *et al.* 2011). Recently, dieback in sown pastures has re-emerged. Since about 2015 highly productive improved grass species across eastern Queensland are being affected by a condition where plant death occurs, initially in patches, then spreading across paddocks (Buck 2017). Initially, the older leaves of affected plants discolour to yellow/orange and or red/purple. As the condition progresses, all leaves discolour, the plant stops growing and eventually dies, sometimes within one season. Dead plants decompose rapidly and are characterised with grey/black leaves and stems with poor soil anchorage. Stock completely avoid affected areas, rendering the pasture unproductive.

Dieback in sown pastures is not new; dieback in buffel grass (*Cenchrus ciliaris*) pastures in central Queensland was reported during the 1990 – 2000's (Graham and Conway 2000; Makiela and Harrower 2008), and a dieback like event was recorded in the mid 1920's at Cooroy in paspalum pasture (Summerville 1928). Recent research indicates this current dieback event in sown pastures is caused by pathogenic organisms, potentially a complex of insects, fungi and viruses (MLA 2021). Environmental conditions and management practices can also contribute. Dieback in sown pastures is generally more common in moderate-high biomass yield situations where pasture utilisation has been low-moderate (Buck 2021b). Many graziers have observed dieback occurring under fence-lines, or in infrequently grazed areas (e.g. lane ways or dam squares), or non-grazed locations (e.g. road-sides). Just about all tropical sown grass pasture species have been affected, however those that can produce high volume of dense plant material (e.g. *Bothriochloa insculpta*; creeping bluegrass cv. Bisset) seem to be more susceptible (Buck 2021a).

While the cause of dieback in sown pastures is espoused to be pathogenic organisms, directly targeting these for control is considered problematic (MLA 2021; Buck 2021d). Applying pesticides across extensive areas of pasture can be impractical, nor cost effective. Reducing pasture biomass through crash grazing, burning, slashing, or single pass cultivation, have resulted in mixed outcomes. Sowing resistant plants, such as legumes, or other forages, have demonstrated to be effective solutions to restore paddock productivity (MLA 2021; Buck 2021c). However some landscapes have features (e.g. trees, gullies) that restrict on-ground machinery movement so this option is better suited to cleared and arable landscapes. Dieback in sown pastures might ultimately be an on-going feature when managing pastures into the future across eastern Queensland.

**Is there a link between dieback in Mitchell grasses and dieback in sown pastures?**

The short answer is, highly unlikely. Research into dieback in Mitchell grass pastures suggests prolonged rainfall deficits and high evaporation (i.e. abiotic plant stressors) being the causes. In contrast, recent research into dieback of sown pastures indicate pathogenic organisms (i.e. biotic plant stressors) being the cause. In sown pastures the role of environmental conditions prior to and during dieback is still unclear; high temperatures, a lack of plant available water and nutrients for prolonged periods are likely factors, however more research is needed to understand how these might contribute to dieback.

The similarity between these two situations might occur with how they are managed. While environmental conditions are the major factors of Mitchell grass dieback, the severity of impact and the recovery of the pasture is determined mainly by grazing management during and after the dieback incidence. Strategic burning could also have a role. While dieback in sown pastures is likely caused by pathogenic organisms, pasture management during and after the dieback incident will influence speed of recovery. Most graziers are 'waiting it out', that is waiting for the pasture to naturally regenerate. However incorporating pasture budgeting by adjusting stock numbers to pasture production and strategic spelling accelerates recovery. A highly profitable alternative approach is to utilise the opportunity of reduced grass competition to sow perennial legumes – if not already present. These forages are highly persistent, productive and palatable, and can add valuable soil-nitrogen to boost

grass productivity. Perennial legumes might also have a place in the Mitchell grass pastures of central and north-west Queensland. One legume, *Desmanthus sp.* cv. Progardes, is being advocated as a persistent and productive forb which can add value to native pasture systems in central and north-west Queensland (Gardiner *et al.* 2013). It produces high quality forage that can boost livestock productivity, is hardy and can regenerate after periods of drought through high amounts of hard seed and doesn't have prickles.

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