Pasture dieback on the North Coast of New South Wales. 2. Symptom development and current recommendations

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Abstract: *Pasture dieback is a condition that kills summer growing grasses and was detected on the North Coast of NSW in March 2020. The condition has spread with about 3500 ha estimated to have been affected over the last 12 months and the area is continuing to increase rapidly during autumn 2021. This paper summarises symptom expression and development in NSW, findings from local demonstration activities and current management recommendations.*

Key words: pasture mealybug, *Heliococcus summervillei,* fertiliser, microbial products, biosecurity, productivity, legumes

Introduction

Pasture dieback (PD) is a condition affecting large areas of sown and native summer growing grass pasture in Queensland (Buck 2017; AgForce 2019) and more recently in New South Wales (NSW). Dieback-affected pastures experience a productivity decline and premature plant death. Livestock avoid grazing affected areas, making them unproductive (Buck 2017; Roberts 2017). There has been a significant spread of the condition throughout eastern Queensland since 2015. The area affected in Queensland is estimated to range from 200,000 to 4.4 million ha (AgForce 2019) with reductions in pasture production of 50% and carrying capacity of 35-40% (M. Vitelli, AgForce, pers. comm.).

Pasture dieback was confirmed in the Tweed Valley of NSW in March 2020. In the subsequent 12 months, the condition has spread south to Bangalow and west to Grevillia with an estimated 3500 ha affected. The affected area has continued to increase rapidly during autumn 2021. Pasture mealybug (*Heliococcus summervillei*), one of the insects under investigation was identified at dieback affected sites in NSW (Boschma *et al.* 2021) and work is continuing to understand its relationship with the condition. In this paper, we summarise the expression of the condition on the North Coast NSW, activities that have been conducted to maintain productive pastures for livestock, and current recommendations.

Susceptible species and condition progression

The tropical grass species commonly sown in NSW and Queensland are susceptible to PD, including several native species (Buck 2017, 2021). On the North Coast, we have noted that the first grasses affected in a paddock are usually broadleaf paspalum (*Paspalum mandiocanum*) and creeping bluegrass (*Bothriochloa insculpta*). Other species affected, in decreasing order of occurrence include: common paspalum *(P. dilatatum),* couch grass (*Cynodon dactylon*), kikuyu (*Pennisetum clandestinum*), bahia grass *(P. notatum),* Rhodes grass (*Chloris gayana*) and setaria (*Setaria sphacelata*).

Similar to reports in Queensland (Makiela 2008; Makiela and Harrower 2008), PD on the North Coast starts as circular-type patches. Often, we first observe symptoms under trees or tree belts on the sides of hills. The symptomatic area spreads from this location in all directions and does not appear to be associated with slope, aspect or wind direction. Occasionally, the spread will form a 'dieback line' and move across an area evenly, but more often the spread is by random patches that join to cover larger areas. Often, pastures on the sides of hills are severely affected. These soils are typically shallow with lower fertility [particularly low phosphorous (P), sulphur (S) and nitrogen (N)] and are highly acidic (pH_{Ca}<4.8) with high levels of exchangeable aluminum. Commonly, flats with deeper soils and better P (>50 mg/kg colwell P), S, N fertility are less affected and slower to succumb to the condition.

Pastures with high grass biomass (>5 t DM/ha) also appear to succumb more rapidly than pastures that are more frequently grazed with less standing biomass (~3 t DM/ha), irrespective of species. Monoculture grass pastures appear to be more severely affected and die faster than pastures with several grass species, possibly because species succumb to PD at different rates. The presence of legumes in a grass pasture can give an illusion of improved resilience as they are not affected by PD, but the grasses can still be affected and die. Symptomatic plants can stop at fence lines or a vehicle or stock track. Appearance of PD seems to be random and its presence in a district does not mean that all farms or pastures in the area are or will be affected. Several impacted properties have an immediate neighbour who is virtually unaffected.

Spread of the condition has caused rapid and dramatic loss of productivity for beef and dairy producers on the North Coast. Reductions in carrying capacity vary depending on the proportion of the farm affected. Producers have reported 50–75% reduction in carrying capacity. Some severely affected properties (>95% affected) have been destocked. Most affected producers have increased supplementary feeding and/or sown annual forages resulting in an increase in their cost of production to maintain some animal production.

Maintaining productivity by resowing pasture/forage species into dieback affected pastures

In late October 2020, we sowed two demonstrations at a site located at Nobbys Creek (23.306502°S, 153.346238°E), 7 km north-west of Murwillumbah, NSW in conjunction with a local beef producer group. The pasture was a mix of broadleaf paspalum, common paspalum, bahia grass, kikuyu and setaria that had died from PD by May 2020. Both demonstrations included ten tropical grasses (teff grass (*Eragrostis tef*; annual), kikuyu, signal grass (*Urochloa decumbens*), digit grass (*Digitaria eriantha*), creeping bluegrass, Bambatsi panic (*Panicum coloratum*), green and Gatton panics (*Megathyrsus maximus*), diploid and tetraploid Rhodes grass), six tropical legumes [burgundy bean (*Macroptilium bracteatum*), siratro (*M. atropurpureum*), glycine (*Neonotonia wightii*), round-leaf cassia (*Chamaecrista rotundifolia*), desmanthus (*Desmanthus* sp.), greenleaf desmodium (*Desmodium intortum*)], a tropical legume blend (siratro, round-leaf cassia, glycine), annual forage legume [cowpea (*Vigna unguiculata*)] and a pasture herb chicory (*Cichorium intybus*).

Each grass treatment was sown in a strip 24 m long x 2.4 m wide. We sowed the legume and herb strips perpendicular to the grass strips to enable each species to be in pure or mixed swards. Each demonstration was sown with the same treatments but different methods; one direct drilled and the other broadcast. The producer group decided several management options for the demonstrations including sowing rates, fertiliser application and weed control. All grasses were sown at 20 kg/ha equivalent except teff grass which was sown at 10 kg/ha. Legumes were sown at 8 kg/ha, cowpeas at 35 kg/ha and chicory at 8 kg/ha. Plots were sown with 150 kg/ha of forage starter (15% N, 7% P, 12% potassium (K), 10% S). No broadleaf weed control was conducted. The area was grazed in mid-February 2021, then 120 kg/ha di-ammonium phosphate (DAP; 18% N, 20.2% P, 1.5% S) applied, and an additional 100 kg/ha urea (45% N) applied in March. Good rainfall (85 mm) was received following sowing, then dry conditions for 7 weeks until mid-December when 220 mm fell. From mid-December 2020 to 1 April 2021, the site received 1241 mm of rain.

Most grass species germinated following the December rainfall event. Teff grass, signal grass, the panics, and both Rhodes grasses in the drilled demonstration area established successfully with >15 plants/m^2. Bambatsi panic, creeping bluegrass and digit grass established poorly (<5 plants/m^2) and kikuyu failed to establish. We noted some regeneration of the background pasture (average 4 plants/m^2) from the soil seed bank in the control strip (no pasture sown); the grasses were patchy, lacked vigour and had significant broadleaf weed invasion. Legume establishment was poor due to broadleaf weed competition. Siratro and round-leaf cassia were the only legumes that established achieving about 5 plants/m^2 in mixed swards and an average of 10 plants/m^2 in pure swards. Chicory germinated quickly on the first rainfall immediately after sowing but died due to poor follow up rainfall.

Direct drilling seed into the soil resulted in better plant establishment (>15 and 5–10 plants/m^2 for the grasses and legumes/herb, respectively) for all species than broadcasting seed onto the soil surface (averaged 9 and 3–5 plants/m^2 for the grasses and legumes/herb respectively). Regardless of the sowing method, the plant densities achieved for the sowing rates used were poor making perennial pasture establishment into PD affected areas expensive. We were unable to determine whether poor establishment was due to seasonal conditions, PD or an interaction of the two.

No PD symptoms were observed in the grasses four months after establishment. We will continue to monitor this demonstration as the grasses may become affected by PD in the future. In Queensland, some resown perennial grass pastures have been reported to succumb to the condition again within 12 months of establishment (S. Buck, QDAF, pers. comm). If the perennial species do succumb to pasture dieback, annual species such as teff grass are more cost-effective short-term feed and ground cover solutions.

Our demonstrations have shown that tropical perennial grasses can be sown directly into PD affected pastures. However, all the standard agronomic factors for successful establishment need to be considered, including suitability of species to the climatic and soil conditions. Legumes/herbs are not affected by PD, but competition from other species can restrict establishment, therefore broadleaf weed control prior to sowing is important. Additionally, establishing the legumes/herbs first, then oversowing grasses later may be more effective. The regeneration of a number of grasses from the soil seed bank has led to some producers questioning if 'doing nothing is as good as doing something'. Whilst it is too early to confirm, this may be an option, however the rate of return to previous plant densities of desirable grasses and overall production appears to be slow. The decision to not sow grasses can make sense from a seed cost point of view, but broadleaf weed invasion and the associated control costs need to be considered, as does potential toxicity of weed species to livestock.

Increasing productivity of a dieback affected pasture with fertiliser and microbial products

In December 2020 two demonstrations commenced on pastures affected with PD located at Eungella (28.3490328°S, 153.3094742°E), 11 km south-west of Murwillumbah. We applied five commercial fertilisers and four microbial products paired with soil conditioner at label recommended rates to a pasture. The pasture was a mix of broadleaf paspalum, setaria, bahia grass and kikuyu. The fertilisers applied were 120 kg/ha sulphate of potash (17% S, 41.5% K), 110 kg/ha urea, 150 kg/ha DAP, 180 kg/ha CK88® (Incitec Pivot; 15.1% N, 4.4% P, 11.5% K, 13.6% S), 250 kg/ha single superphosphate (8.8% P, 11% S, 19% calcium). The microbials were Nutri-Tech Solutions® products with soil conditioners: Nutri-Life Myco-Force™ (three rates: 50, 500 and 1000 g/ha + liquid humus (3 L/ha), Myco-Force (1 kg/ha) + Phos-life Organic™ (3 L/ha), Myco-Force (500 g/ha) + Farm Saver® Multi-Plex (3 L/ha; 10% N, 10% P, 10% K), Myco-Force (500 g/ha) + BAMTM (5 L/ha) and Myco-Force (500 g/ha) + liquid humus (3 L/ha) + Tricho-Shield™ (500 g/ha) + liquid humus (3 L/ha). The plots were grazed over a 2-week period in late January 2021 and the treatments reapplied in February. Each treatment was replicated twice.

There was significant pasture response on all plots which received an N-based fertiliser (i.e. urea, DAP, CK88) two weeks after the first application and 100 mm rainfall. Growth was proportional to the amount of N applied and 2–10 times greater than the control (nil treatment applied). Dieback symptoms in the responsive plots appeared to dissipate, although mealybug numbers were observed to be higher. There was little to no pasture growth response to the other fertiliser and microbial treatments compared to the control.

In early March 2021, following over 500 mm rainfall since the second treatment applications, we observed no pasture growth response. Plants in all plots showed advanced symptoms of PD with broadleaf weeds and legumes germinating in all plots irrespective of the treatment. We did note that mealybug numbers were noticeably higher in the plots that received N-based fertiliser relative to the control.

In the second demonstration, a mixed pasture of kikuyu, setaria, and paspalum was fertilised to increase pasture growth and grazed to manage pasture biomass. A single application of lime (Ozcal™ applied at 300 kg/ha) was surface applied to increase soil pH. From December 2020, the pasture was grazed to maintain biomass <3 t DM/ha and 150 kg/ha of DAP applied after every second grazing. From late February, 100 kg/ha urea was also applied every second grazing. The patches of PD present when the demonstration commenced appeared to subside after the initial fertiliser application. However, by early March, we found that PD symptoms were again evident though milder and less advanced in the fertilised and grazed pasture area than the neighbouring untreated area. This was despite higher mealybug numbers in the fertilised area.

Our demonstrations have shown that PD affected pastures can respond to N fertiliser but growth should be utilised to maintain biomass at a maximum of about 3 t DM/ha. Nitrogen fertiliser resulted in increased mealybug activity which supports Queensland reports (QUT 2018). Fertiliser application without regular grazing resulted in proliferation of mealybug and accelerated progression of PD symptoms to plant death. Based on our observations and results, we suggest that fertilising a PD affected pasture with a low fertility status could be a strategy to increase growth and suppress PD symptom development and spread. However, fertiliser application may not be economic as the effects are only short term and the pasture will still suffer premature death. The most resilient pastures appear to be those with good fertility status prior to infection.

We often see legumes, such as Shaw creeping vigna (Vigna parkeri) or round leaf cassia colonise PD affected pastures once the grasses have died. This is most likely due to the reduced competition from the grass. Whilst the effects of PD are devastating for productivity and ground cover, this is an opportunity to improve compatible legumes as grass pastures in the region commonly have a low legume component.

Current recommendations for producers

Recommendations change as new information becomes available.

Biosecurity

- Practice 'Come clean, go clean' by ensuring vehicles, equipment, footwear and clothing are clean and free of soil and plant material when entering or leaving the property. Ensure staff and visitors adhere to the property biosecurity plan and only use property vehicles to move around the property.
- Monitor grass pastures and crops regularly, especially following rainfall. Additionally, monitor areas where pasture grass (e.g. Rhodes grass) hay sourced from known pasture dieback areas has been stored and fed. Do not bale and sell dieback affected pasture.

Maintaining productivity and ground cover

- In areas with new outbreaks of PD, stock the pasture with high stock numbers as soon as possible to utilise the pasture before it becomes unpalatable.
- Fertilising pastures, especially with N, will result in increased pasture growth. However, when conditions are suitable, there will likely be a corresponding increase in mealybug activity. Utilise the pasture to prevent biomass accumulating above 3 t DM/ha to maximise the benefit of fertiliser application and minimise the effect of pasture dieback.
- Until effective control strategies are developed, quality forage for livestock and ground cover can be maintained by sowing annual forages or pastures, or perennial pastures that are not

susceptible to pasture dieback. For example, legumes such as siratro, glycine and round leaf cassia could be sown provided they suit the soil and environmental conditions of the property.

- Encouraging legumes that regenerate in the bare patches will also provide some feed and ground cover, and improve soil seed banks for the time when grasses are resown/regenerate.

Managing pasture mealybug

In the long-term, the most cost effective, environmentally friendly and effective method to control pasture mealybug will be through integrated pest management. In the short-term insecticides may be useful for control in new outbreaks or small affected areas. However, mealybugs are difficult to control effectively as they live in the soil and dwell protected amongst plant litter and foliage. Additionally, insecticides can also kill beneficial insects. Insecticides currently available for use under minor use permits issued by Australian Pesticides and Veterinary Medicines Authority are: imidacloprid (PER87423; expires 28 Feb 2028), spirotetramat (PER88482; expires 30 Sep 2022), chlorpyrifos (PER90238; expires 31 Oct 2022), also carbaryl, diazinon, malathion and methomyl (PER90239; expires 31 Oct 2022). Seek advice before use and adhere to permit and label details.

Conclusions

Pasture dieback is having a devasting impact on pasture productivity in the North Coast of NSW. Pasture mealybug is associated with the condition on the North Coast. Research is continuing in NSW in collaboration with MLA and organisations associated with the MLA/ Department of Agriculture, Water and the Environment, Australia PD program.

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