WESTERN SYDNEY UNIVERSITY

PAstures and Climate Extremes (PACE) Newsletter

Hawkesbury Institute for the Environment

March 2019

Editors: Amy Churchill, Sally Power

Website: https://www.westernsydney.edu.au/hie/facilities/PACE_pasture_climate_extremes

Summer Scholars

PACE welcomes three WSU Undergraduate Summer Scholars

Alexandra Boyd recently finished her degree in Forensic Science and has been working with us to explore how plant nutrients are affected by extreme climate conditions

Shania Didier Serre is a 3rd year Biological Sciences student with an interest in pasture belowground responses to elevated CO_2

Samantha Weller is finishing her dual degree in Animal Science and Zoology and has been looking at how pastures recover following drought

Spring-Summer 2018/2019 at PACE

Welcome to the 3rd issue of our PACE newsletter! As many of you will already know, PACE is a large scale field manipulation experiment investigating the consequences of extreme climate conditions on many of the key pasture species that underpin our meat, livestock and dairy industries. Our two main climate treatments - warming (+3°C) and (winter/spring) drought - were initiated in 2018 and we're now seeing some interesting treatment effects on many of the 10 species we're working with. The end of spring saw us harvesting aboveground plant material and sampling for root biomass estimation in all 192 plots (Fig 1) – a huge task, involving over 20 staff, students and casual helpers. While all this was happening we also carried out our second PACE glasshouse experiment, focusing on the consequences of elevated CO_2 on tropical grasses and legumes. All these activities meant a flurry of excitement for the end of 2018, and lots of data to work with as we approach the end of the warm season here in Richmond.

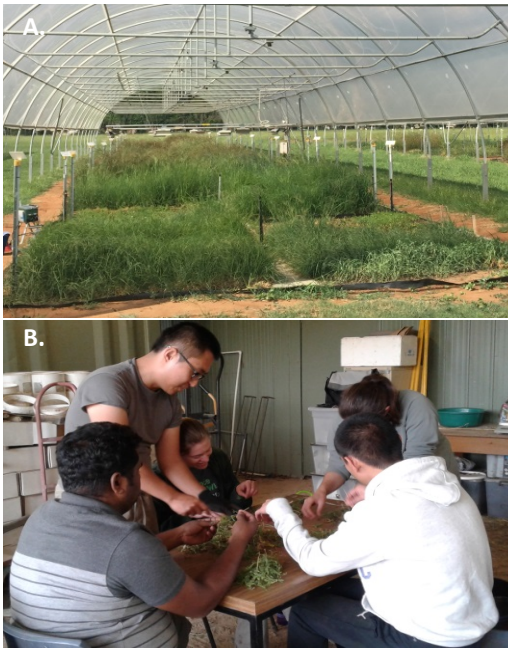

Fig 1. A) PACE experimental plots prior to our end of drought harvest in November 2018 (image by Alison Post) and B) Graduate students and Kate Fuller (PACE Technical Officer) sorting plant aboveground biomass during harvest (image by Amy Churchill).

Winter/Spring Drought 2018

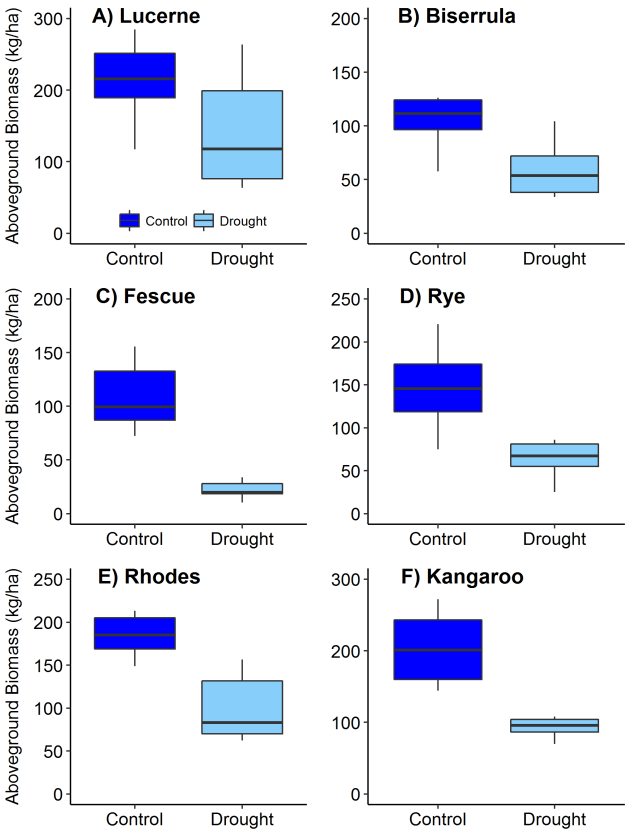

Fig 2. Total fresh aboveground biomass production between June 1st and November 30th during the experimental drought.

One of the overarching aims of PACE is to investigate effects of extreme climate conditions on the productivity and nutrition of key pasture species, and the underlying mechanisms that drive species sensitivity and recovery. Our drought treatment comprises a 60% reduction in rainfall during winter and spring 2018, in line with predictions for future rainfall extremes. Drought treatments were only imposed once a species was fully established in this first year of treatments. This resulted in staggered drought start dates and durations ranging from 50 days (Phalaris and Wallaby) to 180 days (Fescue, Kangaroo, Digit and Rhodes).

Data from the November 2018 harvest (Fig 2) show that Fescue productivity was particularly reduced under drought, with an 80 % decrease compared to control plots. Biserrula the most strongly affected legume, with a 50 % reduction in productivity in droughted plots, compared to a decrease of only 33 % for Lucerne. Our tropical, C4 grasses maintained higher yields under drought than their temperate counterparts, although yield reductions of up to ~ 50% were still observed (Fig 2E-F).

Species recovery following cessation of the drought treatment will likely be driven by both the speed and extent of physiological recovery, and the survival of individual plants. Big species differences in mortality at the end of the drought (e.g. 80% dead Fescue, compared to 0% dead Kangaroo) will undoubtedly influence recovery trajectories and this is one of the things we'll be looking at during autumn.

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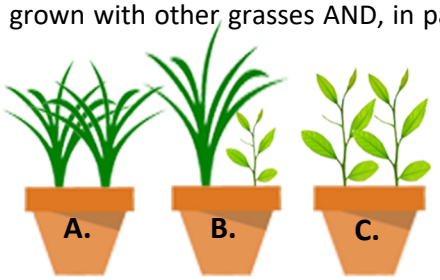
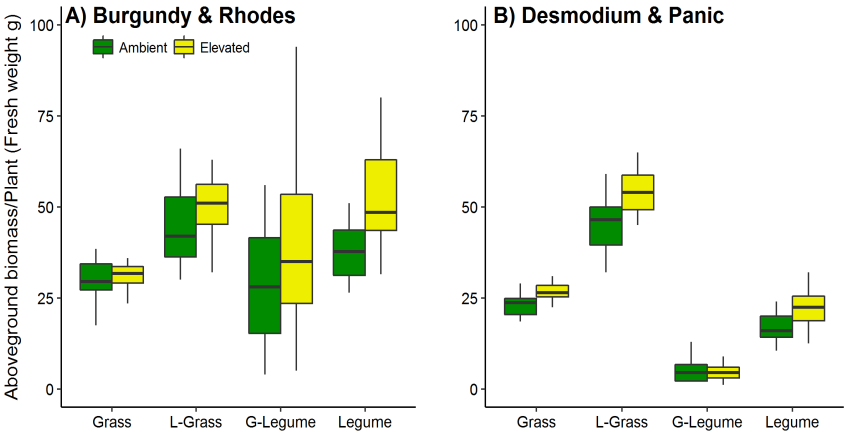
PACE Glasshouse Experiment 2: Elevated CO_2

The start of summer also saw the conclusion of our most recent PACE glasshouse experiment, a study designed to examine the effects of elevated (e)CO_2 concentrations on the performance of tropical grass and legume species. This experiment involved two pairs of tropical grasses and legumes - Burgundy bean and Rhodes grass (Fig 4A), and Desmodium and Panic grass (Fig 4B) - that are grown together in pasture settings. The aim was to understand how the nutritional and productivity benefits that legumes bring to mixed species swards are affected by increased availability of CO_2. While tropical grasses are frequently found to perform better under drought conditions, their comparatively lower nutritive value limits widespread use in pasture systems. Our preliminary findings confirm that grasses grown with legumes are much more productive than grasses grown with other grasses AND, in particular, that they benefit from eCO_2 when grown in combination with legumes, but not when grown alone. Future results will focus on the potential nutritional benefits of eCO_2 for these mixtures!



(Above) **Fig 3**. Tropical pasture species grown under ambient and elevated CO_2 conditions for A. grasses grown independently, B. legumes and grasses grown together to facilitate improved grass nutrition, and C. legumes grown together.



(Right) **Fig 4**. Aboveground biomass for tropical species grown independently (Grass, Legume) and together (grass grown with a legume: L-Grass, and legume grown with a grass: G- Legume) under ambient and elevated CO_2 conditions for A) Burgundy bean and Rhodes grass and B) Desmodium and Panic grass

PACE Facility Field Day: Recap and Future Planning

(Above) **Fig 5**. Post-doc researcher Amy Churchill and PhD student Manju Chandregowda talk about drought, plant phenology and belowground plant trade-offs (image by David Thompson).

Our 2018 Field Day welcomed over 40 guests to learn about our facility at WSU's Hawkesbury Campus and to hear first-hand about the ongoing research happening on site. After gathering on the main campus for a brief overview of the rationale and aims of PACE, visitors were transported to the nearby field site. Groups of attendees rotated through teams of graduate students, post-doctoral researchers and staff to hear about specific projects and research goals all while contributing valuable field expertise and suggestions for how we can improve our pasture management. Following a transition indoors for lunch, we then had themed discussion sessions, involving PACE researchers and our visiting stakeholders. Discussion topics included what to measure to capture pasture resistance and resilience, soil health including microbial community structure and change, fertilizer strategies and aims for improving nutrient use efficiency. We finished up with a discussion of how our experimental findings can be used for future management planning. We appreciate the insights offered during these sessions, and look forward to both learning and sharing more with our stakeholder community moving forward.

Stay tuned for PACE Field Day 2019 details in future issues!

Fig 6. PACE scientists discuss ongoing management plans for the twelve pasture types (nine single species and three mixtures) experiencing different combinations of warming and drought (image by David Thompson).

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