PAstures and Climate Extremes (PACE) Newsletter

Spring 2018

WESTERN SYDNEY UNIVERSITY
Hawkesbury Institute for the Environment

Editors: Amy Churchill, Haiyang Zhang, Sally Power

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

New PhD students at PACE

Chioma Igwenagu

Chioma joins us from Massey University, where she completed her Masters in Environmental Management.

Her PhD work will focus on soil nutrient management and microbial ecology in pastures under climate extremes.

Manjunatha Chandregowda

Manju joins PACE with an MSc from Mysore University, where he has been working on soil nutrient cycling. His PhD research will investigate below-ground plant responses to climate extremes, focusing on carbon allocation strategies and plant-soil interactions.

Winter 2018 at PACE

Welcome to the 2nd issue of our PACE newsletter! PACE is a research project at Western Sydney University investigating the consequences of extreme climate conditions for a range of pasture species that underpin the success of Australia's livestock and dairy industries. Our field-based seasonal drought treatment began on June 1st, and we've had an elevated air temperature treatment running for a sub-set of plots since April 2018 (Fig 1). Winter 2018 was our first opportunity to examine pasture responses to the combination of drought and warming conditions, and we are beginning to analyse data on plant growth, canopy development and nutrition for this period. Early indications are that warming had both positive and negative effects on productivity, depending on species, and there was some evidence that warming exacerbated the negative effects of drought. Fig 2 illustrates warming treatment effects on canopy temperature and frost damage.

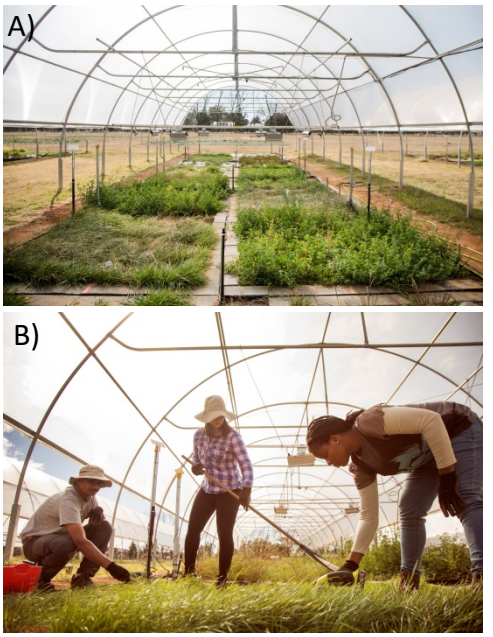

Fig 1. (A) Winter growth of pasture plants at PACE, including plots exposed to drought (foreground) and warming conditions (background, with overhead heating array visible). (B) PhD students (Manju, Karen and Chioma) conducting a ryegrass harvest during August 2018.

Warming Effects During Winter 2018

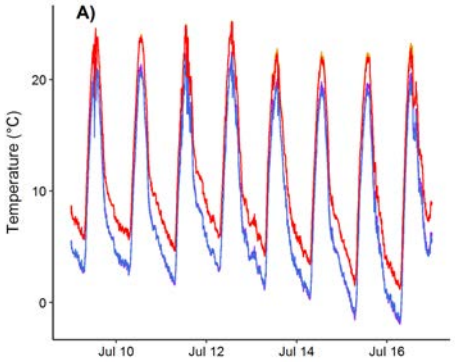

Fig 2. A) Plant canopy temperatures during a week in July when ambient plots experienced freezing conditions and warmed plots did not; B) Frost damage on Digit.

The elevated temperature treatment, consistently produces a +3°C increase in canopy temperature (Fig 2a). This difference between ambient and elevated treatments prevented freezing temperatures in the elevated plots, while species growing in ambient conditions experienced 7 nights with sub-zero conditions. Warmer temperatures and reduced frost events differentially influenced the pasture species we are growing, with, for example, mixed pasture swards of Phalaris and subterranean clover not benefiting from elevated temperatures – either before or after a late June harvest (Fig 3a) - while Lucerne warmed plots were consistently greener through the winter growing period (Fig 3b).

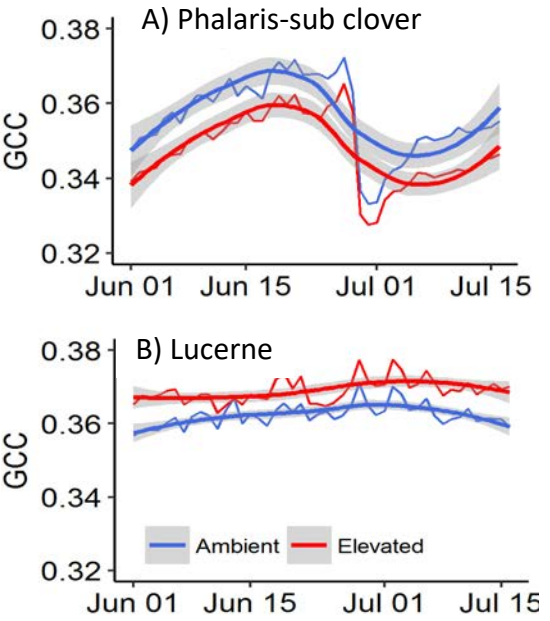

Fig 3. Changes in green chromatic coordinates (GCC; a metric of plant canopy greenness) between June 1st and July 16th 2018 for pasture species exposed to ambient (blue) and +3 °C temperatures (elevated; red) for A) Phalaris and subterranean clover and B) Lucerne.

PAstures and Climate Extremes (PACE) Newsletter

Spring 2018

Editors: Amy Churchill, Haiyang Zhang, Sally Power

PACE Glasshouse Experiment 1 (warming and drought)

Fig 4. PhD students (Vin, Karen and Lena) record aboveground plant biomass for Lucerne and Fescue plants grown under warming and drought treatments.

A second component of the PACE project involves using glasshouse experiments to examine underlying mechanistic explanations for observed patterns in pasture species that are often not possible under field conditions. Our first glasshouse experiment, which focused on understanding the importance of the soil microbial community on controlling plant responses to drought and warming, was completed during August 2018. The experiment included manipulations of the soil community, including the addition of beneficial mycorrhizal fungi. We found that the magnitude of effects of warming and drought treatments differed between plant species and also depended on soil microbial community composition. Warming generally reduced plant investment in root biomass, although it increased the weight of nitrogen-fixing nodules in Lucerne under well-watered (but not droughted) conditions (Fig 5). This suggests that future drought may constrain the benefits of warming conditions on nitrogen fixation in pastures.

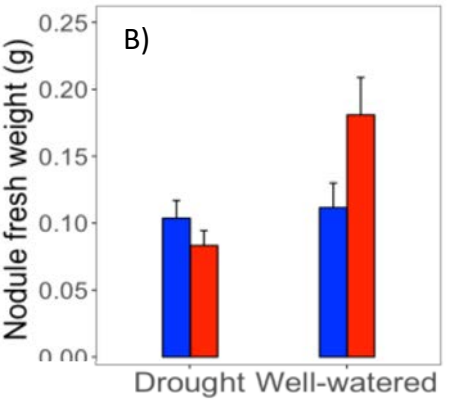

Fig 5 A) Lucerne roots from the PACE glasshouse experiment showing high nodule density (top left) as well as active nitrogen-fixing nodules (pink coloured structures (bottom left); B) differences in the fresh weight of Lucerne nodules between ambient (blue) and elevated (red) temperature conditions for droughted vs. well-watered individuals.

PACE Facility Field Day: October 31st, 2018

Are you concerned about how future climate conditions will affect pasture sustainability across Australia?

Join us for a Field Day at Western Sydney University to learn about a unique new research project that's examining pasture species responses to extreme seasonal drought, elevated temperatures and heatwaves.

RSVP to
https://westernsydney.edu.au/hie/events/pace_field_day
Contact Dr. Amy Churchill (a.churchill@westernsydney.edu.au) or Dr. Jasmine Grinyer (j.grinyer@westernsydney.edu.au) with any questions or for more information.

31st October 2018, 10am-2pm
Hawkesbury Institute for the Environment,
Western Sydney University,
Richmond, NSW