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# Understanding the impact of mulching on early tree growth



# Introduction – Why should we care about our soils?

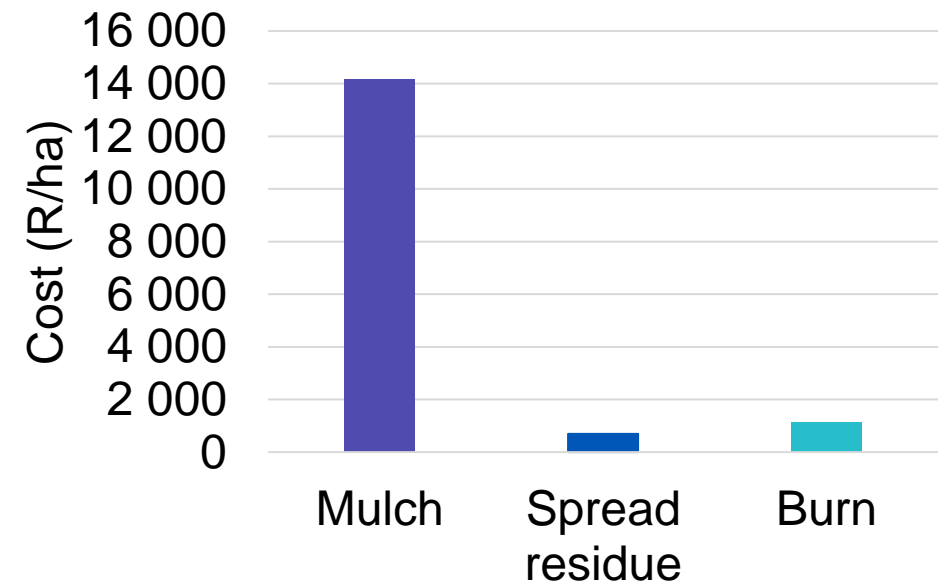
- Tree growth is dependent on availability of water and nutrients from the soil
- Soil fertility has 3 components
  - **Chemical:** Ability to supply essential nutrients to plant in appropriate forms, quantities and proportions. (Includes toxicity risks)
  - **Physical:** Properties that influence soil water regime (storage, infiltration), root growth and biological activity (porosity / aeration)
  - **Biological:** Influence of living organisms on availability of mineral elements (weathering, recycling, symbiosis)





# Slash / Harvest residue management

- Burning of slash reduce fuel load and fire risk; facilitates pre-planting, planting and post-planting activities
- However, burning does reduce soil organic matter content which is important for
  - Improving water holding capacity of the soil; soil texture; soil fertility
  - Regulation of soil temperature
  - Habitat for soil organisms
- Nutrient loss (especially N) is a concern
- Hydrophobicity in soil after fire can reduce water infiltration and increase soil erosion



# Benefits of mulching

- Protect soil from erosion and compaction
- Conserve soil moisture
  - Increase percolation and retention
  - Reduce evaporation
  - Reduce weed growth
- Moderate soil temperature
- Increase soil nutrition (organic carbon & mineralization)
- Higher fungal biodiversity
- Increase tree survival and growth
- Allows mechanization of silviculture operations and easier harvesting
- Reduce GHG emissions
  - Avoided burning emissions (3.8 t CO<sub>2</sub>e/ha)
  - Additional CO<sub>2</sub> removal due to faster growth



# Data sources used to demonstrate effects of mulching

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- Heinrich Hechter, Student report, 2015, (6 paired plots = 3 sites)
- Tebatjo Machaka, MSc Dissertation, 2017, (2 sites)
- Dean da Costa, PHD Dissertation, 2021, (5 sites)
- Sebastian Nieto Lawrence, MSc Dissertation, 2022, (2 sites)
- Sappi:
  - Residue management x fertilizer trials (3 sites)
  - Burn vs Mulch plots in Zululand and KZN Midlands (11 sites)



Positive response



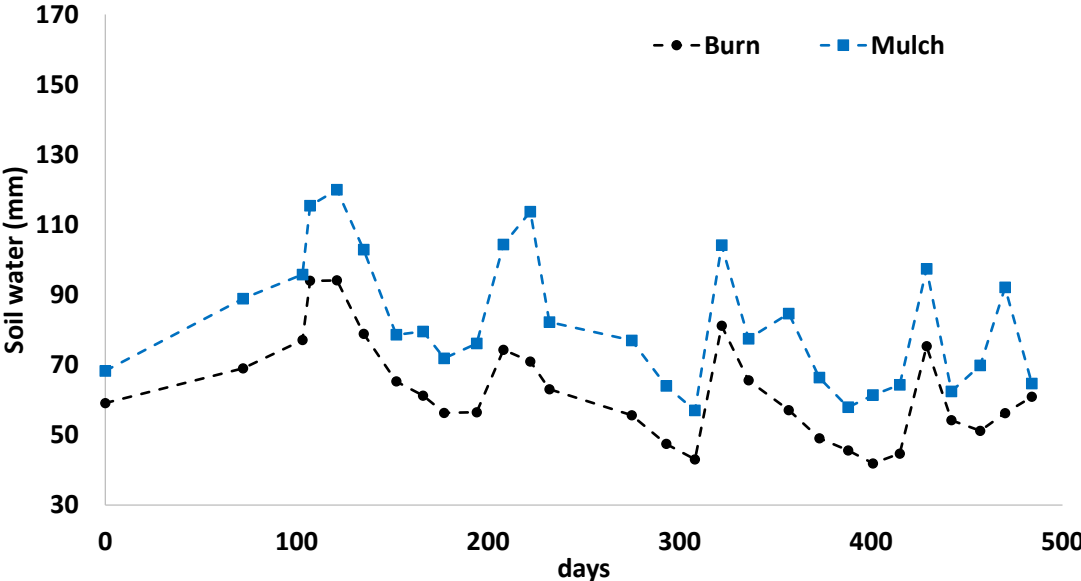
Neutral response



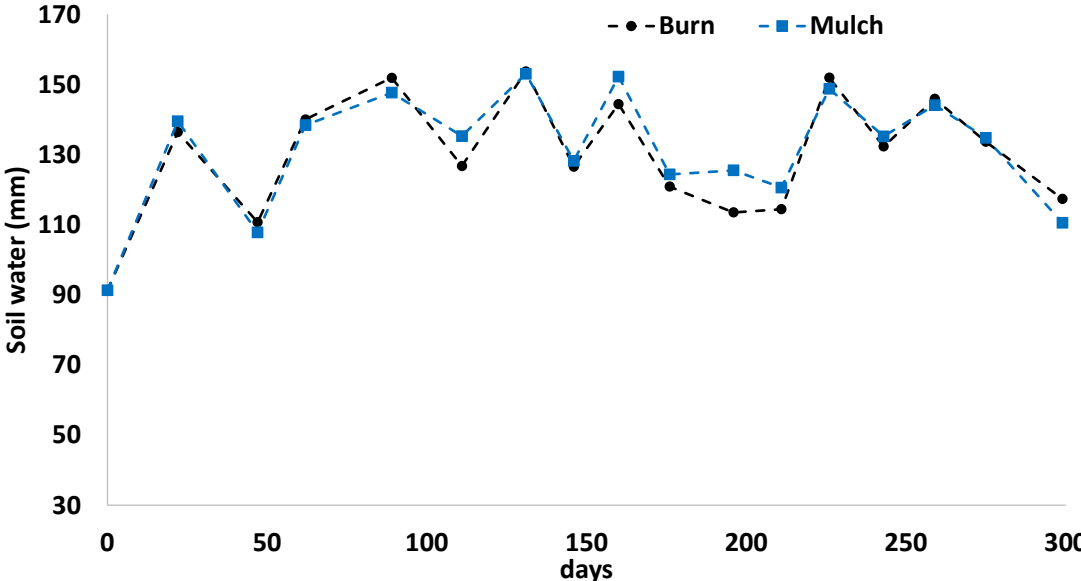
Negative response

# Mulching increase total soil water content (1.2m depth)

### Planted with poor rainfall



### Planted with good rainfall



Under dry conditions the benefit of mulch for soil moisture is very clear

Benefit of mulch when rainfall is good is not obvious

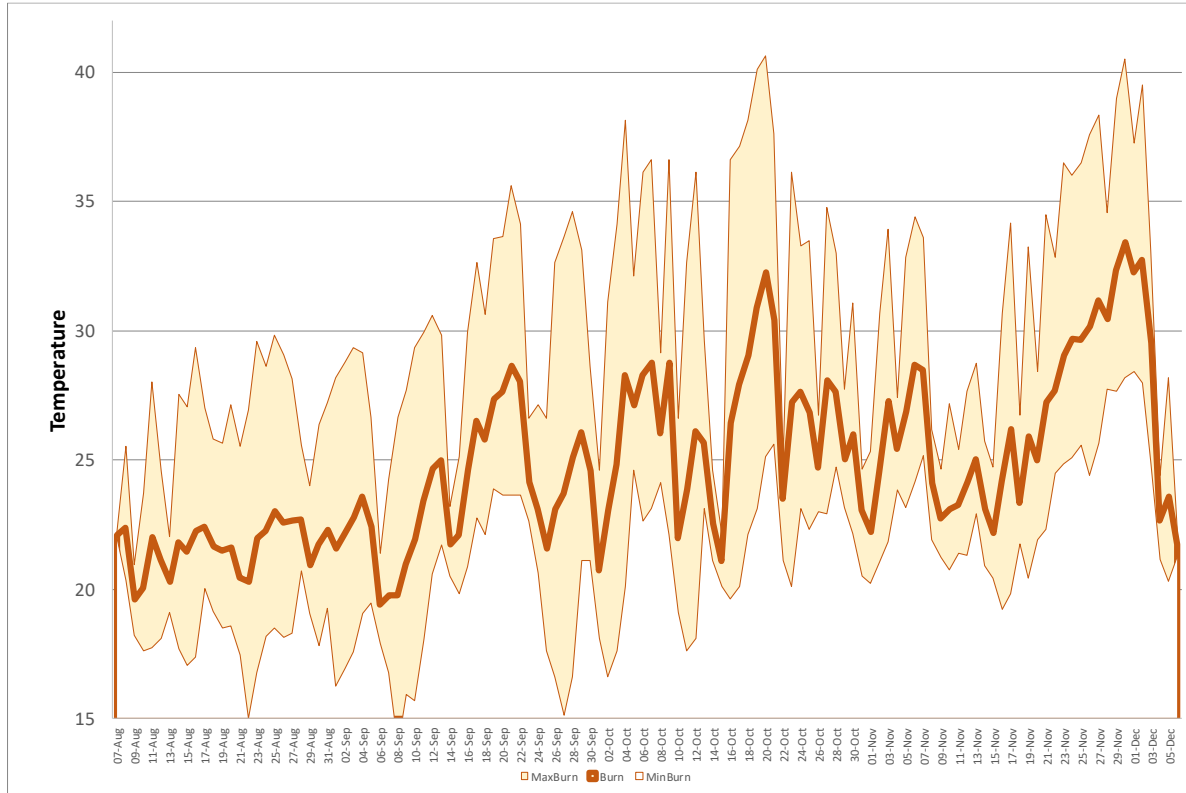


Source: Sappi mulch vs burn plots

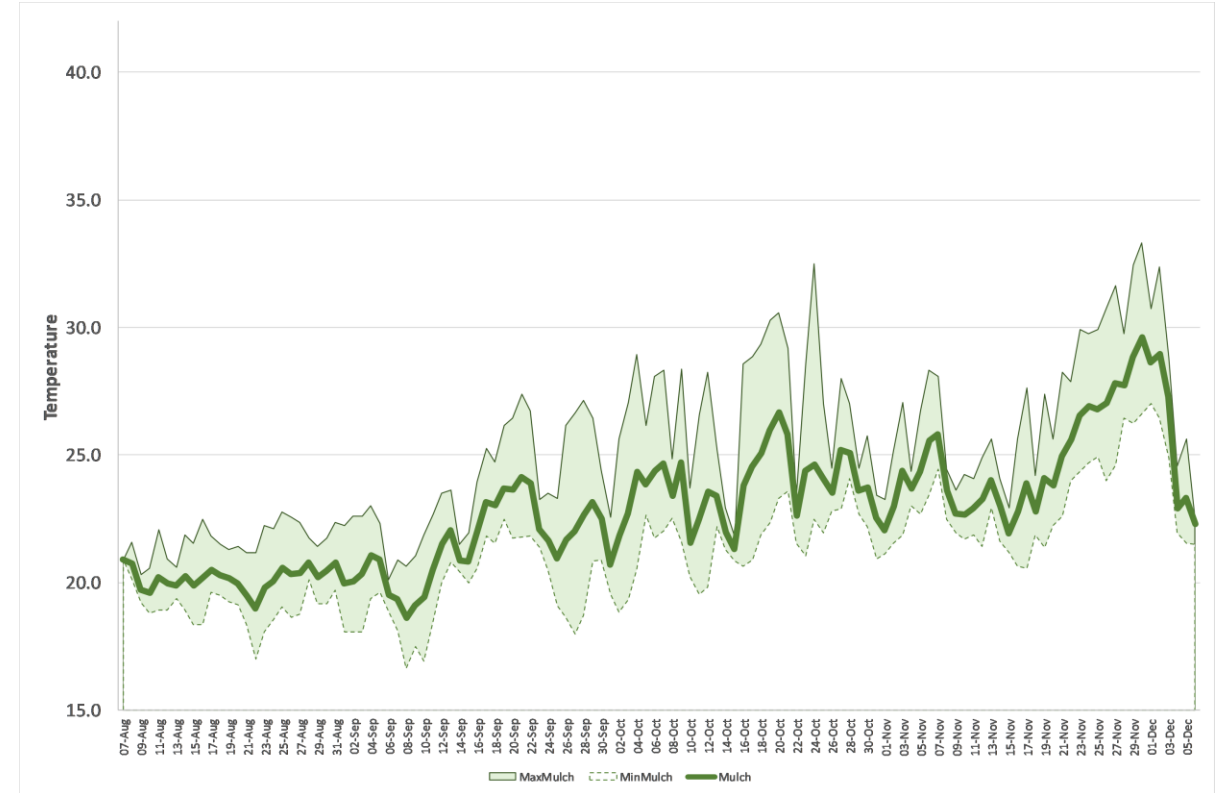


# Mulching moderates surface soil temperatures

## Burn



## Mulch



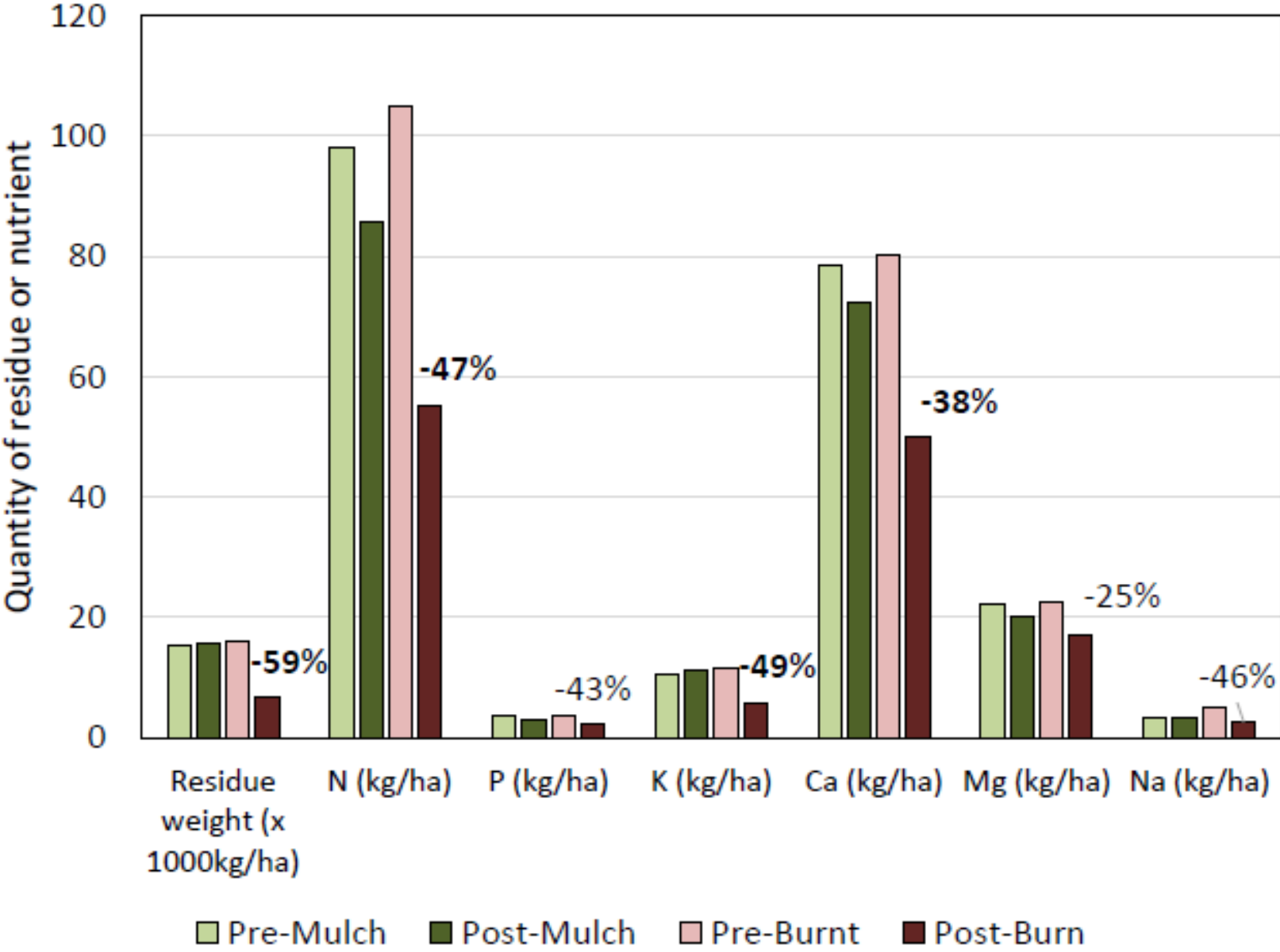
- Higher temperatures during the day
- Lower temperatures at night
- Greater extremes



- More stable soil temperatures
- Root and root collar heat stress lower after mulching

Source: Sappi mulch vs burn plots

# Mulching conserves organic matter and nutrients

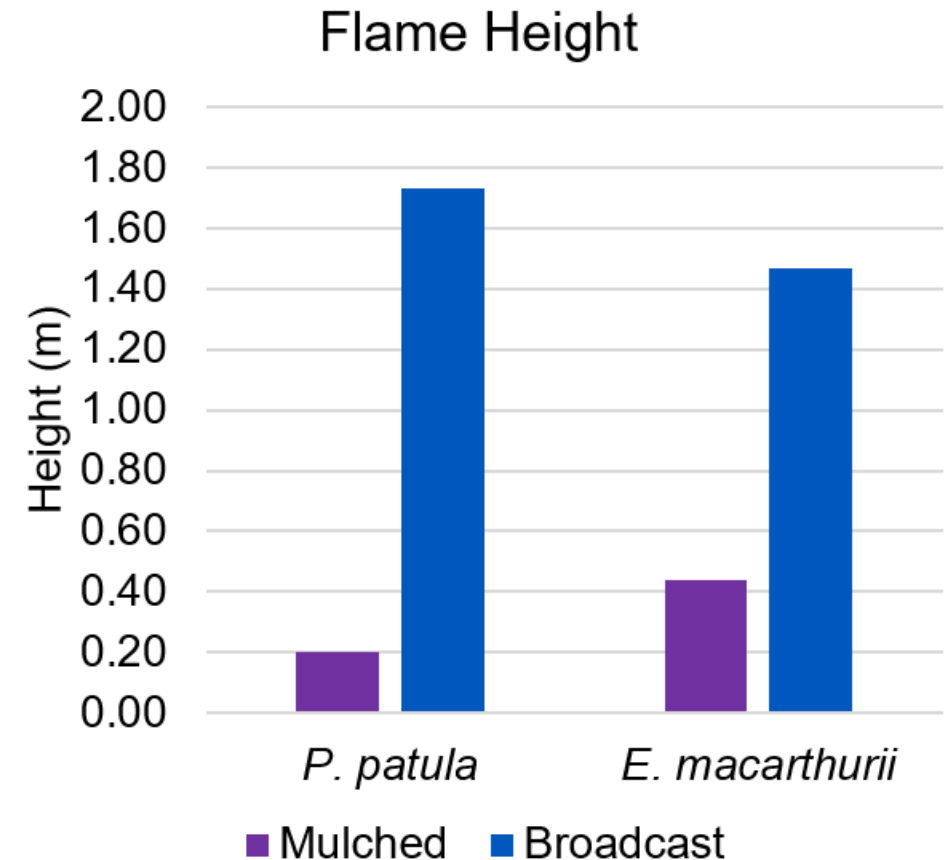


Source: Machaka 2017

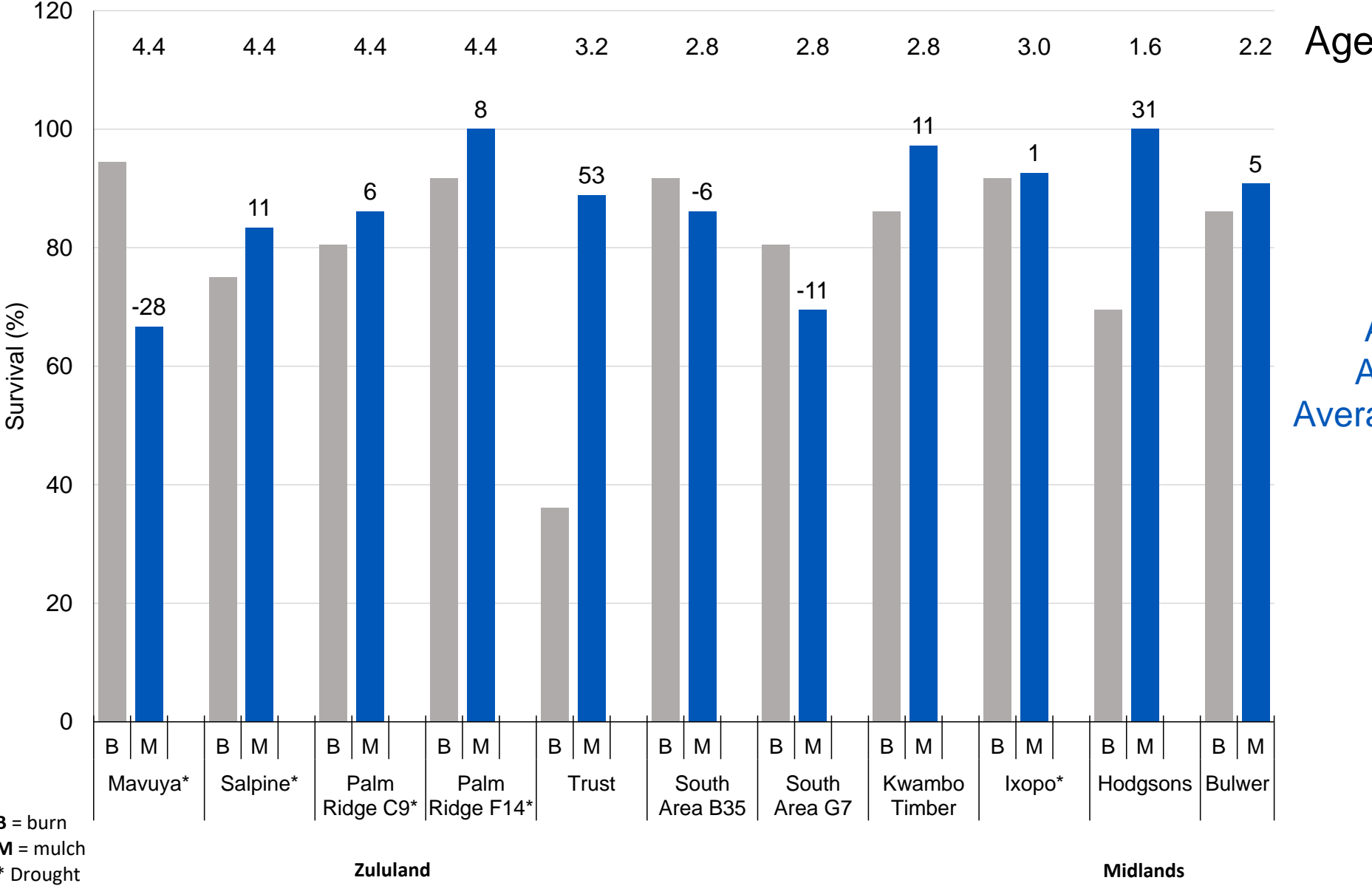


# Benefits of mulching (Fire management)

- Mulching reduced
  - Fuel load after 8-9 months
  - Rate of Spread
  - Average flame height
  - Average fire temperature
- Finer fuel in mulched plots
- Fuel more compact
- Fire consumed less fuel within mulched areas
- Indirect benefits
  - Increased fuel and soil moisture



# Mulching vs burning: Survival

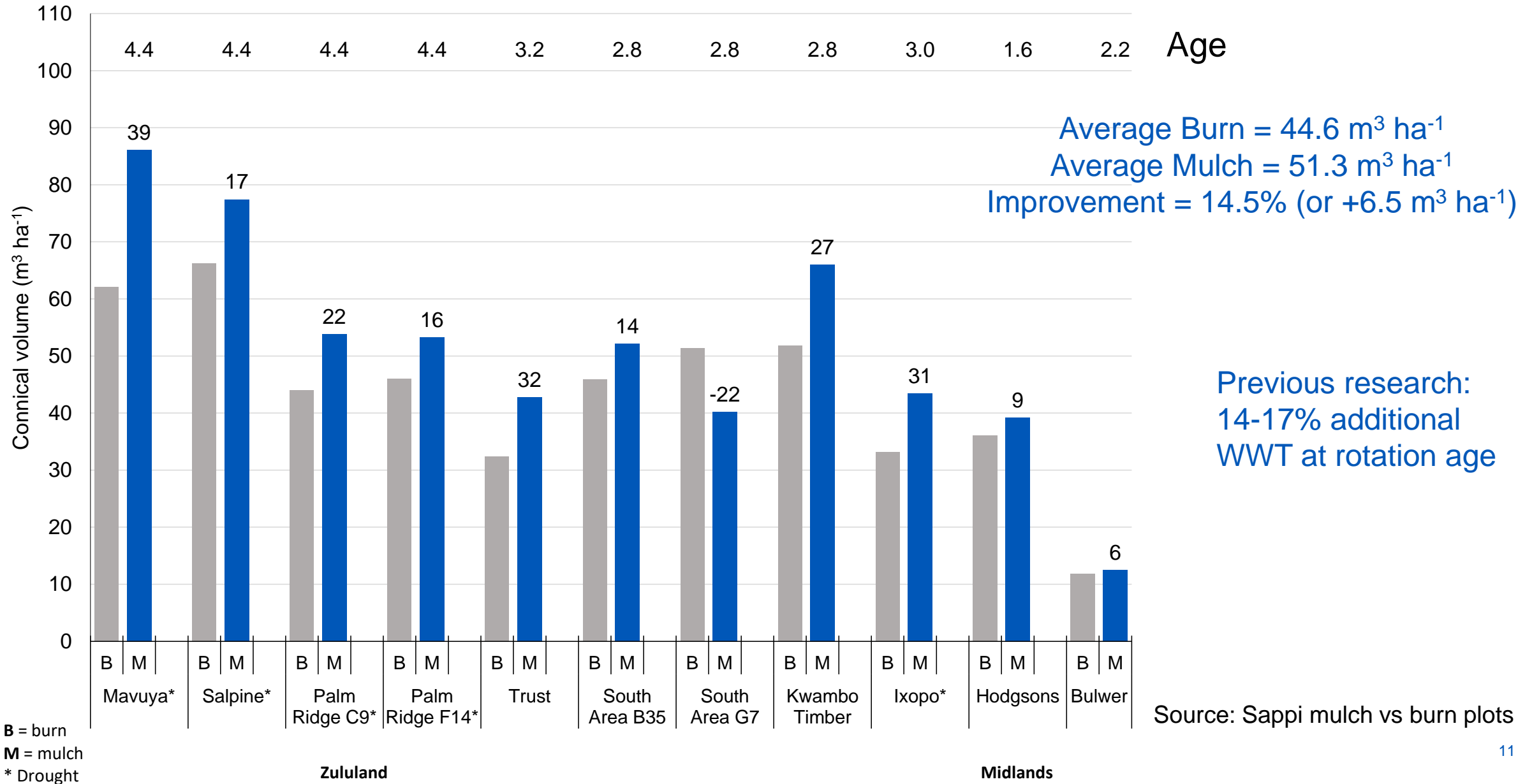


Average Burn = 79.8%  
 Average Mulch = 88.9%  
 Average Improvement = + 8.7%

B = burn  
 M = mulch  
 \* Drought

Source: Sappi mulch vs burn plots

# Mulching vs burning: Total volume production



# Potential negative effects of mulching

- Heat-reflecting mulches can increase surface air temperature (< 1m)
- Increase frost injury (more radiation, less heat absorption by soil)
- Mulch from diseased wood can contain pathogens (keep mulch away from tree stem)
- Mulches can interfere with moisture penetration to underlying soil layers (interception)
- Nitrogen deficiency: Unlikely that N in woody mulches will be “tied up” by microbes
  - Zone of N deficiency exists at mulch/soil interface
  - Too small to have influence on plants with deep root systems (i.e. trees)
  - Only if woody material is mixed into soil
- Increase pitting cost (clear mulch from pit-area, before pitting to prevent mixing with soil)



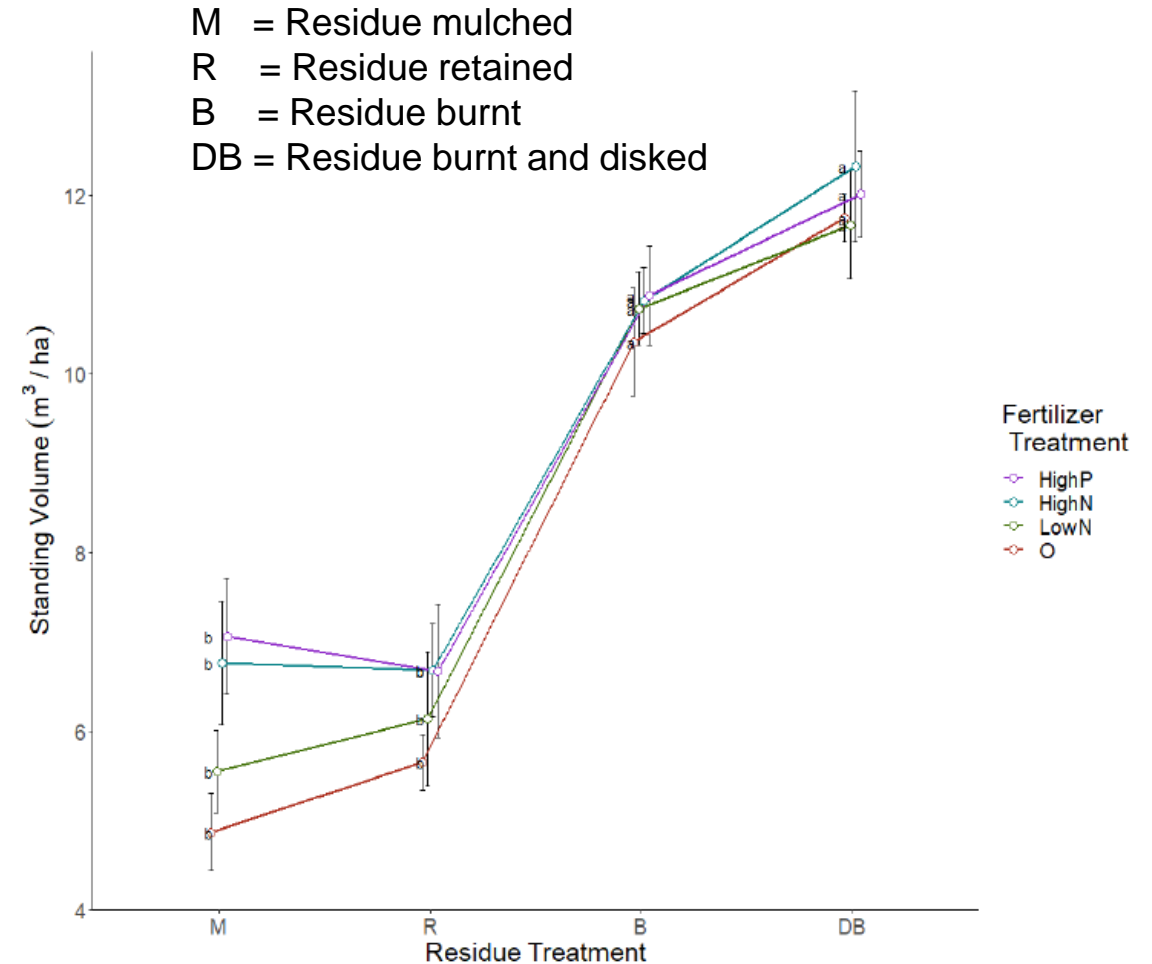
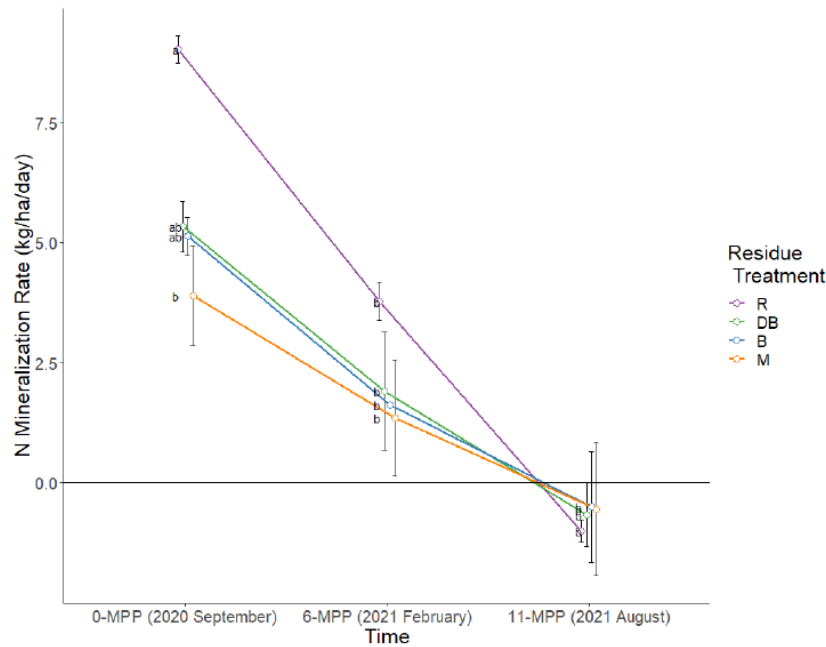
Photo credit: Neil Doby - Hodgsons



# Negative growth response observed in Nieto Lawrence's study

Mulching resulted in:

- Poorest overall growth of eucalypts
- Greatest response to fertilization
- Locking up of soil N (C:N >30)
- Net N immobilization – aerobic incubation of soil



- **Mulching should be the preferred slash-management practice**
- **Short term response**
  - Not all sites respond positively (depend on site conditions, mulching, etc.)
  - Generally, survival and growth increases (more under dry planting conditions)
- **Long term response**
  - Improve or maintain growth rates under climate change (adaptation)
  - Reduce GHG emissions (mitigation)
- **Future focus**
  - Understand reasons for positive and negative responses
  - Reduce mulching cost (equipment, mulching only planting line)
  - Find equipment capable of mulching on steep slopes

# Thank you

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