Truffle culture research in Idaho

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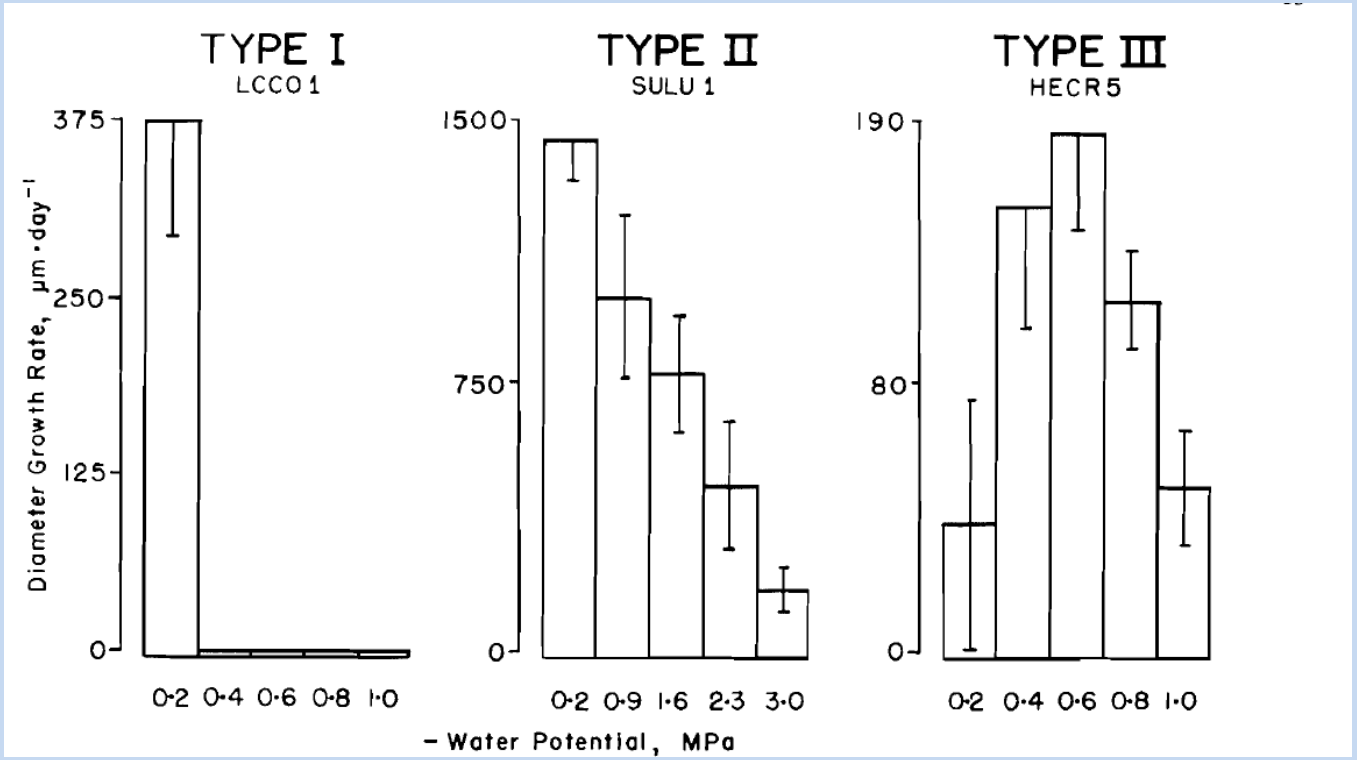
Mycorrhizal water relations

Todesco et al 2019 conclude:

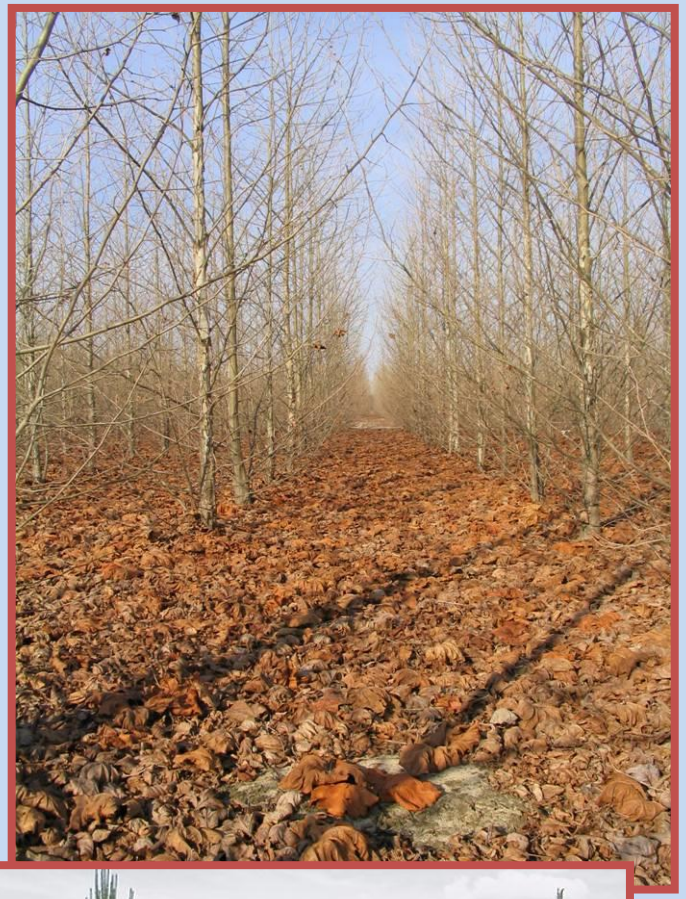
- T aestivum is type III
  - As with desert truffles
  - Tolerates -2000 kPa
- T. magnatum is Type I
    - Favors -100 kPa



Coleman et al 1989

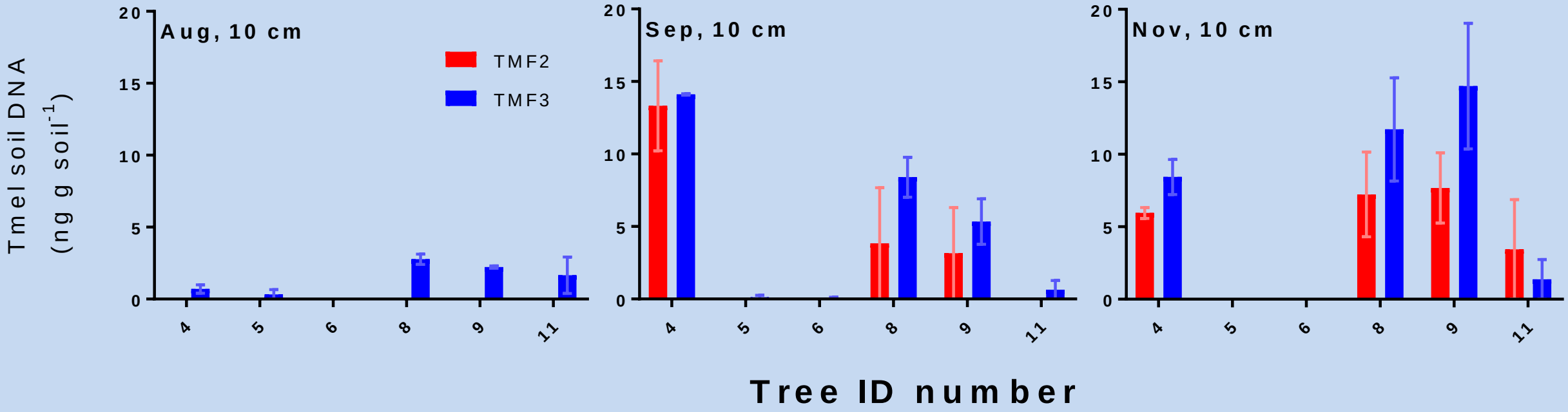
Intensive forest management research

- Multiple species
- Irrigation and fertilization
- Simplified forest stands



Sunken pot trial

- Sunken pot trials with T melanosporum inoculated hazel nut seedlings
  - Mycelial abundance over time
  - Biochar based potting soils



On-going orchard trials

- Irrigation and mulching
- Hedge-row pruning x organic fertilizer
- Establishment monitoring

Irrigation and mulching trial
Eagle, ID

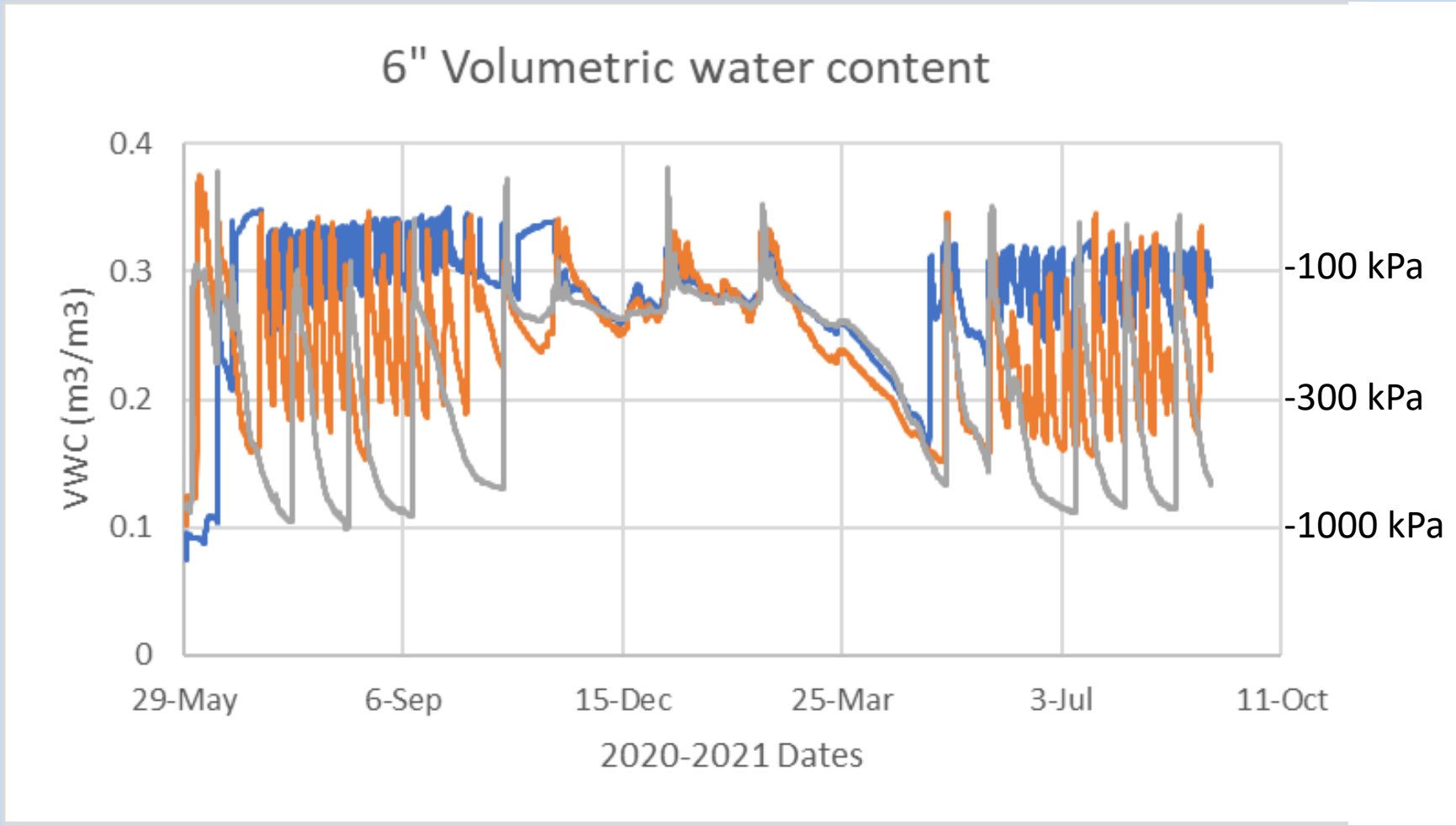
- Le Tacon et al 1982 show production of *T mealanospoum* required soil moisture is below pF 3.5; maintained with irrigation and mulching
- Todesco et al 2019 show that soil mycelium of *T aestivum* increases as pF increases from pF 2 to 4
- Objective is to test irrigation effects on tree, soil and mycelium

Irrigation treatment

	-100 kPa pF 3	-1000 kPa pF 4	-300 kPa pF3.5
Block 1	MANURE	CHAR	
	Man + Char		MANURE
	CNTRL	MANURE	CHAR
	CHAR	CNTRL	CNTRL
		Man + Char	Man + Char

Block 2	Man + Char		CHAR
	CHAR	MANURE	MANURE
		CNTRL	Man + Char
	CNTRL	CHAR	
	MANURE	Man + Char	CNTRL

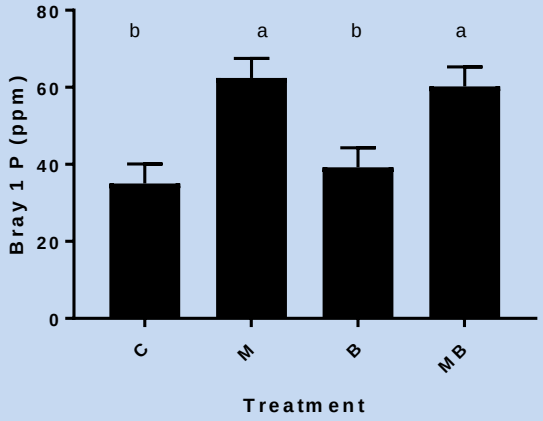
Irrigation treatment



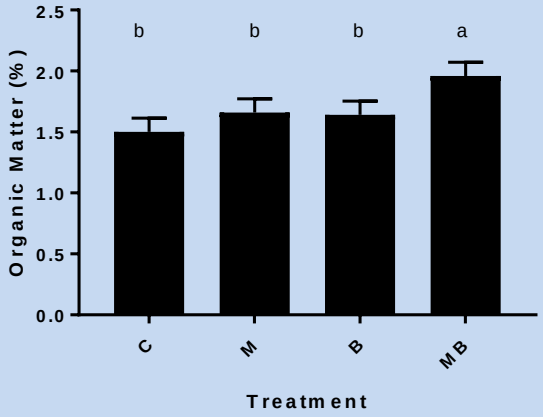
Mulching treatment

Influence on soil chemistry

- Manure improves soil P concentration

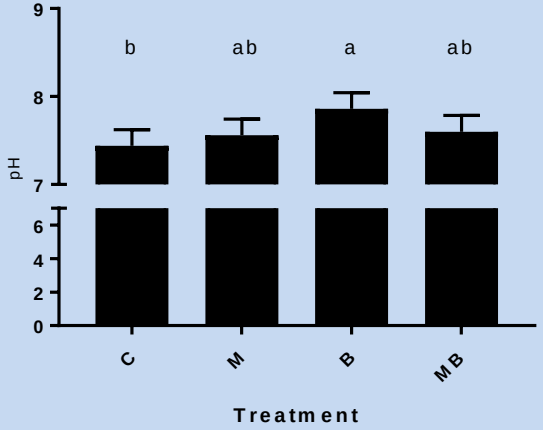


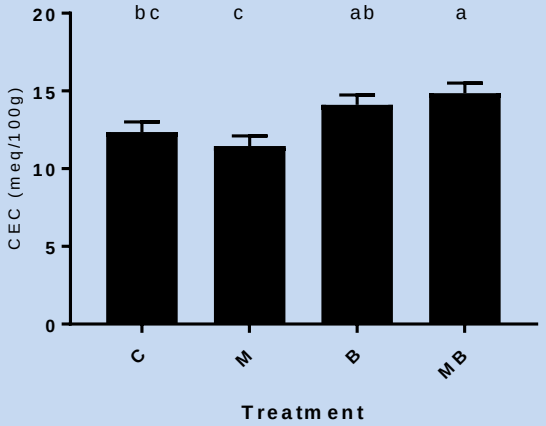
Manure + biochar enhances soil organic matter

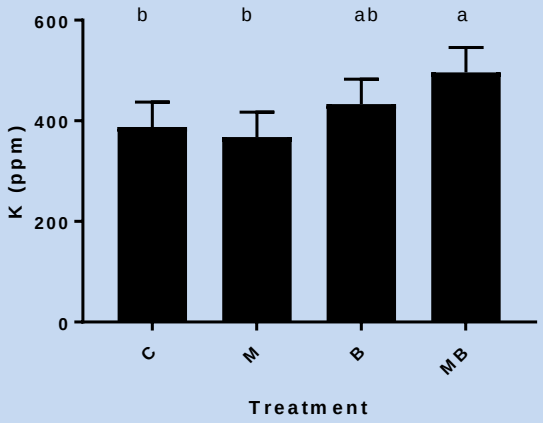


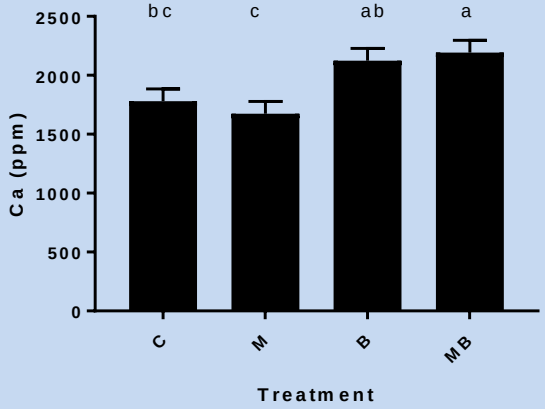
C = Control
M = Manure
B = Biochar
MB = M + B

- Biochar improves soil pH, CEC, K and Ca concentration





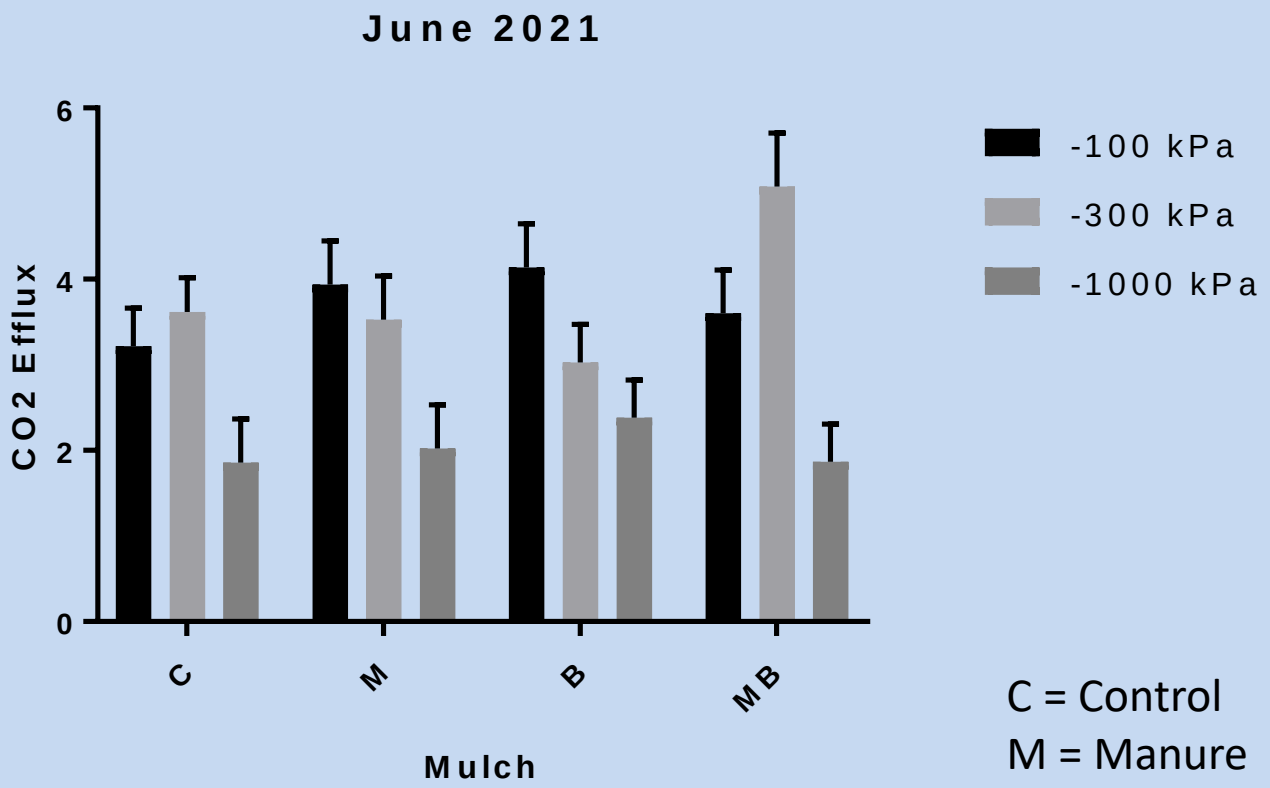




Soil CO2 efflux

A measure microbial activity

- Efflux response to irrigation depends on Mulching treatment, especially with high water availability
- Lowest efflux always occurs with water stress treatment
- Includes tree root respiration and other soil microbes



C = Control
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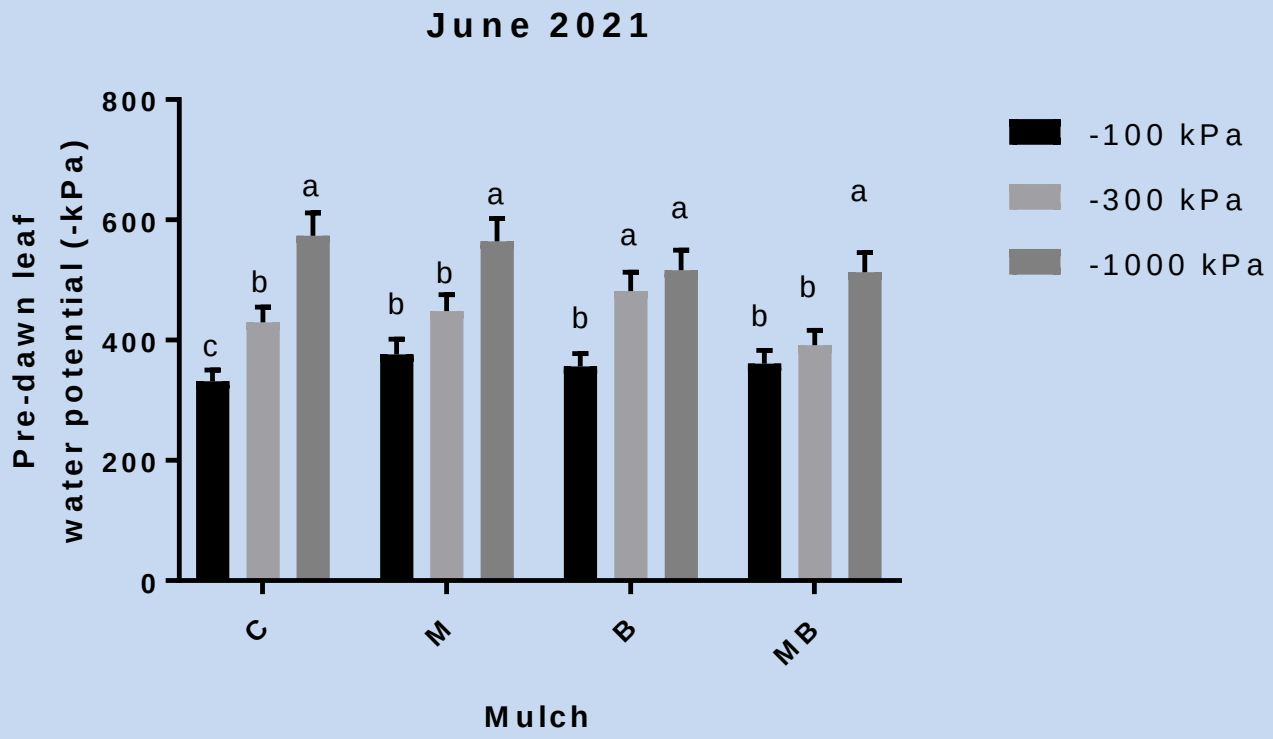
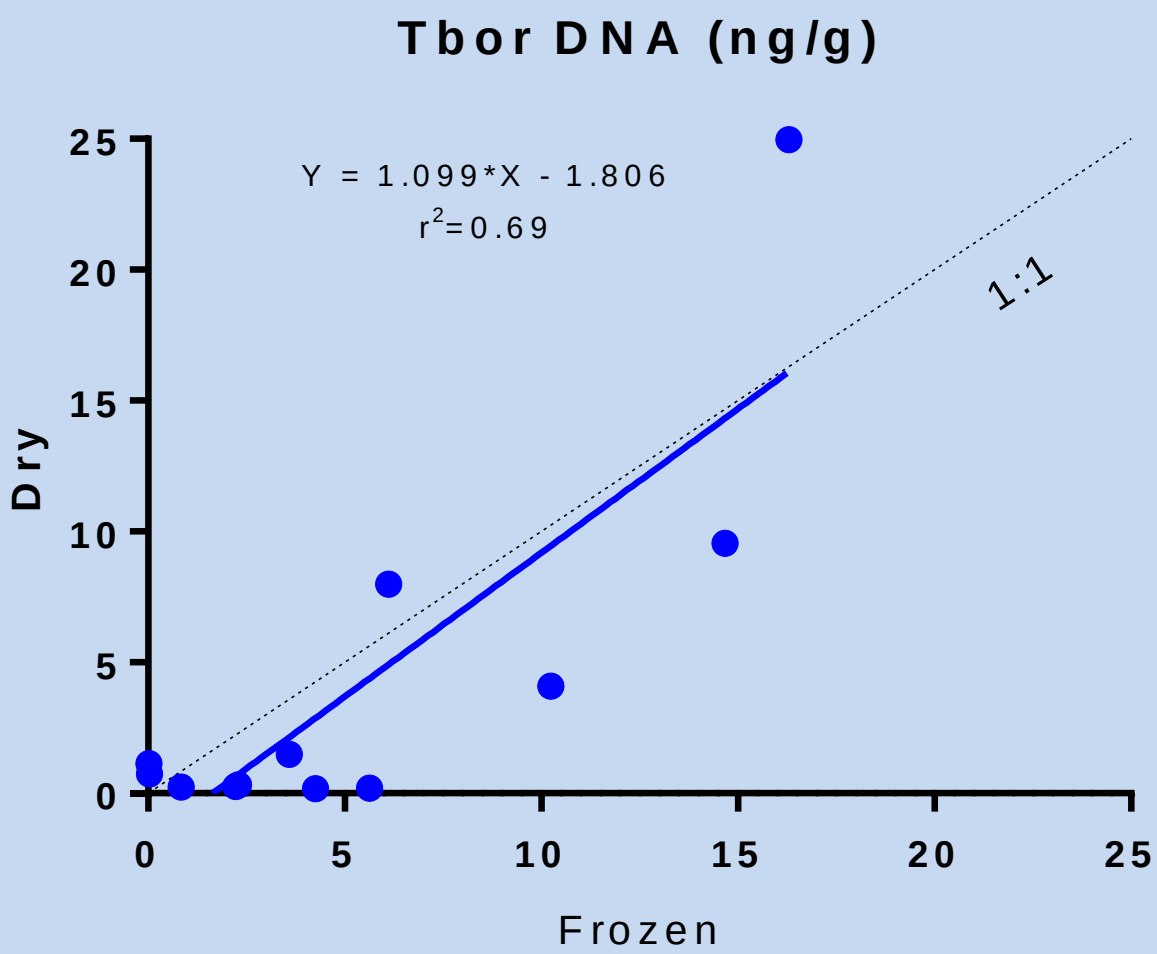
Plant water stress

- Irrigation treatments cause expected water stress
- High irrigation: plant stress is greater than target soil potential
- Low irrigation: plant stress is lower than target soil potential



T. Borchii abundance

- Developing a SYBR-green qPCR assay for T. borchii
- Agreement between subsamples that were flash frozen vs. air dried

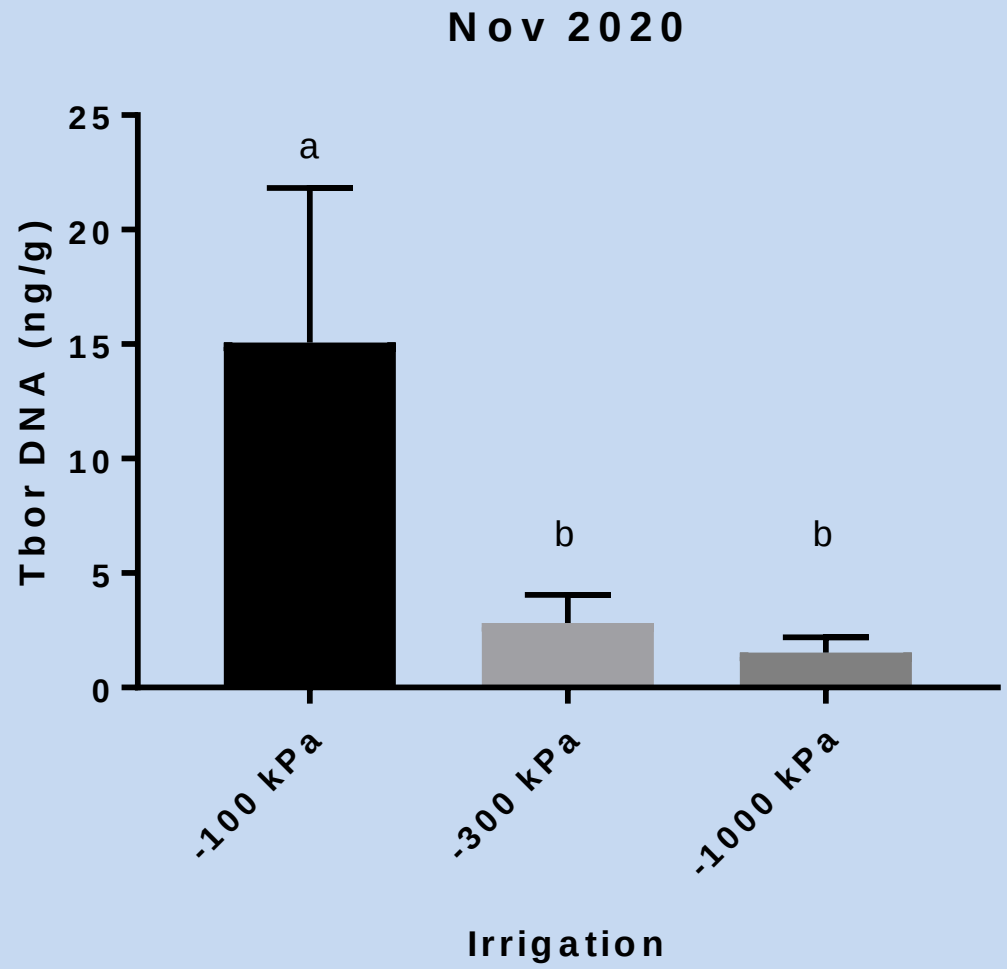


T borchii mycelial response

Strong response to irrigation, but not to mulching treatments

T. borchi appears to be Type I

- i.e., low level of drought tolerance



Hedge-row pruning x organic fertilizer

- Pruning:
  - None
  - Spring
  - Summer
- Organic Fertilizer
  - Plus/minus
- 20’ plots
- 5 replicates along 600’hedge

Establishment monitoring

Conclusions

- Irrigation, pruning and other management practices can boost yield
- Monitoring of management impacts on yield is complicated
  - Variable between years and across orchard
  - Sampling incomplete
- Soil mycelium holds potential to monitor management impacts
- Need to verify that mycelium concentration translates to fruiting

Relevant literature

- Amicucci, A., C. Guidi, A. Zambonelli, L. Potenza and V. Stocchi. 2000. Multiplex PCR for the identification of white Tuber species. Fems Microbiology Letters. 189:265-269.
- Coleman, M.D., C.S. Bledsoe and W. Lopushinsky. 1989. Pure culture response of ectomycorrhizal fungi to imposed water stress. Canadian Journal of Botany. 67:29-39.
- Garcia-Montero, L.G., M.A. Casermeiro, I. Hernando and J. Hernando. 2007. Effect of active carbonate, exchangeable calcium, and stoniness of soil on Tuber melanosporum carpophore production. New Zealand Journal of Crop and Horticultural Science. 35:139-146.
- Le Tacon, F., J. Delmas, R. Gleyze and D. Bouchard. 1982. Effect of Soil-Water Regime and Fertilization on Fructification of the Black Truffle of Perigord (Tuber-Melanosporum Vitt) in South East of France. Acta Oecologica-Oecologia Applicata. 3:291-306.
- Suz, L.M., M.P. Martín and C. Colinas. 2006. Detection of Tuber melanosporum DNA in soil. FEMS Microbiology Letters. 254:251-257.
- Todesco, F., S. Belmondo, Y. Guignet, L. Laurent, S. Fizzala, F. Le Tacon and C. Murat. 2019. Soil temperature and hydric potential influences the monthly variations of soil Tuber aestivum DNA in a highly productive orchard. Scientific Reports. 9