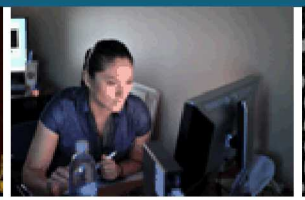
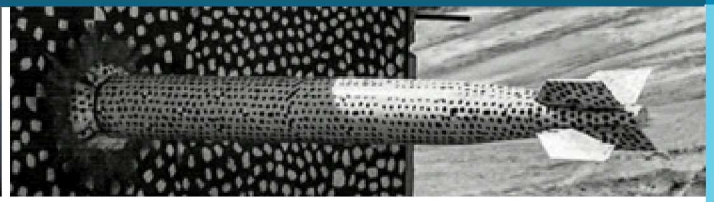
SAND2020-8810C

Turning Over a New Leaf: Cultivation of Multiple Algae Strains for Biofuels and Bioproducts with Plant Waste





Amanda Barry (Formerly at LANL)

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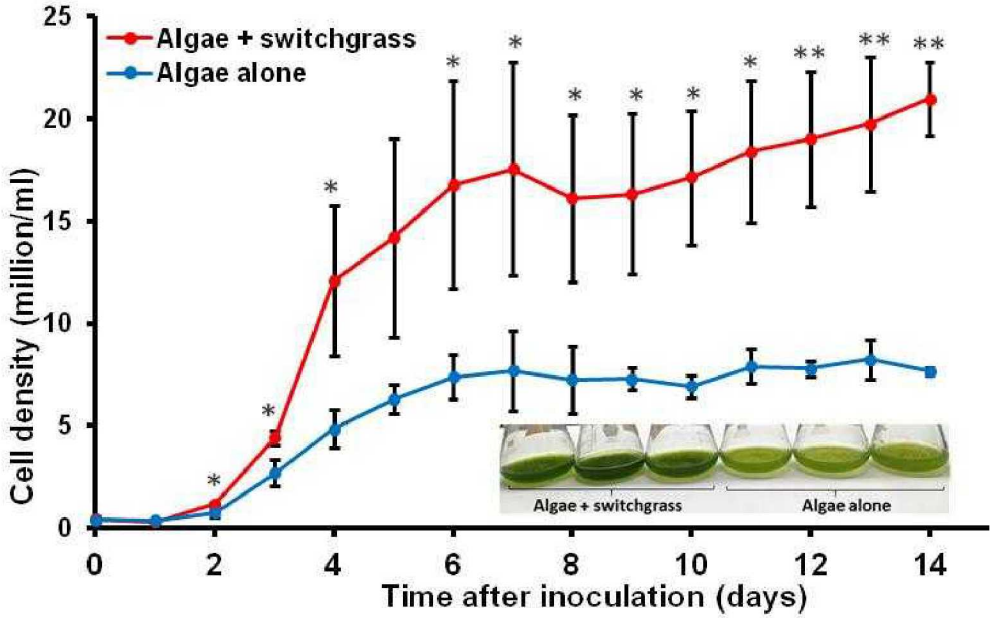
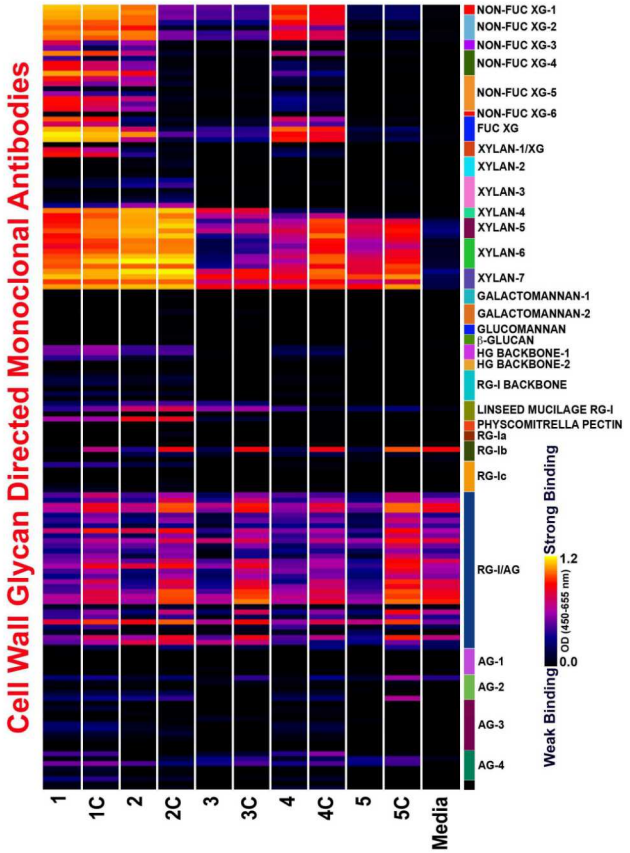
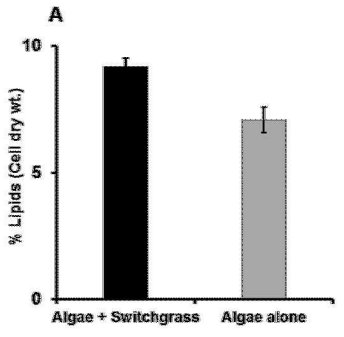
Characterization of plant carbon substrate utilization by *Auxenochlorella protothecoides*

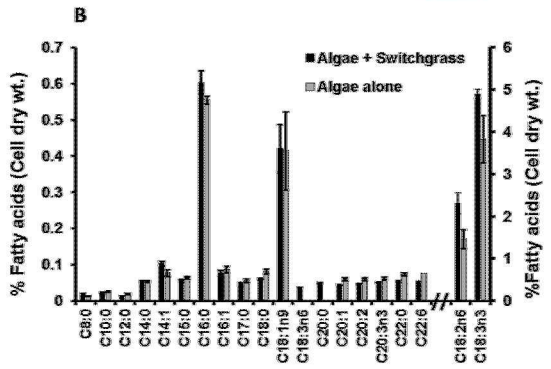
Brian W. Vogler [a, b], Shawn R. Starkenburg [a], Nilusha Sudasinghe [a], Jenna Y. Schambach [a], Joseph A. Rollin [c], Sivakumar Pattathil [d, 1], Amanda N. Barry [a]



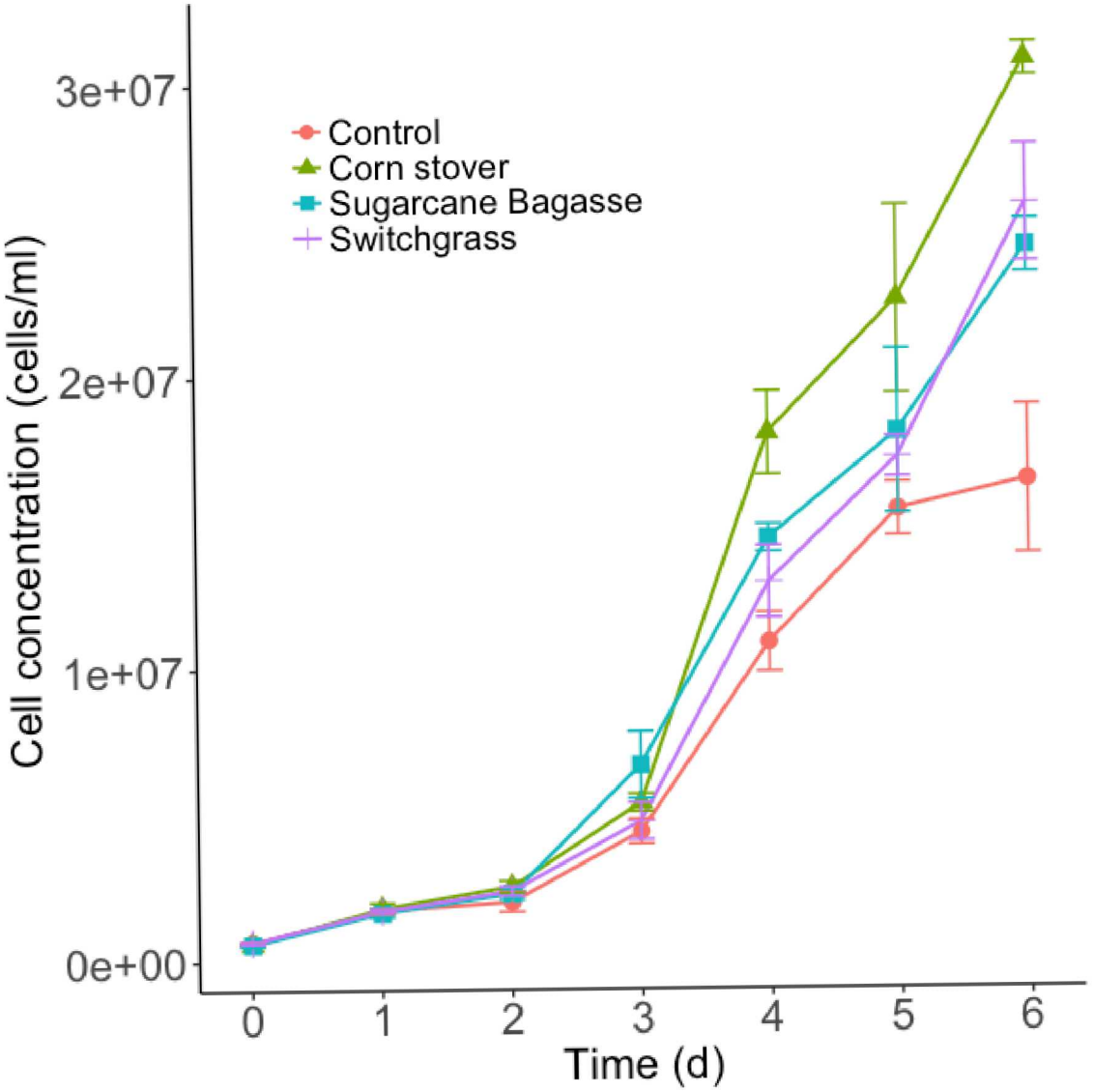


Gene ID		CDD GH Hit		Transcriptome Analysis: CMC Dark		CMC Light	
UTEX 25	sp. 0710	Family	E-Value	*FC*	*p*-value	*FC*	*p*-value
APUTEX2500001730	KFM23057.1	GH2	0.0E+000	1.0	7.84E-01	0.9	4.40E-01
APUTEX2500000235	KFM29315.1	GH5	1.9E-020	0.5	**1.59E-05**	1.1	5.56E-01
APUTEX2500000742	KFM23002.1	GH5	7.1E-020	1.2	2.31E-01	1.3	9.65E-02
APUTEX2500000844	KFM25716.1	GH5	1.3E-022	1.3	6.66E-02	1.2	2.06E-01
APUTEX2500000985	KFM28016.1	GH5	3.5E-017	0.2	**8.26E-10**	1.2	6.12E-01
APUTEX2500002156	KFM22632.1	GH5	4.0E-025	1.0	8.95E-01	1.1	4.56E-01
APUTEX2500002671	KFM29130.1	GH5	2.7E-021	1.2	2.55E-01	1.1	6.37E-01
APUTEX2500003890	KFM28332.1	GH5	7.4E-013	0.9	7.76E-01	1.0	7.96E-01
APUTEX2500004827	KFM23138.1	GH5	8.2E-021	1.6	**7.48E-03**	0.9	7.69E-01
APUTEX2500000468	KFM25061.1	GH9	2.9E-084	1.1	6.18E-01	1.0	7.91E-01
APUTEX2500000981	KFM28012.1	GH9	3.4E-050	1.4	2.17E-02	0.9	6.95E-01
APUTEX2500003119	KFM24581.1	GH9	4.6E-098	1.0	9.80E-01	1.2	2.00E-01
APUTEX2500005369-A	KFM24183.1	GH9	1.1E-113	1.8	**2.09E-03**	1.3	1.70E-01
APUTEX2500005369-B	KFM24184.1	GH9	9.2E-104	0.9	6.35E-01	0.9	5.24E-01
APUTEX2500005369-C	KFM24182.1	GH9	2.8E-100	1.4	3.50E-02	0.9	4.54E-01
APUTEX2500005777	KFM24064.1	GH9	3.6E-067	1.4	1.07E-02	1.1	4.89E-01
APUTEX2500000143	KFM24770.1	GH16	3.0E-065	1.2	3.73E-01	1.2	3.66E-01
APUTEX2500002026	KFM25245.1	GH18	6.8E-009	1.5	**9.56E-03**	0.9	7.15E-01
APUTEX2500002706	KFM22671.1	GH20	2.9E-104	1.5	1.73E-01	1.0	1.00E+00
APUTEX2500005097	KFM28226.1	GH27	8.8E-128	0.7	5.57E-02	1.2	2.21E-01
APUTEX2500001996	KFM25289.1	GH31	0.0E+000	0.7	5.00E-02	1.0	1.00E+00
APUTEX2500003474	KFM25547.1	GH31	0.0E+000	0.5	**4.20E-04**	1.0	9.63E-01
APUTEX2500000041	KFM23987.1	GH32	1.7E-067	1.6	2.85E-02	1.1	5.19E-01
APUTEX2500000101	KFM28270.1	GH38	6.6E-065	0.9	6.64E-01	1.0	8.29E-01
APUTEX2500005781	KFM24068.1	GH43	3.9E-015	1.1	5.89E-01	0.7	1.02E-01
APUTEX2500000370	KFM24944.1	GH43	2.3E-005	1.1	4.15E-01	1.0	8.85E-01
APUTEX2500000577	KFM26117.1	GH47	3.7E-172	0.9	6.71E-01	1.2	2.64E-01
APUTEX2500002068	KFM28922.1	GH47	6.1E-111	1.0	7.84E-01	1.0	8.47E-01
APUTEX2500004355	KFM22865.1	GH47	0.0E+000	1.1	4.19E-01	1.1	4.14E-01
APUTEX2500001195	KFM26337.1	GH63	0.0E+000	1.4	1.45E-02	1.1	6.12E-01

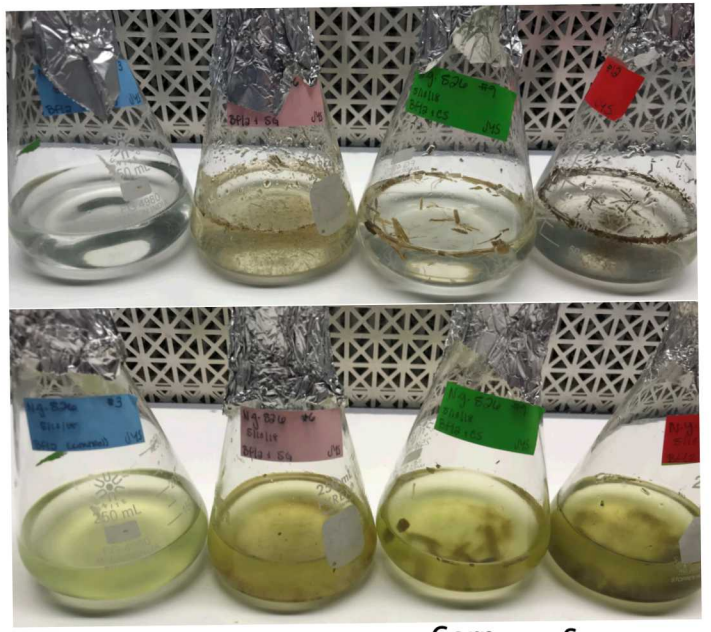




Nannochloropsis gaditana demonstrates improved cell growth with plant substrates at flask scale

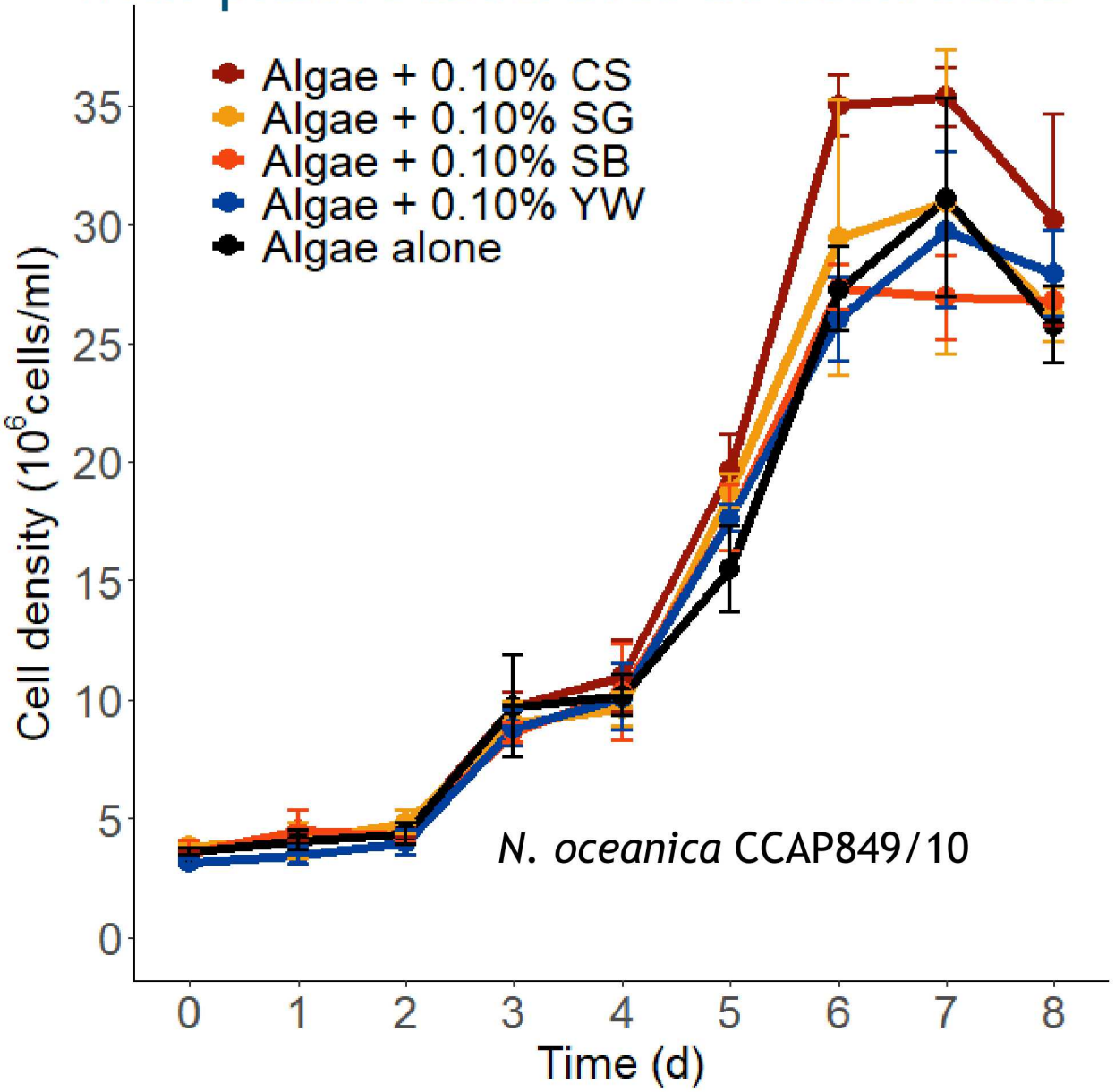


Treatment	Specific Growth Rate (μ)
Control	0.53 ± 0.03
Corn Stover	0.64 ± 0.03
Sugarcane Bagasse	0.62 ± 0.01
Switchgrass	0.61 ± 0.02



Control Switchgrass Corn Stover Sugarcane Bagasse

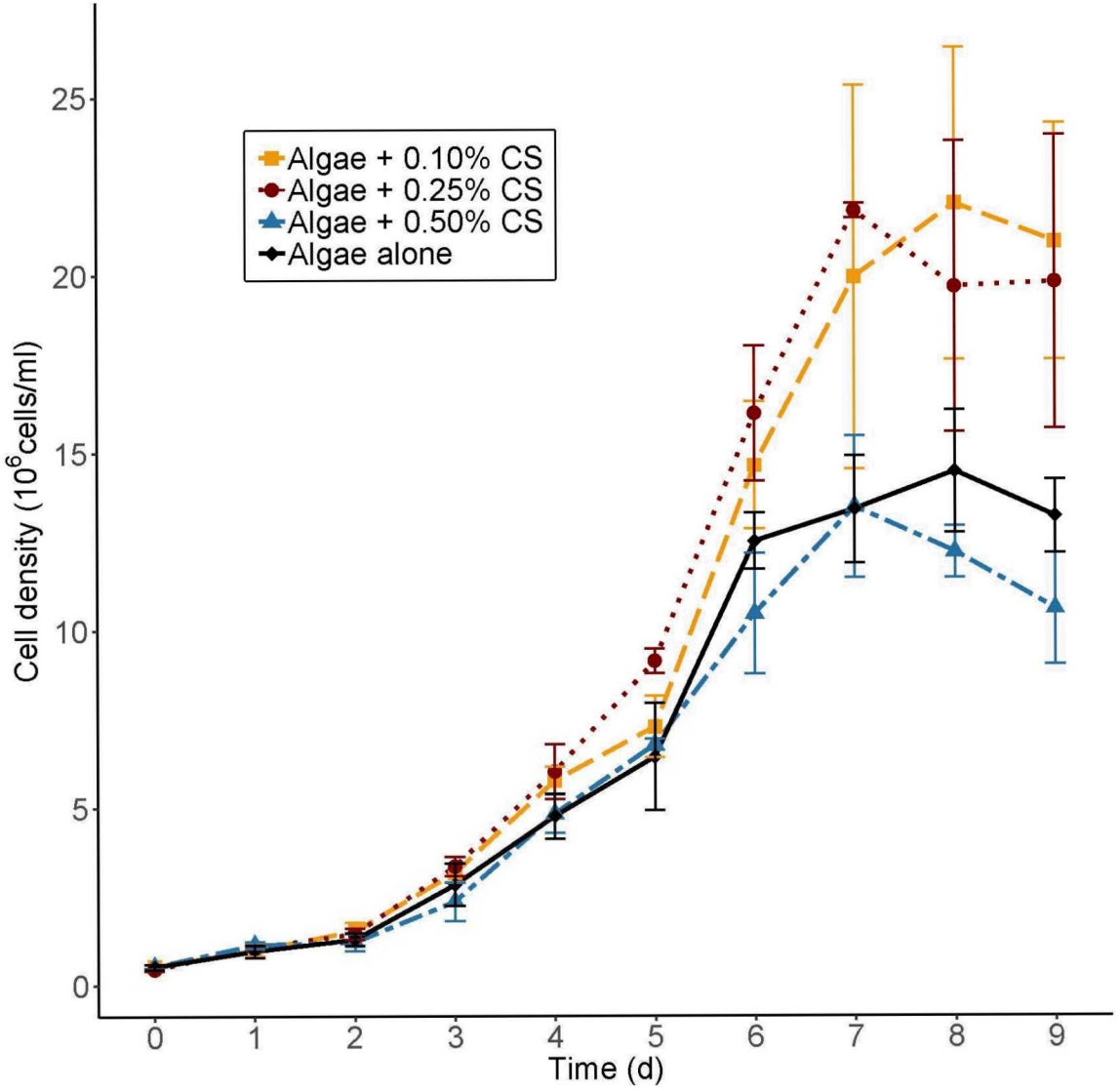
Nannochloropsis oceanica demonstrates improved cell growth with plant substrates at flask scale

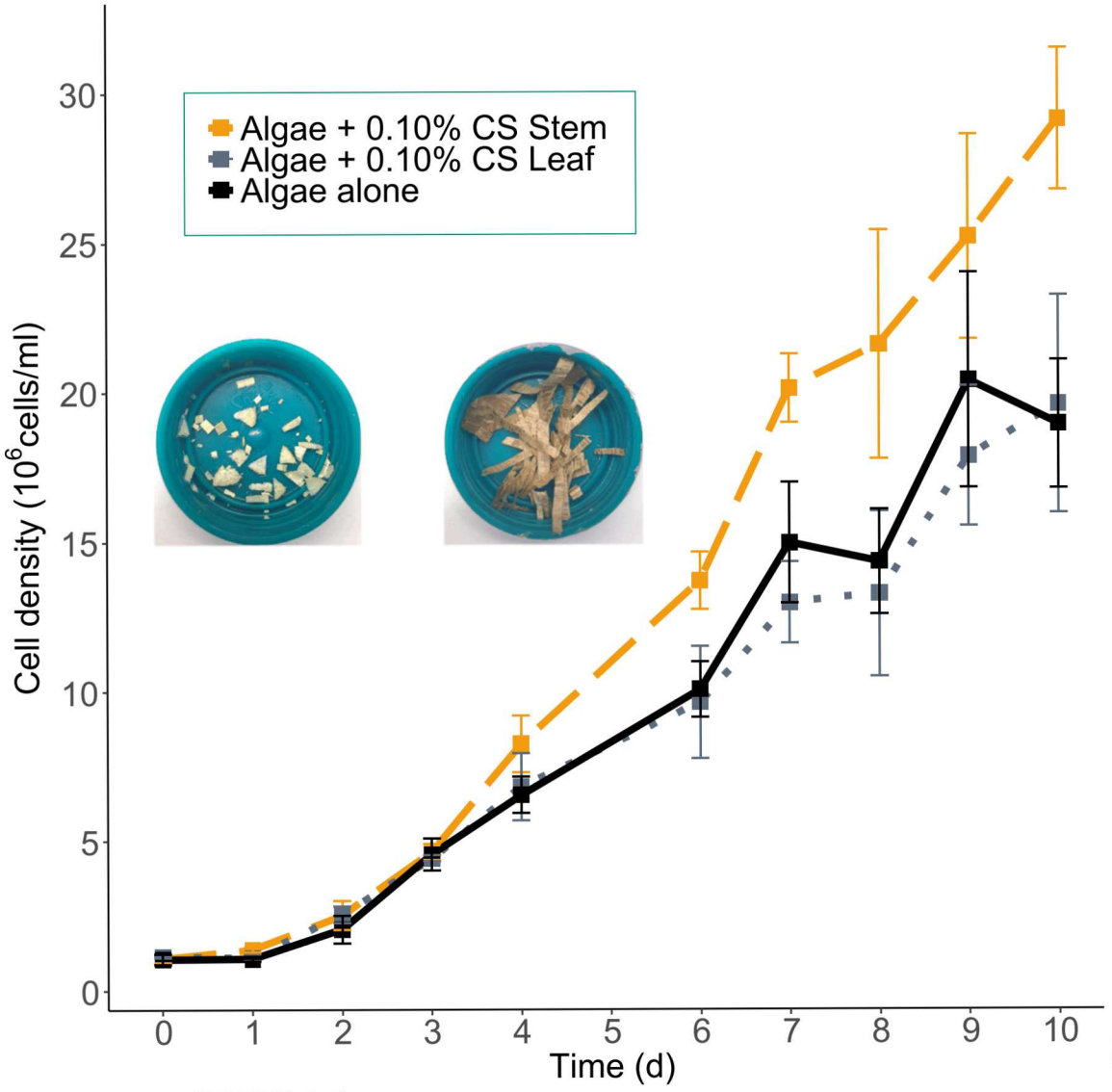


Treatment	Specific Growth Rate (μ)
Control	0.49 ± 0.03
Corn Stover	0.58 ± 0.03
Sugarcane Bagasse	0.50 ± 0.01
Switchgrass	0.56 ± 0.02

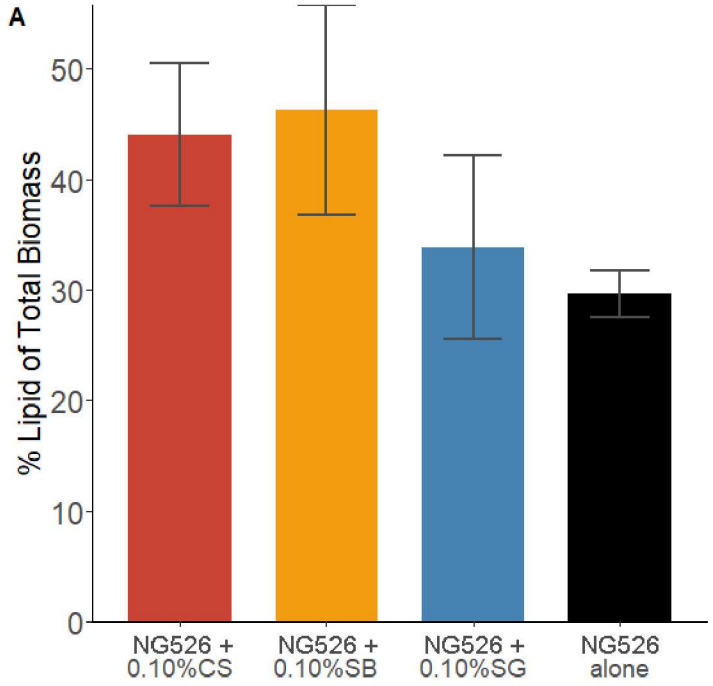
Control CS SG SB YW

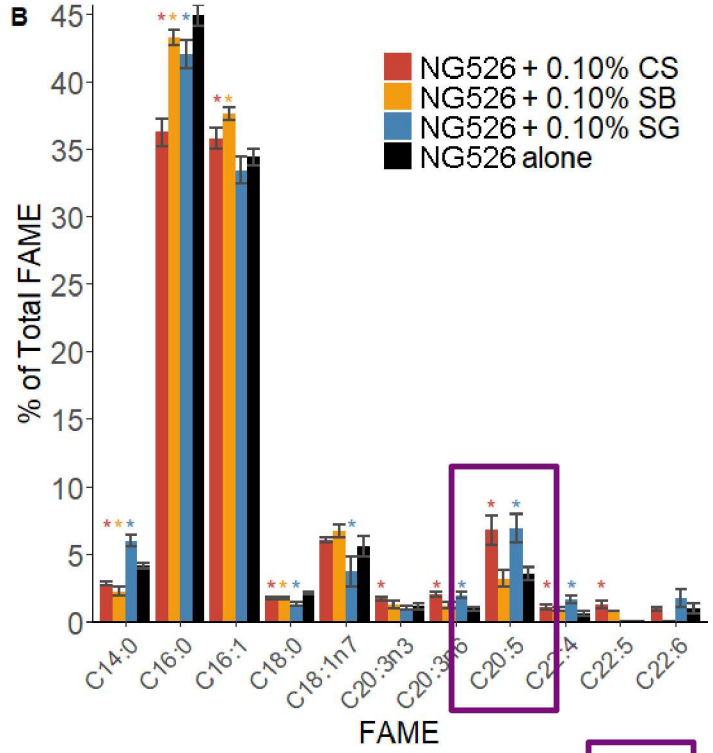
Plant substrate concentration and physiology matter



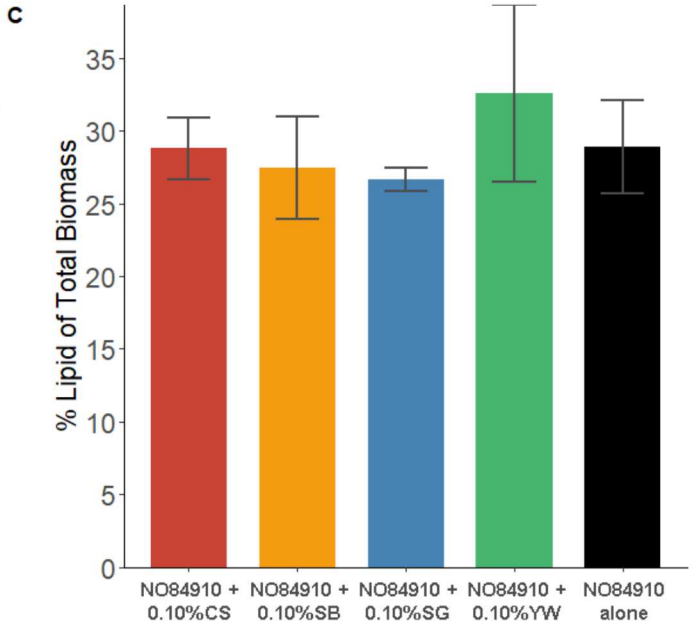


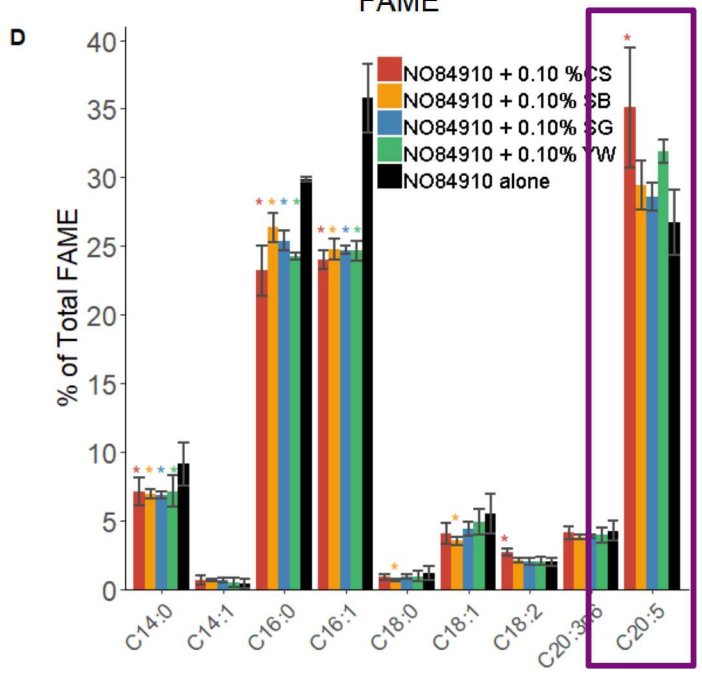
N. gaditana has increased total lipid content and changes in the lipid profile

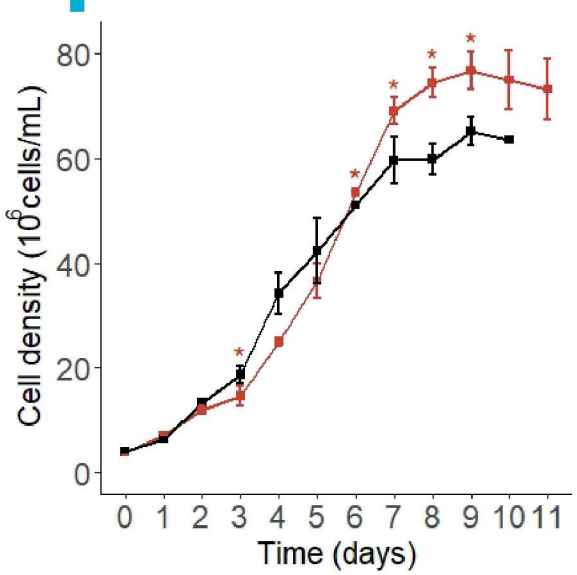


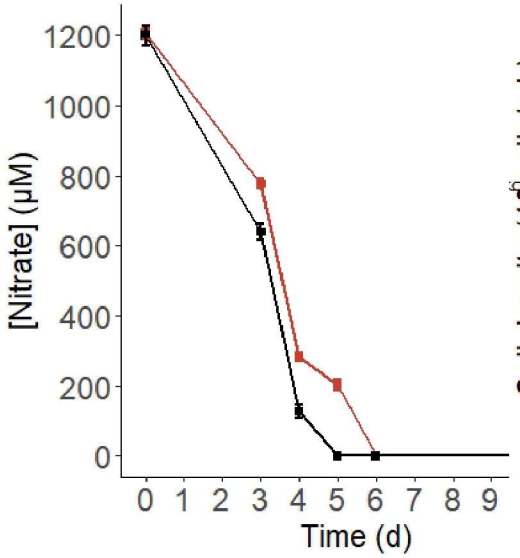


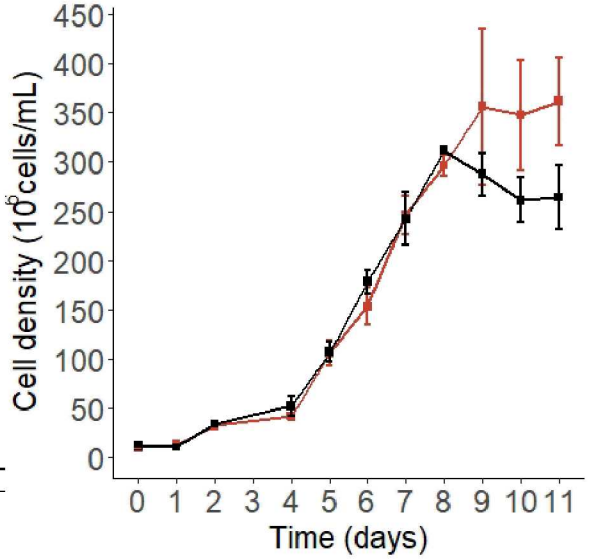
N. oceanica does not show a difference in total lipid content, but there is a shift in the lipid profile

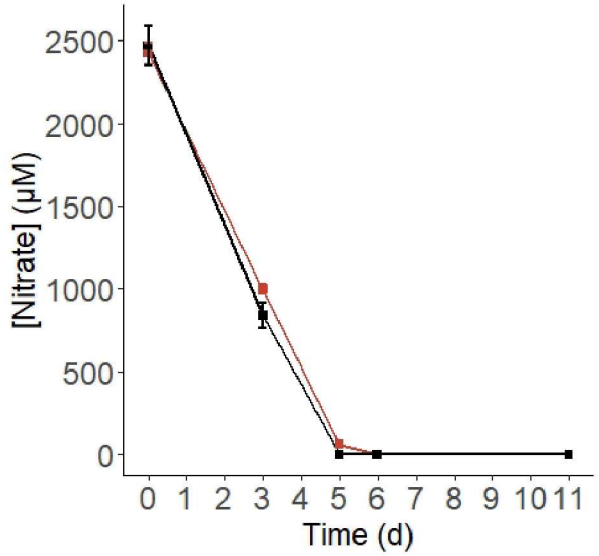












NG526 + 0.25% CS — NG526 alone

NO84910 + 0.10% CS — NO84910 alone

Mini raceway outdoor pond experiments demonstrate improved growth for *N. gaditana* with plant substrates with a delay in N starvation

N. oceanica shows no difference with plant substrates at mini raceway pond scale

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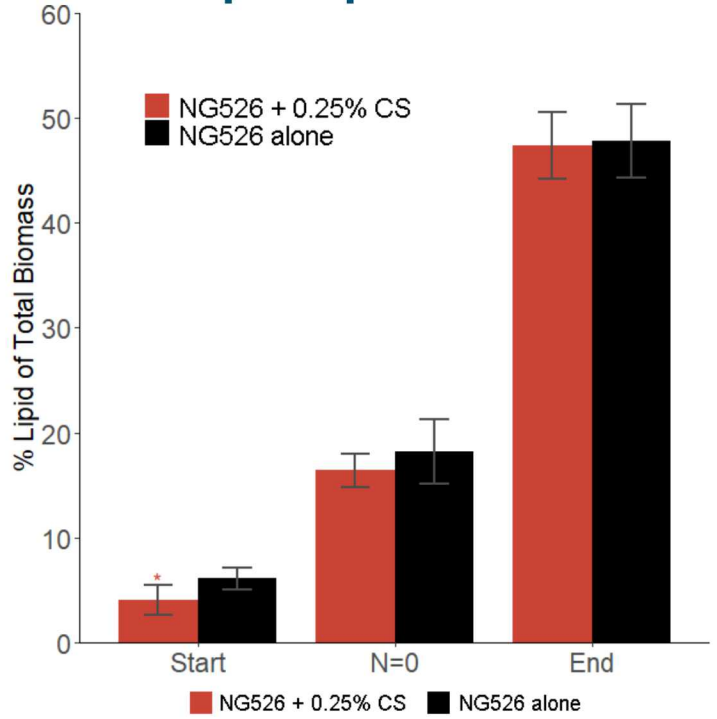
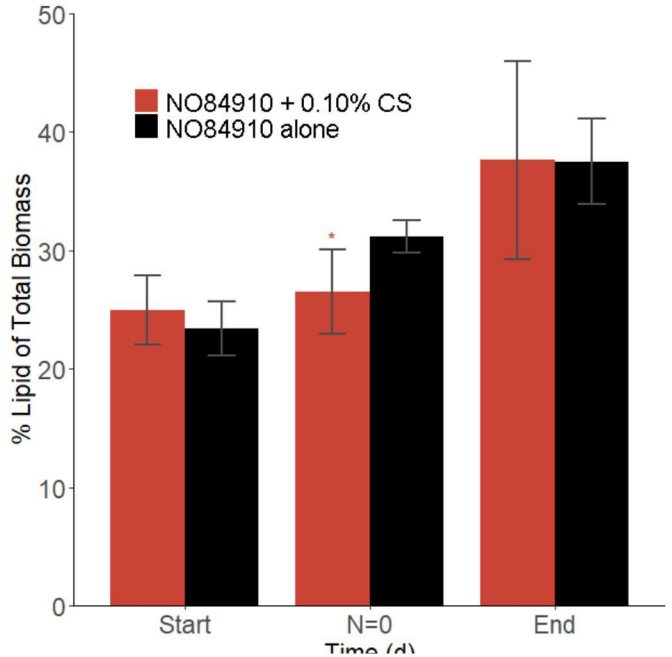
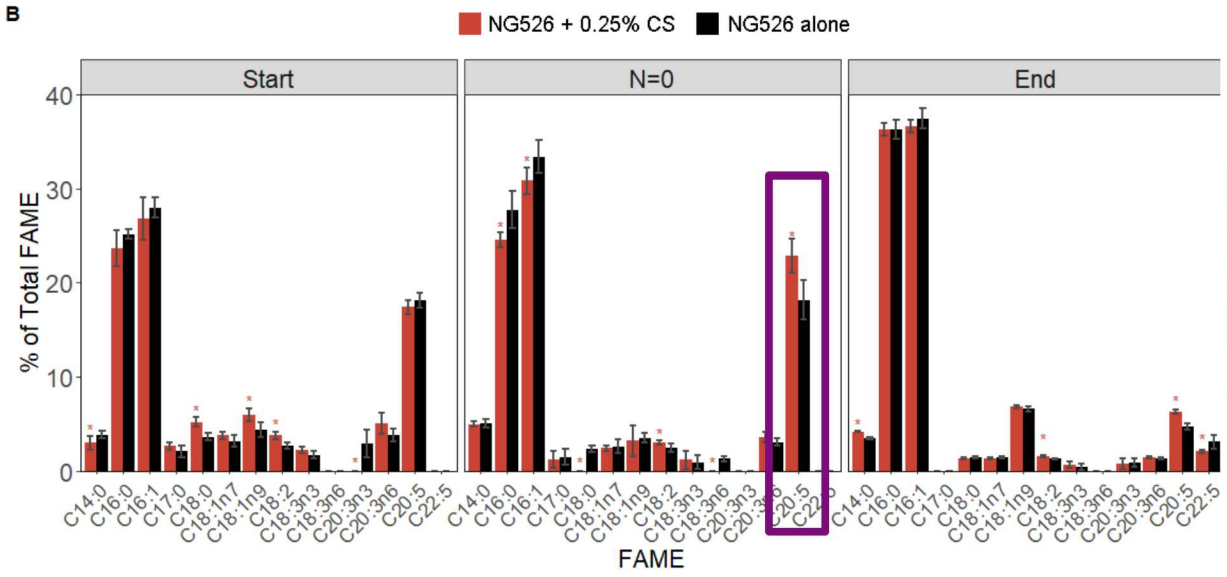
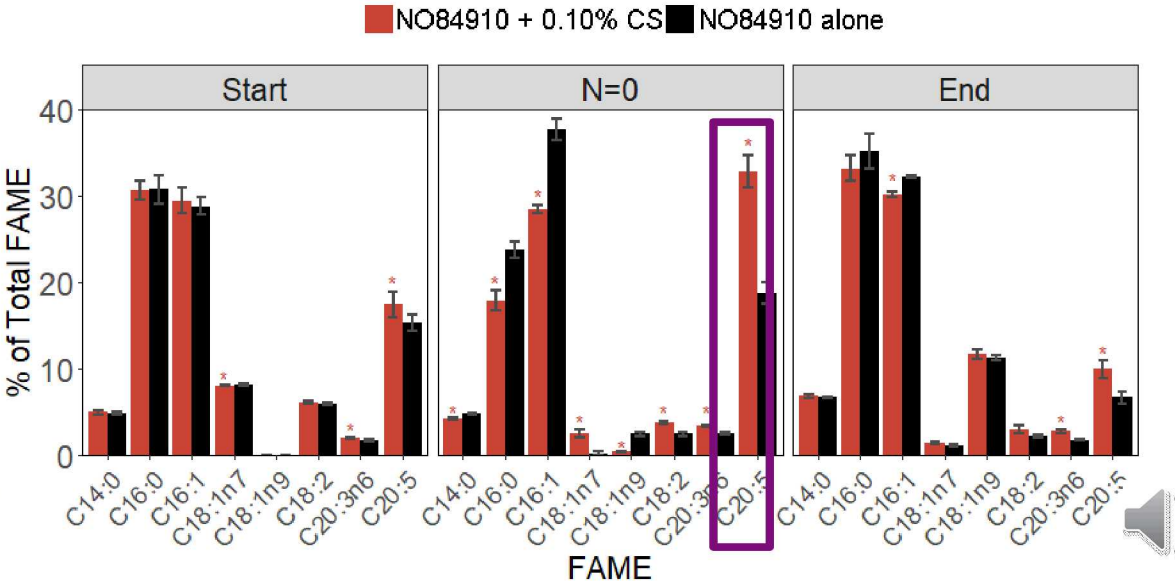
Mini pond experiments show no difference in total lipids but a shift in the lipid profile at N starvation

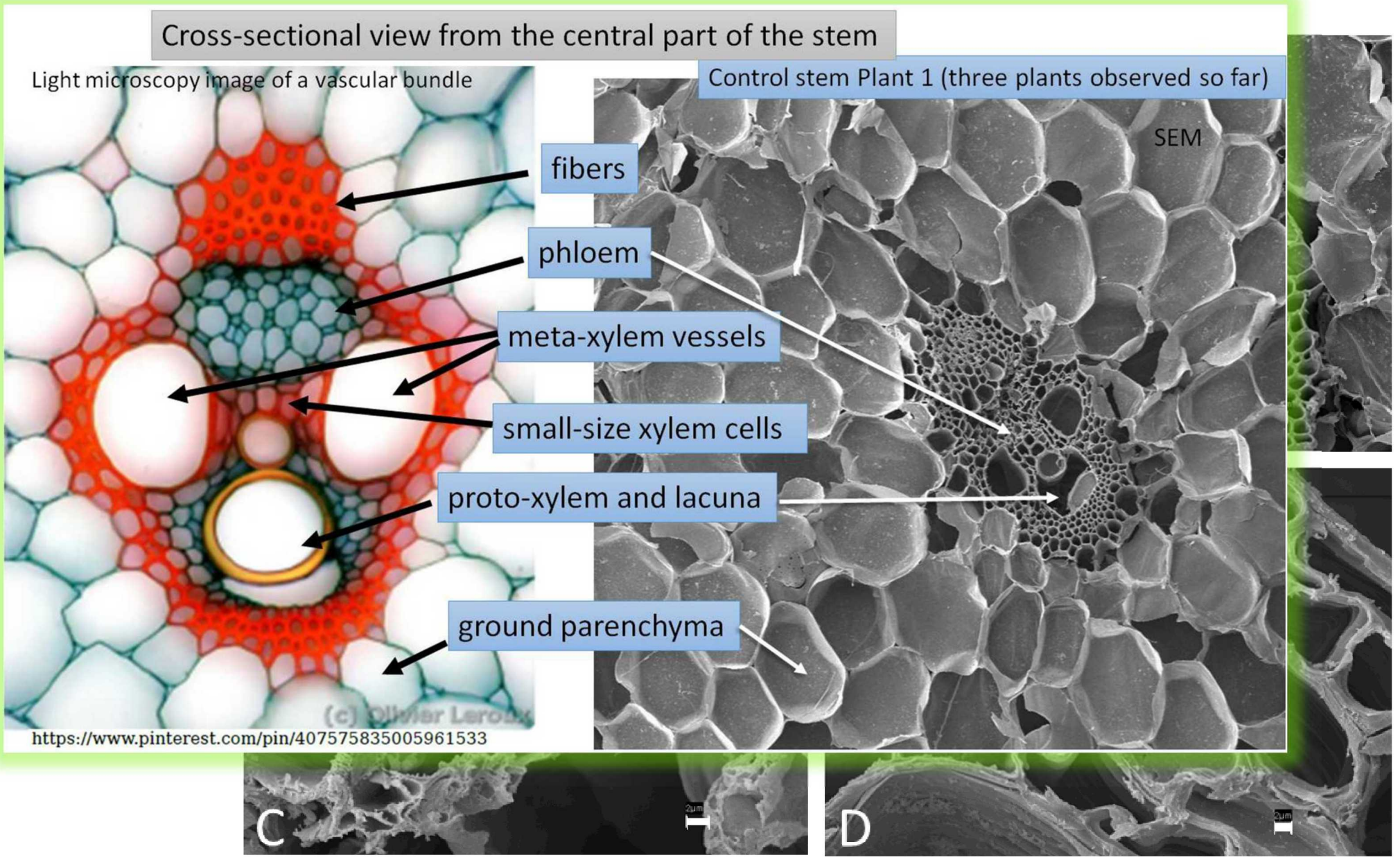






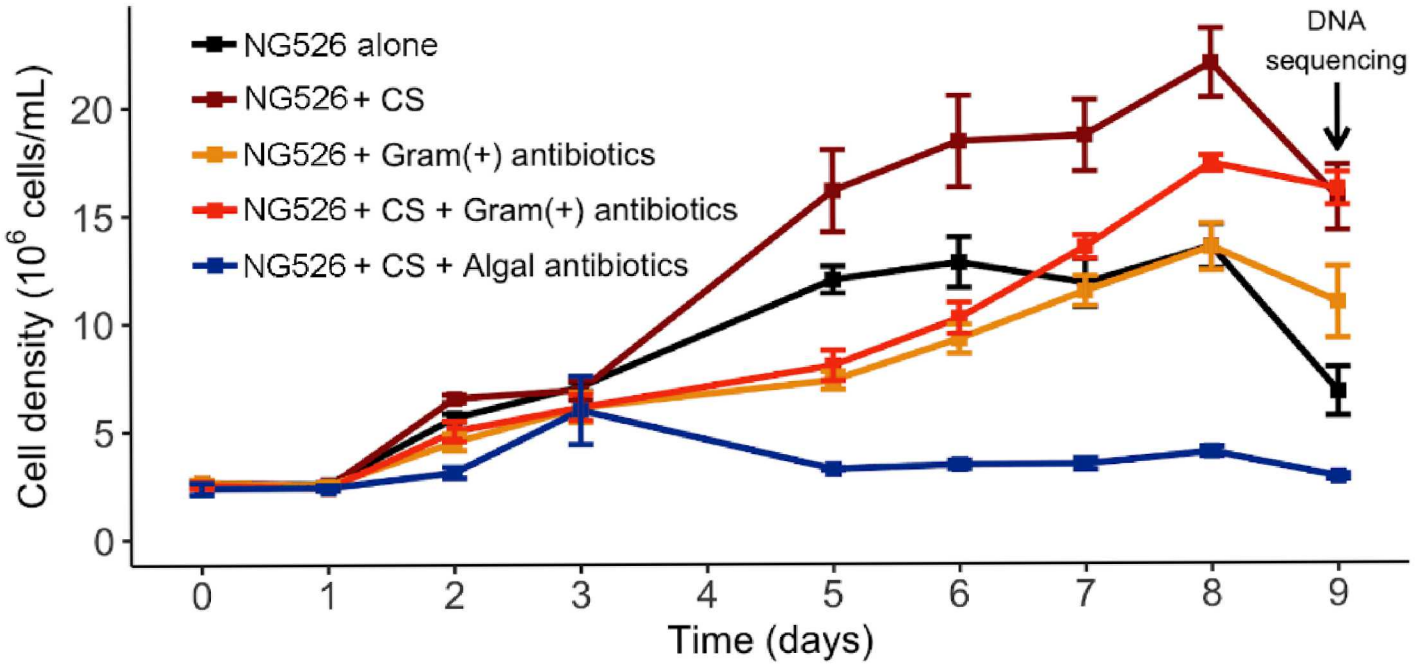


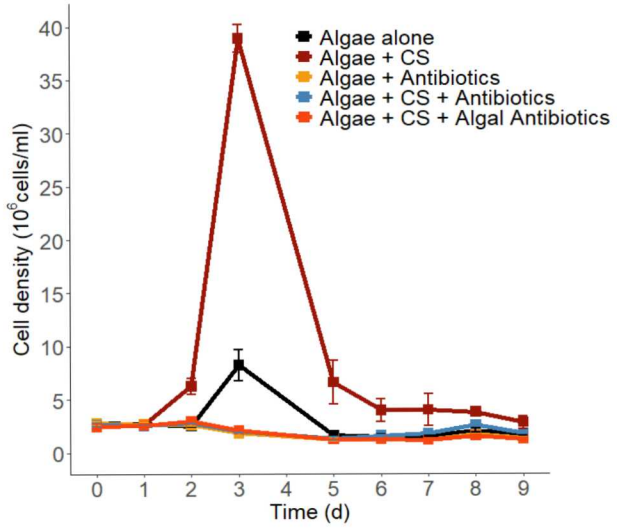
Plant substrate structure changes with algae growth

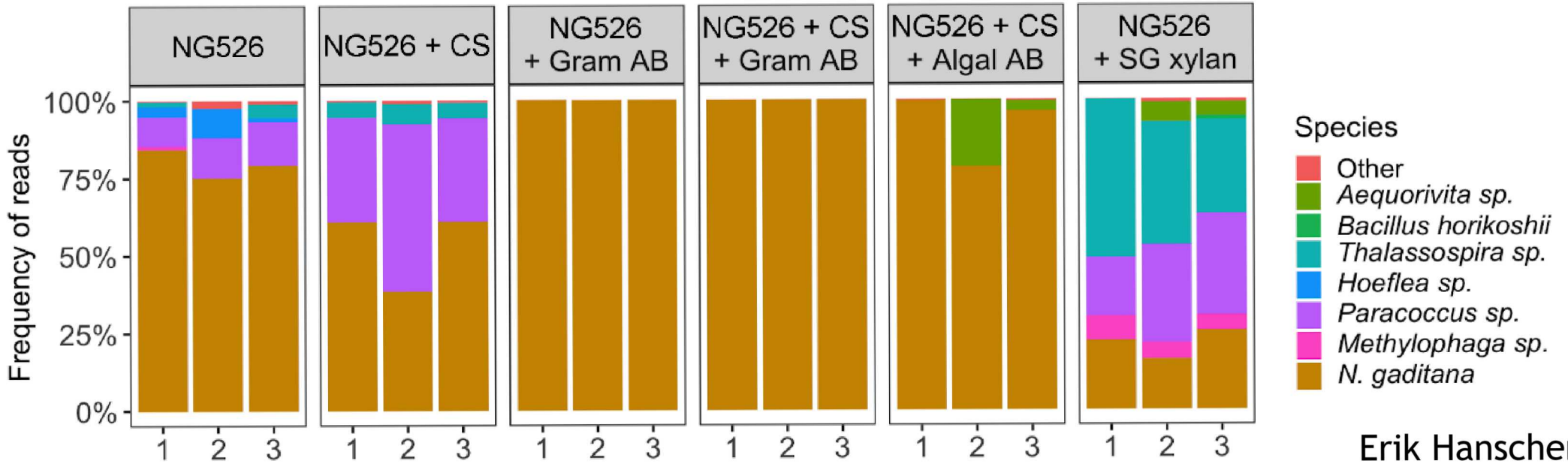


Peter Kitin and Chris Hunt, USDA

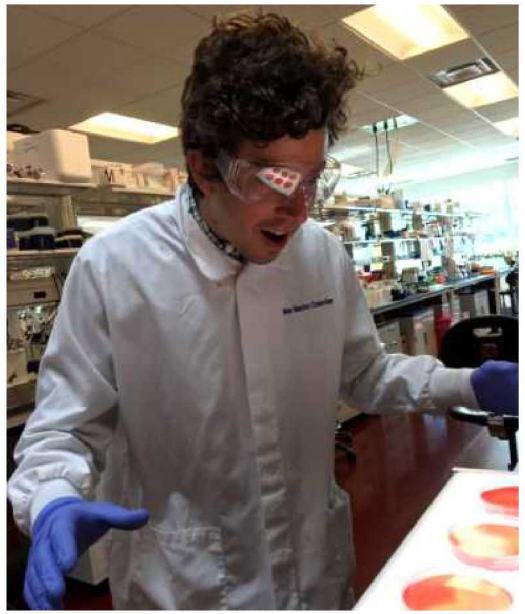
What about the microbiome?







Erik Hanschen, LANL



Brian Vogler
(Now at Conagen)

Jenna Schambach

Anna Finck

LEAF Project Collaborators

Nick Nagle, NREL
Phil Pienkos, NREL
Christopher Hunt, USFS
Peter Kitin, UW-Madison
Shawn Starkenburg, LANL
Erik Hanschen, LANL

LANL LDRD Early Career Award FY17-FY19
3-year AOP LEAF Project started FY20

	Ash	Klason Lignin	Arabinan	Galactan	Glucan	Xylan	Mannan	Tot Carb	Yield
CS	0.9 (0.9)	13.4 (1.8)	3.2 (0.8)	0.6 (1.2)	33.1 (3.4)	18.6 (1.9)	0	55.4 (4.4)	69.8(7.0)
NG526 + CS	0.6 (1.1)	14.1 (1.1)	3.5 (1.0)	0	33.6 (2.1)	18.5 (1.9)	0	55.7(4.7)	70.4(5.5)

	Arabinan		Galactan		Glucan		Xylan		Mannan	
	Avg	**95% C.I.**	**Avg**	**95% C.I.**	**Avg**	**95% C.I.**	**Avg**	**95% C.I.**	**Avg**	**95% C.I.**
NG526 alone	0.0	N/A	54.6	18.6	49.1	37.3	9.0	8.6	16.0	11.4
CS alone	30.9	19.9	55.3	43.8	109.5	30.1	59.2	30.1	0.0	N/A
Sum	31.0	19.9	110.0	37.5	159.0	31.4	68.0	27.4	16.0	11.4
NG526 + CS	29.5	16.9	100.9	64.7	78.5	11.5	44.0	18.3	20.2	43.8
p value	0.797		0.656		0.002		0.051		0.716	