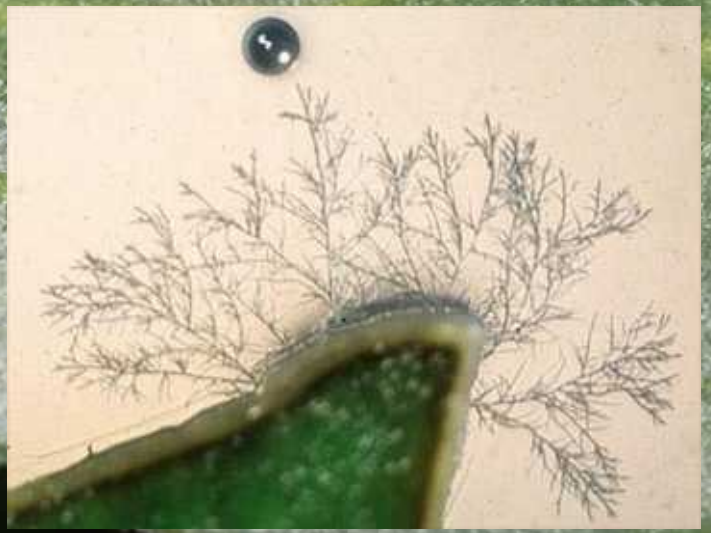
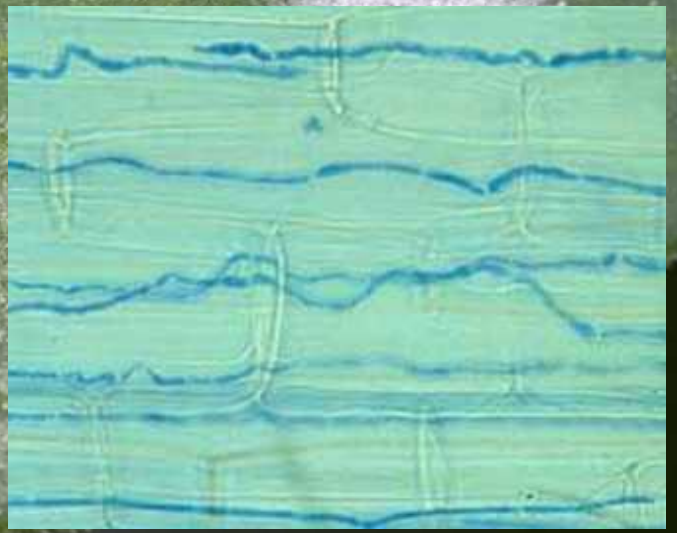
Probiotics for endangered plants: plant conservation from a fungal perspective


MAUNA LOA
OBSERVATORY


NORM
B1
NORM
B2
NORM
A2
NORM
A3

Inside every leaf, there are dozens or even *hundreds* of different fungi





GENOME RESEARCH

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Genome Res. 2010 Oct; 20(10): 1411–1419. PMCID: PMC2945190
doi: 10.1101/gr.107987.110

Reshaping the gut microbiome with bacterial transplantation and antibiotic intake

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Fecal Transplant for Recurrent Clostridium difficile Infection in Children With and Without Inflammatory Bowel Disease

Russell, George H.*; Kaplan, Jess L.*; Youngster, Ilan*; Baril-Dore, Mariah*; Schindelar, Lili*; Hohmann, Elizabeth†; Winter, Harland S.*

Journal of Pediatric Gastroenterology & Nutrition:
May 2014 - Volume 58 - Issue 5 - p 588–592
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Original Articles: Hepatology and Nutrition

RESEARCH ARTICLE | OPEN ACCESS | OPEN PEER REVIEW

Towards microbiome transplant as a therapy for periodontitis: an exploratory study of periodontitis microbial signature contrasted by oral health, caries and edentulism

Alex E. Pozhitkov, Brian G. Leroux, Timothy W. Randolph, Thomas Beikler, Thomas F. Flemmig and Peter A. Noble

BMC Oral Health 2015 15:125 | DOI: 10.1186/s12903-015-0109-4 | © Pozhitkov et al. 2015
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Fecal Microbial Transplant Effect on Clinical Outcomes and Fecal Microbiome in Active Crohn's disease

David L. Suskind, MD,[1] Mitchell J. Brittnacher, PhD,[2] Ghassan Wahbeh, MD,[1] Michele L. Shaffer, PhD,[1] Hillary S. Hayden,[2] Xuan Qin, PhD,[3] Namita Singh, MD,[4] Christopher J. Damman, MD,[5] Kyle R. Hager, Heather Nielson, and Samuel I. Miller, MD[2,5,6,7]

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METHODOLOGY | OPEN ACCESS

Stool substitute transplant therapy for the eradication of *Clostridium difficile* infection: 'RePOOPulating' the gut

Elaine O Petrof[†], Gregory B Gloor[†], Stephen J Vanner, Scott J Weese, David Carter, Michelle C Daigneault, Eric M Brown, Kathleen Schroeter and Emma Allen-Vercoe
[†]Contributed equally

Microbiome 2013, 1:3 | DOI: 10.1186/2049-2618-1-3 | © Petrof et al.; licensee BioMed Central Ltd. 2013
Received: 20 March 2012 | Accepted: 18 July 2012 | Published: 9 January 2013

10,320 research papers on human microbiome in the past year alone.

5,460 of those are about transplantations.

"Pro-biotics"

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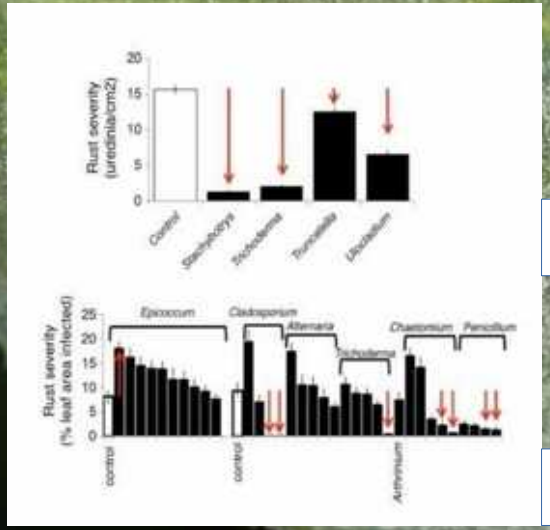
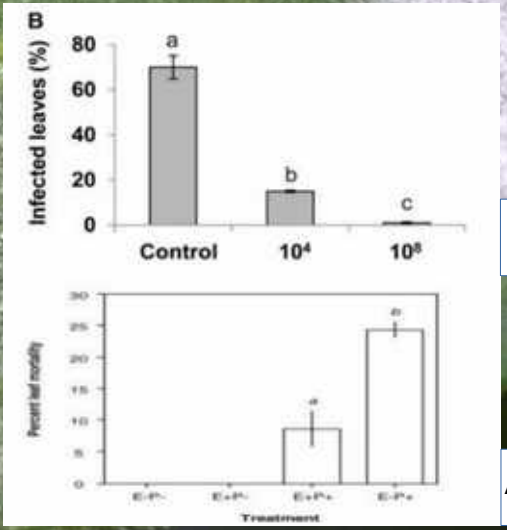
Fungal endophytes modify plant disease



Raghavendra and Newcombe, 2013

Busby, *et al.,* 2015



Buxdorf, *et al.,* 2013

Arnold, *et al.,* 2003

Phyllostegia kaalaensis

- **O'ahu endemic**
- **Extant only in two greenhouse populations**
- **Ecological extinction blamed on habitat loss, feral ungulates, and invasive pathogens**
- **Greenhouse populations dependent on regular applications of fungicides**
- **Outplanting efforts typically fail within months**
- **New approaches needed**

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Neoerysiphe galeopsidis disease progression

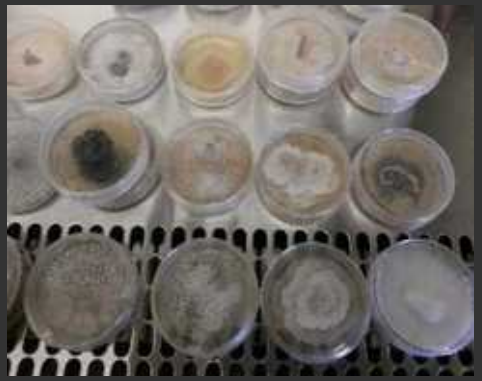
~30 Days

Study Design Overview

Phyllostegia hirsuta

Filtered (100 µm)
Leaf Slurry from healthy wild relative

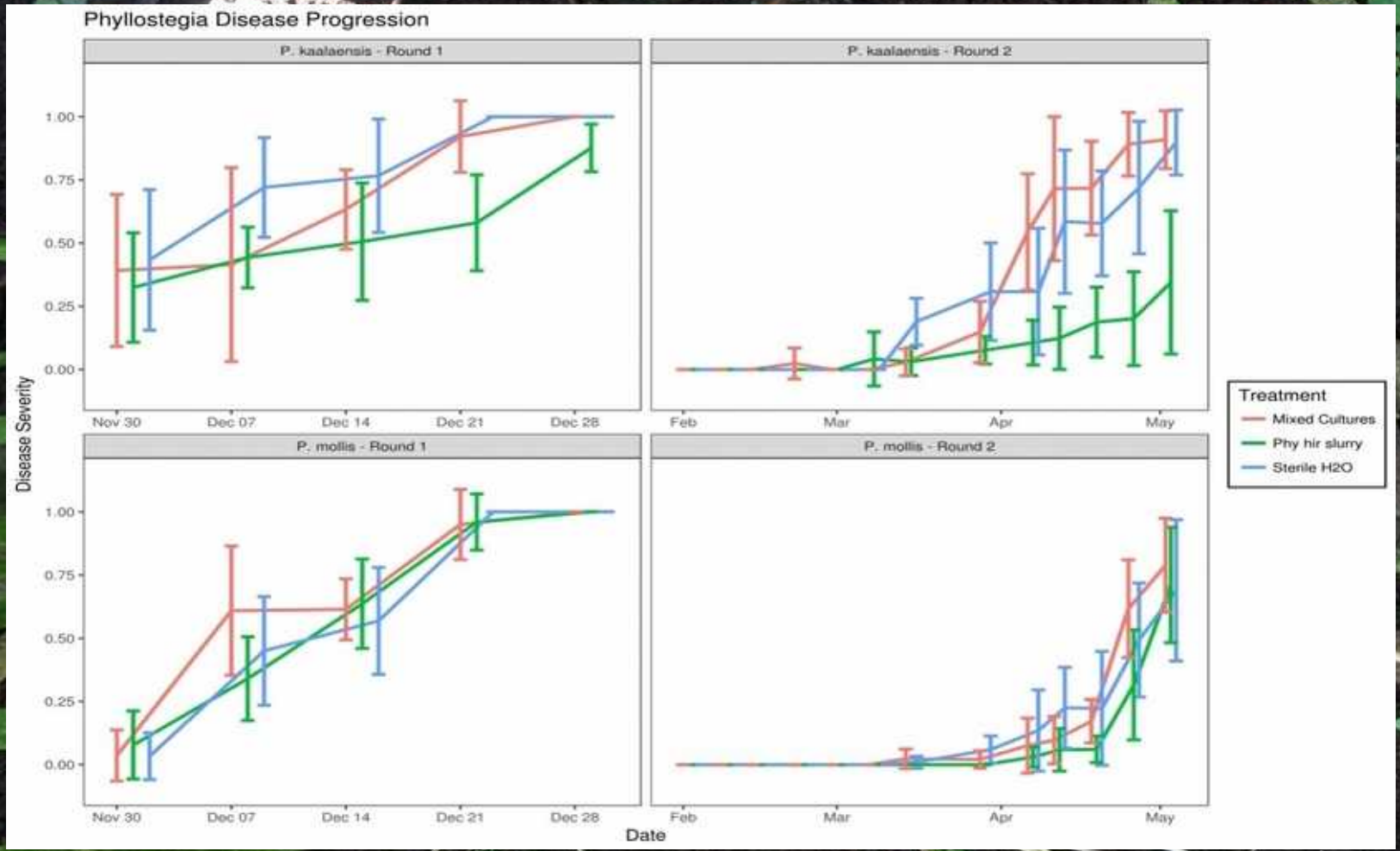
Sterile H2O



Fungal isolates from *P. hirsuta*

Cultured isolates from wild relatives

Slurry from wild relatives decreased disease severity



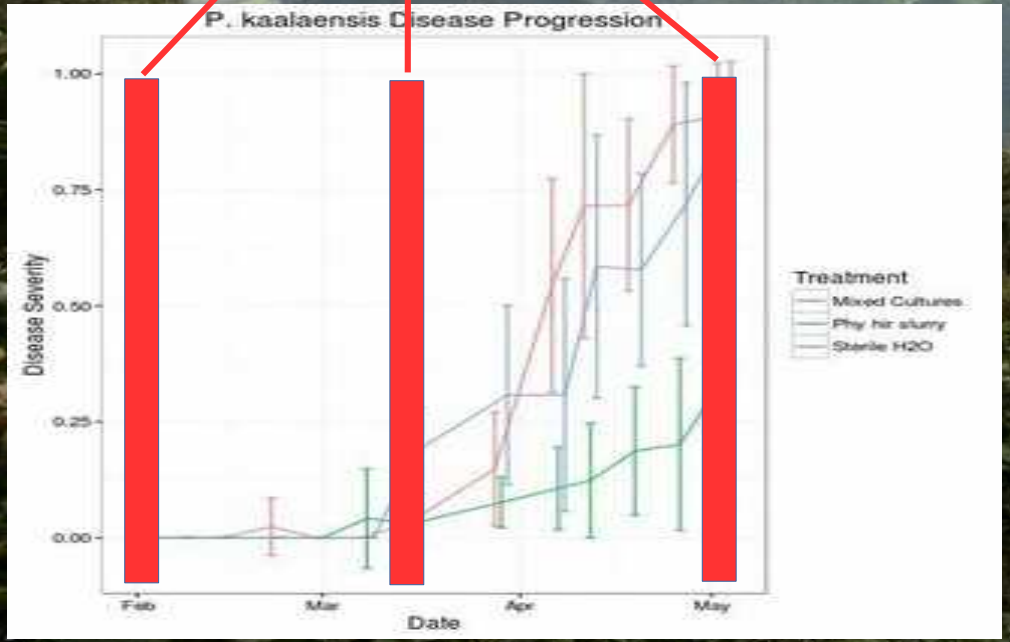
Paired-End
Illumina MiSeq

ITS Amplifications

Merge reads

Extract ITS1 Region

Pick OTUs
Assign taxonomy



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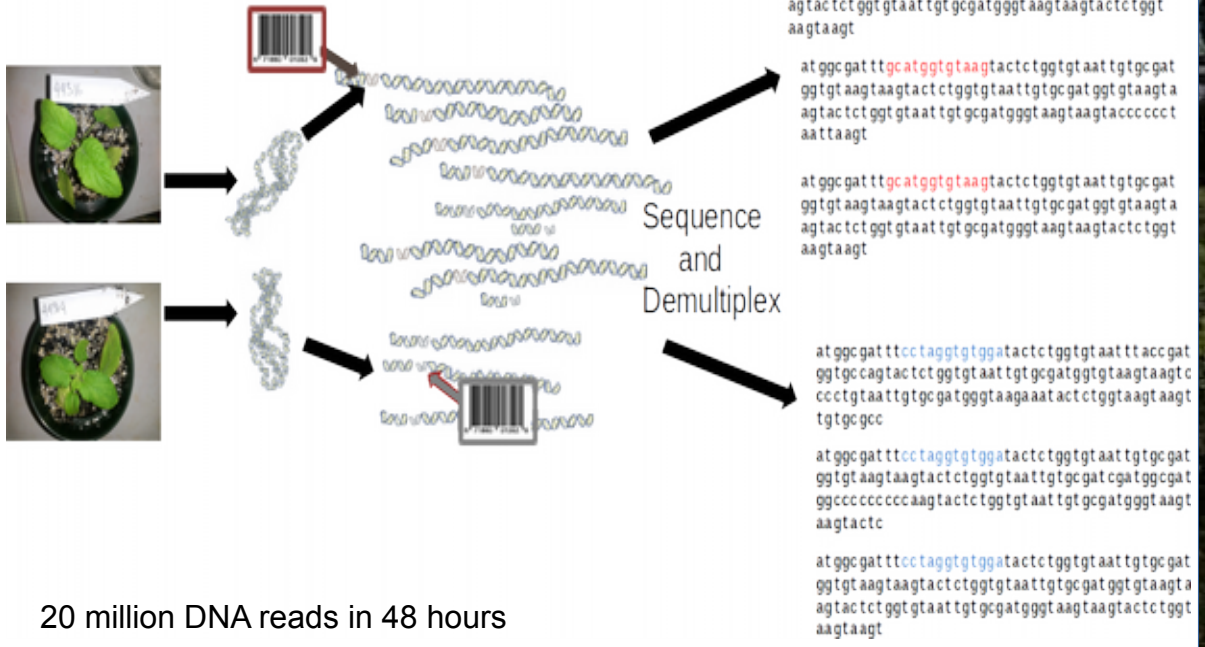
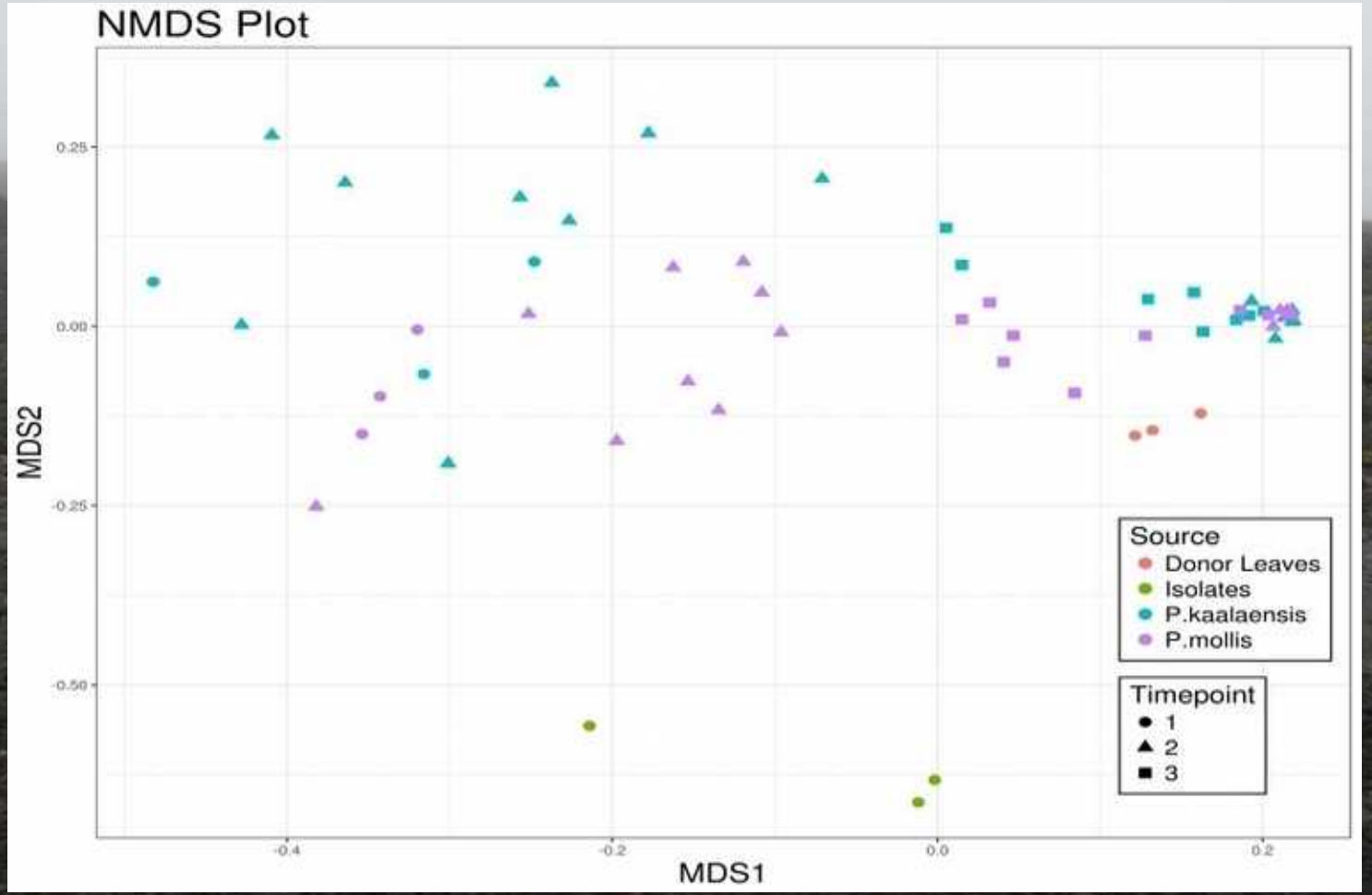


20 million DNA reads in 48 hours

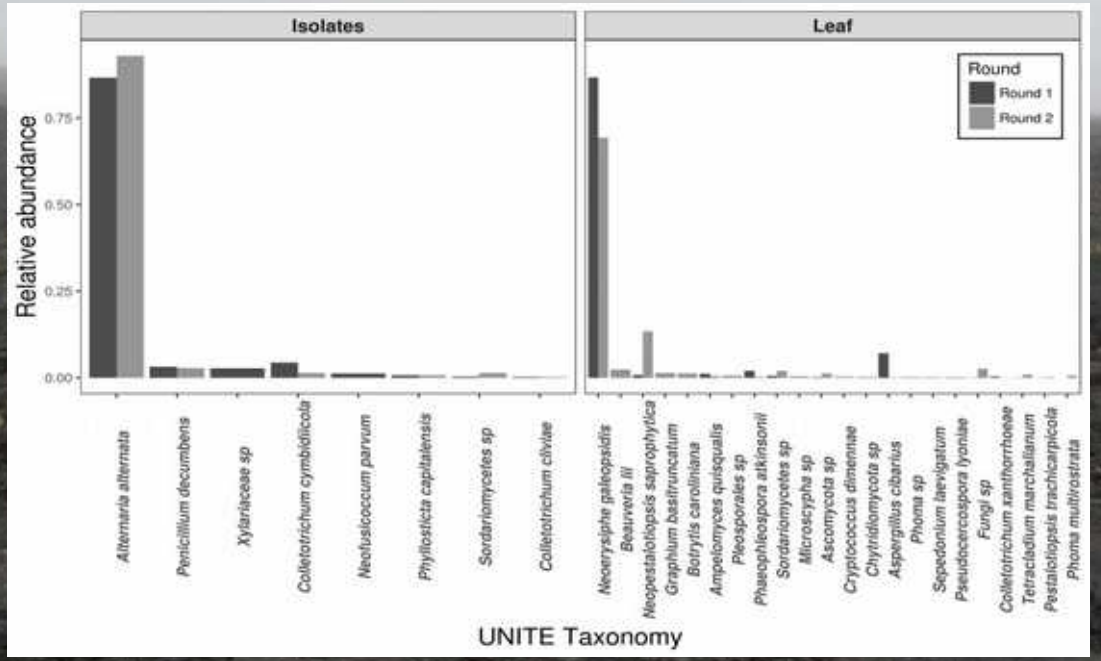
"Species" Abundance Table

	A	B	C	D	E	F
1	OTU_ID	Sample1	Sample2	Sample3	Sample4	Sample5
2	Species1	2	0	0	0	0
3	Species2	0	1	0	0	0
4	Species3	0	0	3	0	0
5	Species4	0	758	0	1	87
6	Species5	15	0	0	0	3
7	Species6	3929	1890	1520	3238	1803
8	Species7	0	0	0	0	0
9	Species8	0	0	0	0	4
10	Species9	0	0	233	0	0
11	Species10	0	0	0	0	455
12	Species11	18	3	0	4543	0
13	Species12	0	0	0	0	0
14	Species13	91	0	0	34	0
15	Species14	0	11	0	0	46
16	Species15	0	0	0	0	0

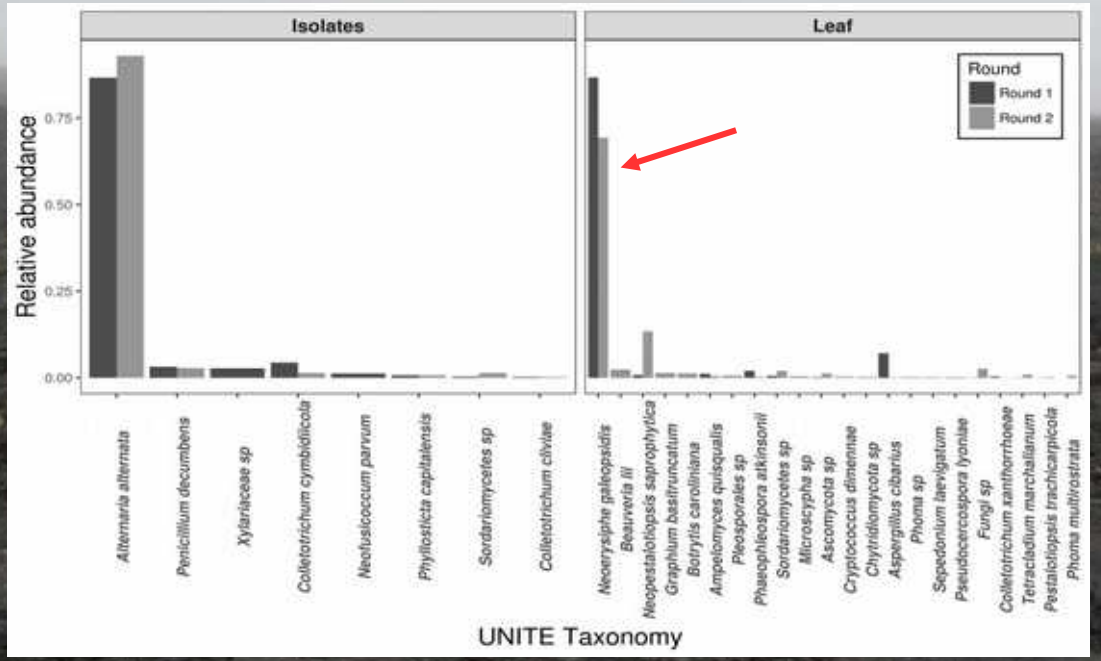
OTU = Operational Taxonomic Unit


NMDS Plot
MDS2
MDS1
0.25
0.00
-0.25
-0.50
-0.4
-0.2
0.0
0.2
Source
Donor Leaves
Isolates
P.kaalaensis
P.mollis
Timepoint
1
2
3

So, who was in that beneficial leaf slurry inoculum?

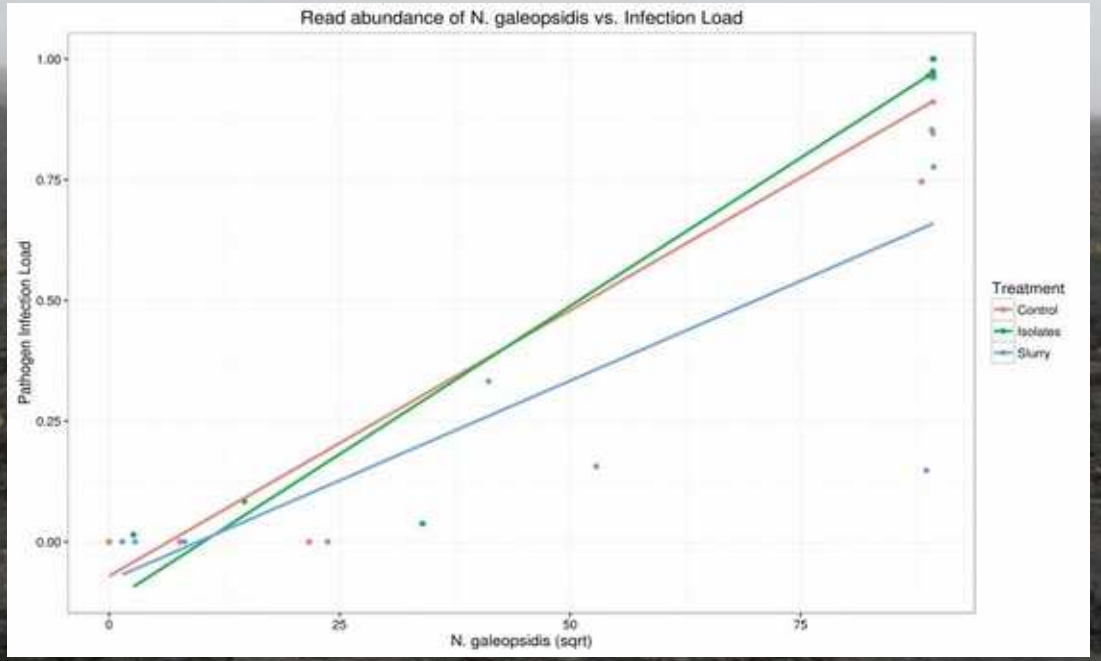


So, who was in that beneficial leaf slurry inoculum?



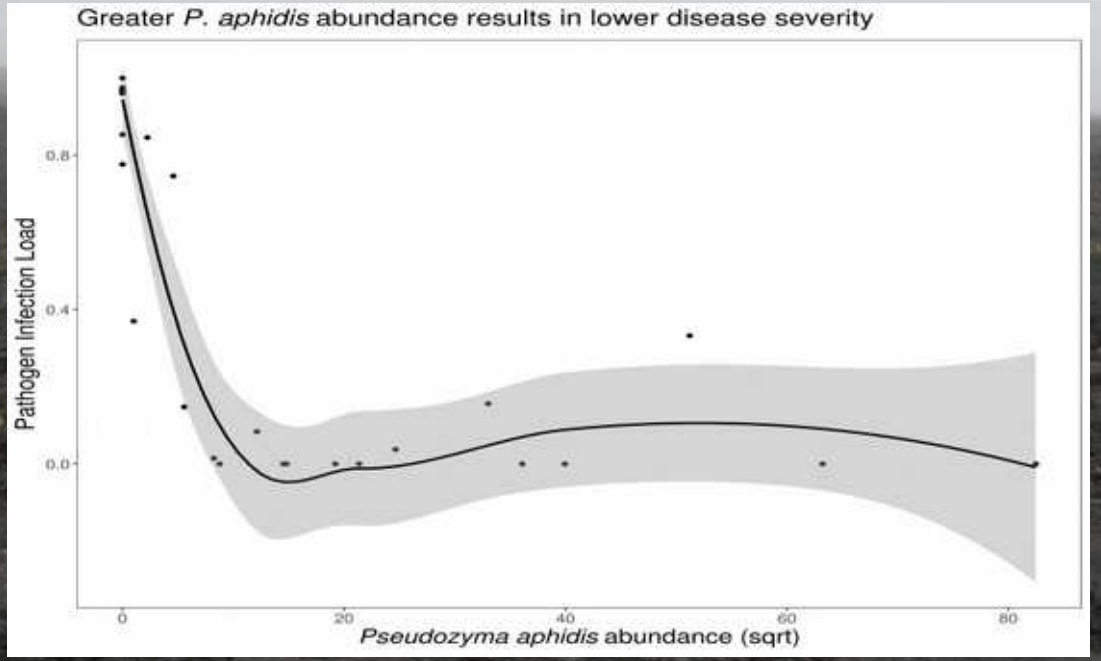
Turns out, it was mostly the pathogen we were trying to prevent!
(*N. galeopsidis*)

Two species were significantly associated with infection severity

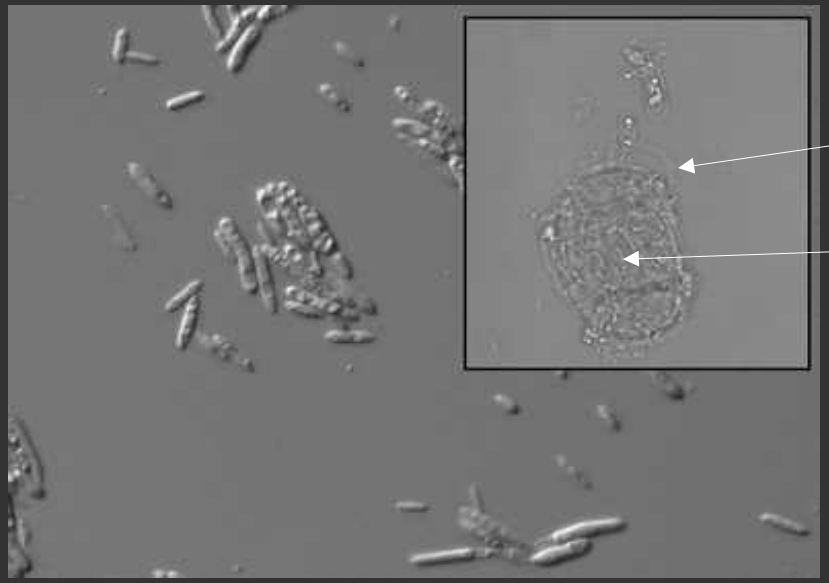


Neoerysiphe galeopsidis, the pathogen, obviously

Two species were significantly associated with infection severity

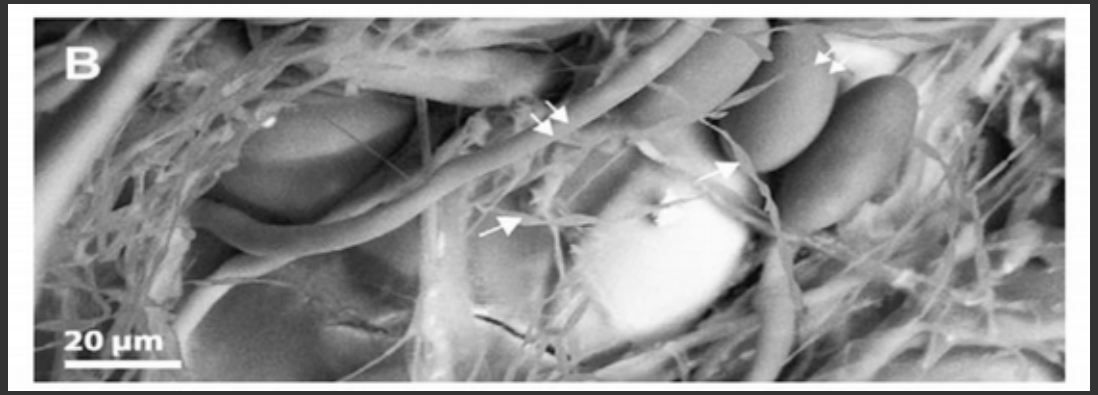


...And a little yeast, *Pseudozyma aphidis* that seemed to prevent infection!

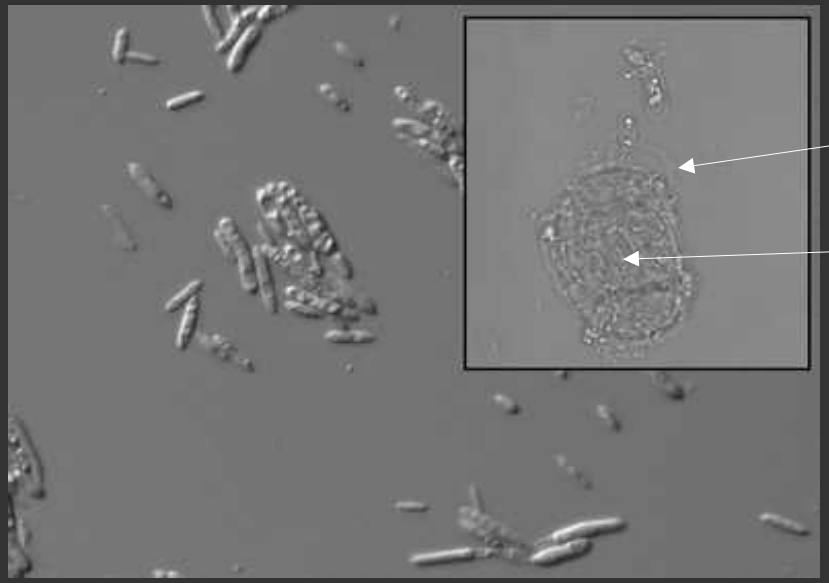


P. aphidis attacking

Pathogen spore



Clement-Mathieu et al., 2007, Fungal Ecology



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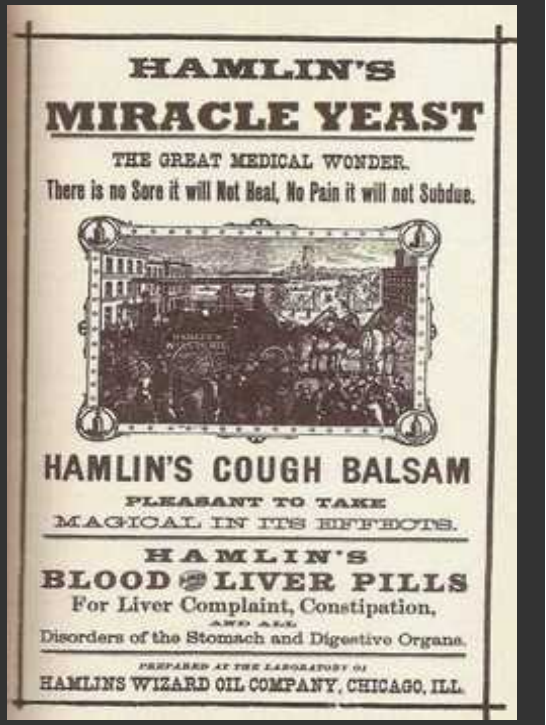

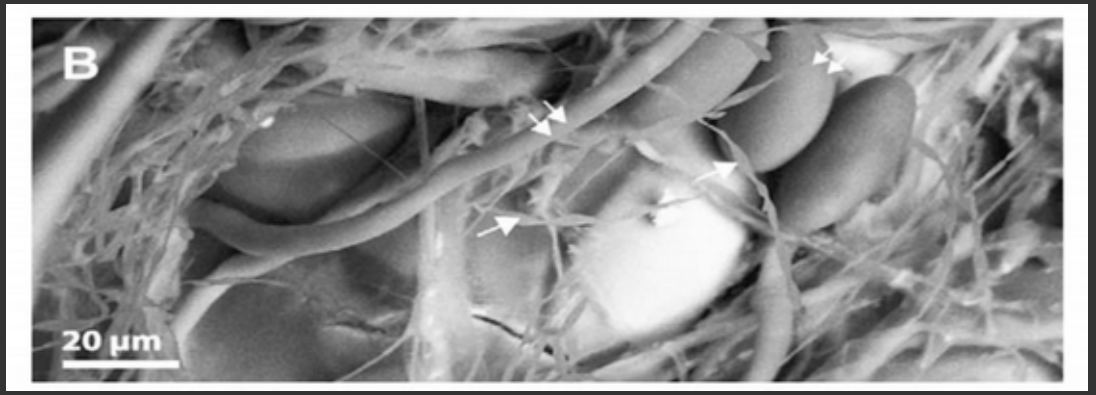

Clement-Mathieu et al., 2007, Fungal Ecology

geoffreyzahn.com

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