The Absence of Soil-dwelling Microflora will Decrease the Fitness of *Arabidopsis thaliana* in Presence of Opportunistic Fungus such as *Penicillium* spp.

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Hypothesis:

The absence of preexisting soil microbes will greatly diminish the development and pathogenic resistance of *Arabidopsis thaliana* grown in the same soil.

Introduction:

Soil microbial communities play a crucial role in the pathogenic resistance, growth and development of vascular plants. Specifically, endomycorrihizal and ectomycorrihizal interactions by endophytic bacteria and fungi enhance vascular plant's ability to cope against infection from potentially harmful microorganisms. It has been documented that when soil microbes are removed, plants that have adapted to grow in an environment with soil microbes, are by the whole less healthy than plants grown in the presence of soil microbes. The mechanisms by which soil microbes influence vascular plant root system's development and nutrient acquisition are not fully understood. By further understanding the mechanisms of below-ground phyto-immunology, advances can be made in the agricultural industry as well as being applied to the preservation of species.

Abstract:

To support this claim, *A. thaliana* strain Col-0, was grown in either autoclaved or non-autoclaved soil and in the presence or absence of *Penicillium* spp. The *Penicillium* spp. was utilized into a cultural suspension and sprayed at the base of stems of treatments 1 and 3. The culture suspension proved relatively ineffective for the infection of healthy mature plants. However, the suspension did have a minimal effect on young still-developing plants. Autoclaved treatment had a higher mortality rate on juvenile plants than non-autoclaved treatment when suspension was applied. Illustrating that young vascular plants are more susceptible to fungal infection than mature plants.

Materials and Methods:

Growing Conditions:
Strain: *A. thaliana*, Col-0
Photoperiod: L-16:D-8
Pathogen: *Penicillium* spp.
Treatments:

1. Autoclaved soil with introduced *Penicillium* spp.
   - Juvenile *A. thaliana* and mature *A. thaliana*
2. Autoclaved soil without *Penicillium* spp.
3. Non-autoclaved soil without *Penicillium* spp.
4. Non-autoclaved soil with introduced *Penicillium* spp.
   - Juvenile *A. thaliana* and mature *A. thaliana*

Fig 1. *Penicillium* spp. was isolated from nutrient agar. Then, was cultured on Sabouraud Dextrose Agar (SDA) (shown).

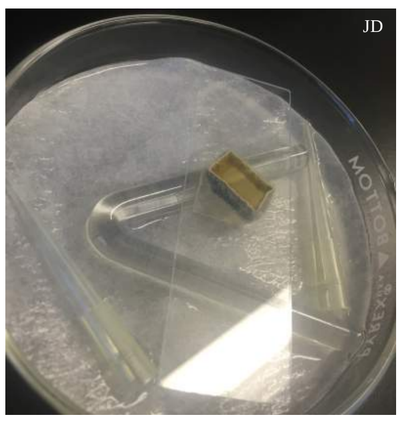


Fig. 2. Fungal Slide Culture. Once *Penicillium* spp. was isolated, spores were streaked along the sides of the SDA cube.

Fig. 3. *Penicillium* spp. conidiophore with cluster of conidia magnified under 10x. Taken using fungal slide culture as shown in Fig 2.

Results:

Table 2: Contingency Analysis of Survivorship by Soil.

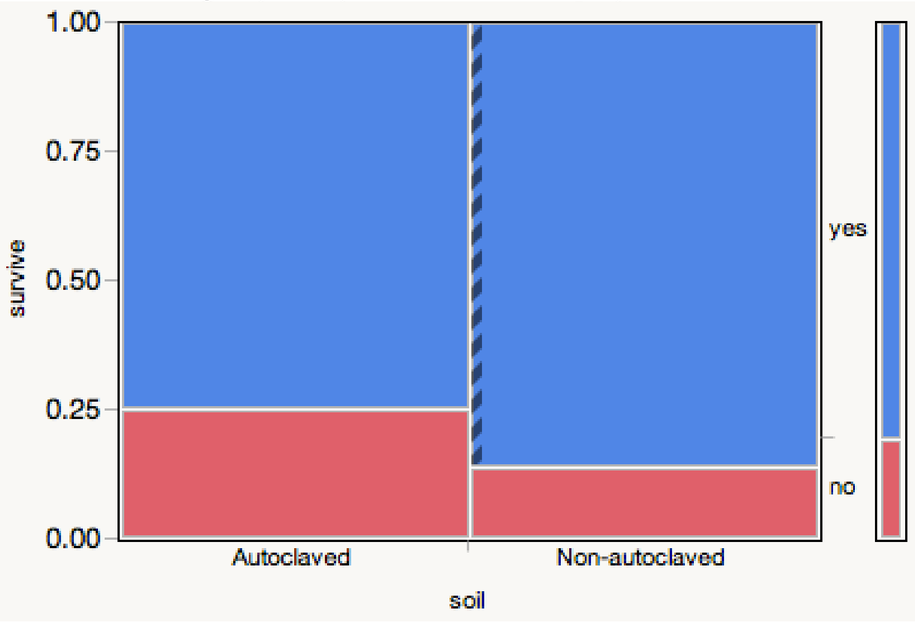


Table 3: Contingency Table and Fisher's Exact Test for Table 2.

survive

Count / Total % / Col % / Row %	no	yes	Total
Autoclaved	9	27	36
	12.50	37.50	50.00
	64.29	46.55	
	25.00	75.00	
Non-autoclaved	5	31	36
	6.94	43.06	50.00
	35.71	53.45	
	13.89	86.11	
Total	14	58	72
	19.44	80.56	

soil

Fisher's Exact Test	Prob	Alternative Hypothesis
Left	0.9326	Prob(survive=yes) is greater for soil=Autoclaved than Non-autoclaved
Right	0.1862	Prob(survive=yes) is greater for soil=Non-autoclaved than Autoclaved
2-Tail	0.3723	Prob(survive=yes) is different across soil

Table 2: Contingency analysis of the survivorship by soil treatment showed that plants grown in the non-autoclaved treatment had a higher frequency of survivors.

Table 3: Fisher's exact test is typically used for 2x2 contingency table. The closer to 0 the more the hypothesis can be accepted.

Table 4: Contingency Analysis of Juvenile Age.

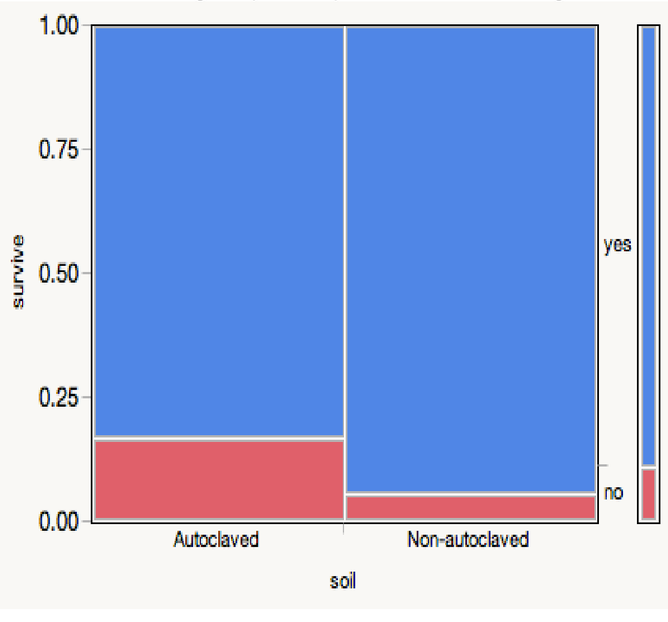


Table 5: Contingency Analysis of Mature Age.

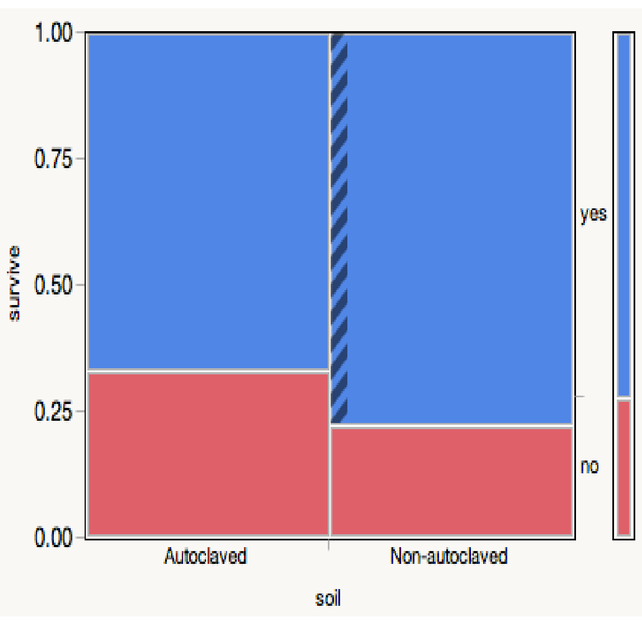


Table 6: Overlay Plot of Leaf Number by Date

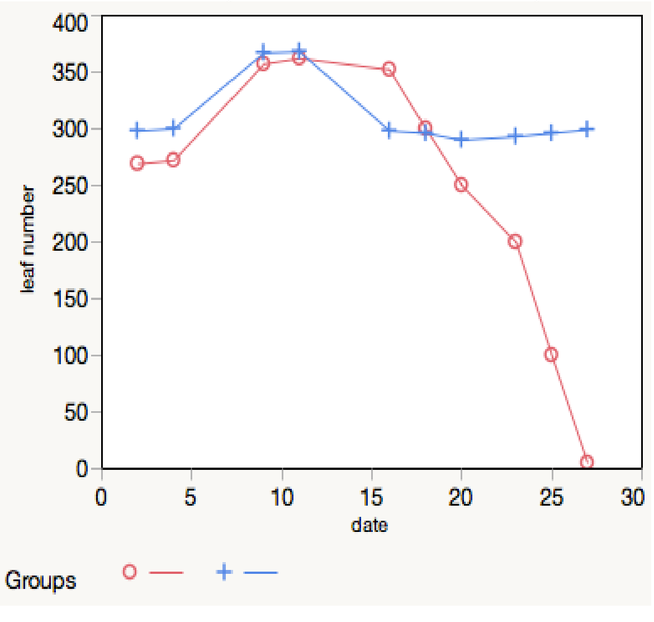
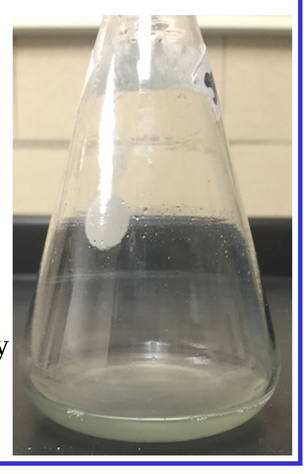


Table 6. Red is 'autoclaved' and blue is ' non-autoclaved'. At the start of the treatment there was relatively the same total number of leaves for both treatments 1 and 4. After the fungal exposure mortality rate was higher in treatment 1 and 4.

Table 4 and 5: Analyses that illustrate the relationship between age: juvenile and mature of *A. thaliana* after exposure to fungal treatment.

Fig. 4: Culture filtrate. Filtrate was by filtering through cheese cloth after gently agitating mature colony with sterile water.



Conclusion:

- Soil microbial communities play a crucial role in the development and immunity of vascular plants specifically in below-ground root systems.
- Age of vascular plants could play a role in their resistance to potential harmful fungi.
- *Penicillium* spp. proved to act as a opportunist and not phytopathogenic which explains the low amount of mortalities overall.

Fig. 5: Penicillium spp. affecting decaying plant material. Once conidiophores mature, fungus spores and affecting healthy plant material.

References:

1. Wang, Hili, Kai Wen, Xiuyun Zhao, Xuedong Wang, Aiying Li and Huazhu Hong. "The Inhibitory Activity of Endophytic Bacillus strain CHM1 against plant pathogenic fungi and its plant growth-promoting effect". Crop Protection 28.8.2009. 634-639
2. Durrell, James, Wenshu Hu and Jasmine Reid. How Differing Microbial Communities and Dehydration Stress affect Arabidopsis thaliana's Morphological Development. University of Bridgeport. N. d. 1. December. 2014.

Acknowledgements:

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