Permafrost Grown 2022 (Year 1) Project Highlights

About the Project

Permafrost Grown is a five-year project funded by the National Science Foundation and based at the University of Alaska Fairbanks. The project is working with farmers in Alaska to understand how permafrost and agricultural activities interact. We will be developing management strategies and create best practice guides for farmers cultivating on permafrost-affected soils to support sustainable agriculture in Alaska.

Types of Permafrost

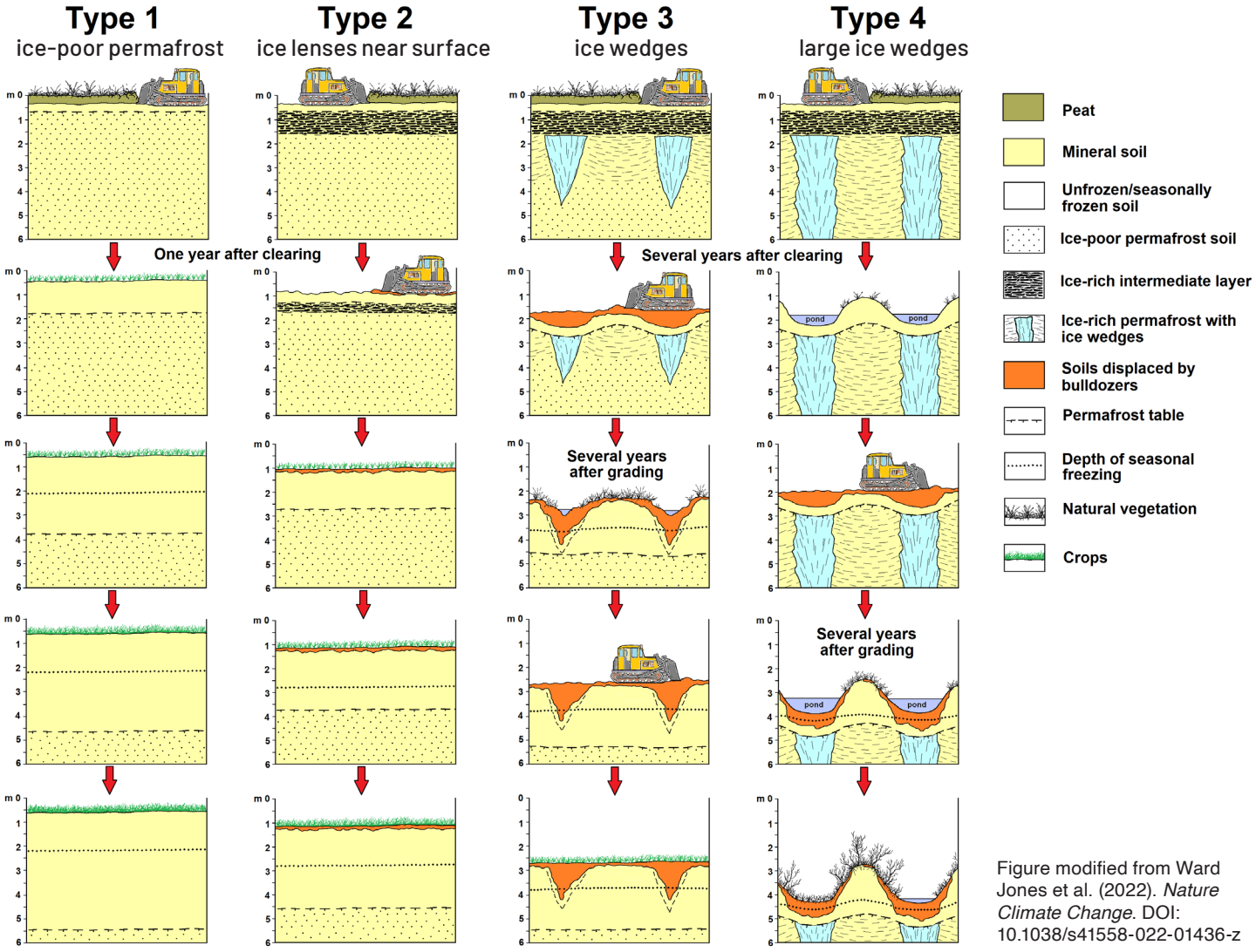


Figure modified from Ward Jones et al. (2022). *Nature Climate Change*. DOI: 10.1038/s41558-022-01436-z

Permafrost Grown has developed degradation scenarios based on permafrost type and ground-ice content. Type 1 is ice-poor permafrost that will not experience ground surface collapse or subsidence. Type 2 has ice lenses near the surface that will lead to some subsidence until the ice lenses completely melt. Type 3 and 4 consist of ice bodies called ice wedges, which can cause significant subsidence and sinkholes to develop in farm fields. These permafrost types are most likely to lead to partial or complete field abandonment.

The **top three problems** related to permafrost thaw for Permafrost Grown collaborator farms are: (1) abandoning whole or parts of fields, (2) changes to surface water flow, and (3) problems with fencing.

Preliminary Data for 2022 Growing Season

We are collecting a wide range of data to understand the physical, social, economic and policy impacts of permafrost on northern farms. We are working to identify heat sources, such as agricultural plastics, that may unintentionally thaw permafrost and cause issues, as well as identifying potential cooling sources such as crop type that may mitigate permafrost thaw. See below for preliminary data that we will be continuing to collect in future project years!

Thermal Impact of Various Crop Footprints

Farm 1 Crop Types and Average July Surface Soil Temperatures

Onion plant: 19.0 °C (66.2 °F)

Carrot plant: 18.2 °C (64.8 °F)

Squash plant & landscape fabric: 17.5 °C (63.5 °F)

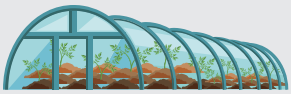
Farm 2 Crop Types and Average July Surface Soil Temperatures

Carrot plant: 16.7 °C (62.0 °F)

Cabbage plant & IRT plastic: 15.9 °C (60.6 °F)

Effect of Low Tunnel on Soil Temperature*

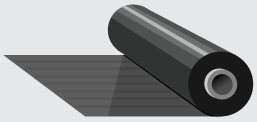
Surface	3.8 °C/6.8 °F
15 cm/6 inches	2.8 °C/5.0 °F
50 cm/20 inches	1.5 °C/2.7 °F
100 cm/~40 inches	0.5 °C/0.9 °F



* 28 May to 8 September data measurement; poly plastic low tunnel and data is compared to average carrot and cabbage data from Farm 2.

Effect of Poly Geotextile Weed Barrier on Soil Temperature*

Surface	2.8 °C/5.0 °F
15 cm/6 inches	2.6 °C/4.7 °F
50 cm/20 inches	2.0 °C/3.6 °F
100 cm/~40 inches	1.5 °C/2.7 °F



*Application 1 August to 23 August; data compared to averaged carrot and squash data from Farm 1.

Effect of Compost on Soil Conditions

Preliminary data measured at 15 cm/5.9 inch soil depth under a 100 cm/~40 in a 1 m x 1 m^2 compost pile suggests that active compost is a heat and moisture source that inhibits complete ground freezing in winter. (Data collected 2022–2023 winter.)

Policy

The State of Alaska offers no legal guarantees about the quality of land being cleared or sold for agricultural purposes and has no programs or safeguards in place in the event of disruptions, losses or field abandonment related to permafrost thaw.

Year 2 (2023 Growing Season) Plan Highlights

- Monitoring the thermal and moisture impact of 10 mulch types as well as various irrigation techniques;
- Agricultural trials evaluating crops that may tolerate field subsidence (i.e., saturated soils) or stabilize soils;
- Understanding how soil properties change between areas of undisturbed forest, cultivation type and abandoned areas;
- Understanding the timing and rate of permafrost thaw using drone remote sensing and dendro-geomorphology (tree-ring) techniques; and
- Public outreach and education activities at the UAF Georgeson Botanical Garden and Tanana Valley State Fair.

Meet the Team

UAF Research Team

- Melissa Ward Jones, Institute of Northern Engineering, Principal Investigator (PI), Geomorphology and Permafrost Sciences
- Glenna Gannon, Institute of Agriculture, Natural Resources and Extension, Co-PI, Sustainable Food Systems and High-latitude Agriculture
- Benjamin Jones, INE, Co-PI, Remote Sensing and Permafrost Sciences
- Mikhail Kanevskiy, INE, Co-PI, Ground Ice Stratigraphy and Permafrost Sciences
- Tobias Schwoerer, International Arctic Research Center (IARC), Co-PI, Natural Resources Economics
- Benjamin Gaglioti, INE, Senior Personnel (SP), Dendro-geomorphology and Boreal Ecosystems
- Yuri Shur, INE, SP, Permafrost Engineering
- Nicholas Parlato, IARC, PhD Student, Legal Geography and Arctic Policy

Collaborating Farms include

- Goosefoot Farm, Fairbanks
- Ice Wedge Art and Farm, Fairbanks
- Boreal Peonies, Two Rivers
- Porcupine Ridge Farm, Fairbanks
- Meyers Farm, Bethel
- Offbeet Farm, Fairbanks
- Polar Peonies, Fairbanks
- Rough Cut Farm, Fairbanks
- Slimtree Farm, North Pole

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www.permafrostgrown.org