Living Lab – Ontario is a five-year innovation project that brings together farmers, organizations, researchers, and other experts to co-develop, test, and evaluate beneficial management practices (BMPs) that address climate change challenges in livestock and cropping systems.

User-Centred Innovation | **Working in Partnership** | **Real Life Context**

NO-TILL WINTER SQUASH

PRELIMINARY SUMMARY 2025

Conducted in participation with EFAO's Farmer-Led Research Program

OBJECTIVE

The objectives of this ongoing study are to increase adoption of no-till mulching practices through co-development of research methods, support farmers to refine their practices within a collaborative network of support, and to introduce research skills to farmers.

Mulch-based no-till potato production offers meaningful climate benefits in several ways. Mulch adds organic matter to the soil, building carbon storage over time, while fewer tillage passes reduce fuel use and associated emissions. The mulch itself also strengthens resilience to a changing climate — moderating soil temperature, reducing irrigation needs, and making productive use of materials that would otherwise go to waste.

FARMER-RESEARCHERS

Sean Smith - Crooked Farmz - CENTRAL

Nathan Klassen - Nith Valley Organics - WEST

Duncan Ivany - Kite Hill Farm - WEST

Dillon Muldoon - Trent Farm Research Centre - EAST

Alberto Suarez Esteban - Nature's Apprentice Farm - EAST

METHODS

Farmers prepared beds according to typical methods on their farm and used typical spacing for seeds or seedlings. Then, they mulched with one or more of the following materials:

- Woodchips
- Spent hay
- Straw
- Leaves
- Waste wool
- Deep compost

Farmers could choose to compare mulching against a "business as usual" planting or test the no-till method alone. They could also test multiple mulches. Refer to Trial Notes and Caveats for additional details.

MEASUREMENTS

- Marketable and unmarketable yield
- General observations of health, disease, and pest pressure, etc.

MAIN FINDING TO DATE

Using a benchmark of 2.0 kg/m² as a comparison to the farmer-researchers' results, a majority of the trials met or exceeded the benchmark using no-till mulching methods. Read more about how we established the benchmark under Yield Benchmark: Basis and Limitations.

Photo 1. Dillon and the Maxima squash landrace harvest

Winter squash varieties trialed in 2025

Species: C. pepo C. moschata C. maxima

Farmer	Varieties grown
Alberto	Early Butternut Honey Boat Delicata Table Queen Acorn Table Sugar Acorn
Dillon	Maxima landrace
Duncan	Delicata
Nathan	Butternut (Avalon) Butternut (Lofthouse) Delicata JS Honeyboat Delicata Small Sugar Pumpkin Orange Summer Sweet Mama Winter Sweet
Sean	Buttercup

TRIAL NOTES AND CAVEATS

- There was great variability in the various farm operations, including: soil type, growing zone, bed preparation methods, level of mechanization, amendments applied, and irrigation practices.
- Farmers grew different squash varieties rather than a standardized variety across sites. Yield differences between sites, therefore, may partly reflect variety choice, in addition to the mulching treatment. Winter squash species vary significantly in yield potential. C. maxima and C. moschata tend to produce larger fruit and higher total weight per plant than C. pepo. As such, results presented in the table are presented by species rather than collapsed to a single per-farmer figure.
- Plot sizes range from 55.74 m² (Sean) to 2,043.9 m² (Nathan) — a roughly 37-fold difference. All yields are normalized to kg/m² to allow cross-site comparison, with the assumption that the data can be scaled accordingly.
- Nathan grew multiple species across a single undivided plot. Because plot area was not allocated by species, per species kg/m² cannot be calculated. Species rows show total kg only, and kg/m² is reported for the full plot. Nathan has no marketable yield breakdown and only total yield is available.
- Dillon is the only farmer to have run replicated trials (four replicates per treatment), making his data more robust than single-plot observations from other sites. His % marketable figures represent the mean across four replicates.

> ***This was our first time growing winter squash at the TFRC. The yields were fair considering the drought we experienced. We would use mulches again in the future to grow winter squash.***
>
> - Dillon

YIELD BENCHMARK: BASIS AND LIMITATIONS

The benchmark of 2.0 kg/m² is derived from Ontario Ministry of Agriculture, Food and Rural Affairs Publication 839 (Pumpkin and Squash Production), which reports that most winter squash varieties yield approximately 20,000 kg/ha under conventional production. This was converted to 2.0 kg/m² using the standard factor (1 kg/m² = 10 t/ha). Other notes about the benchmark:

- Publication 839 does not distinguish between species; the 20,000 kg/ha figure is a blended average that likely reflects commercially dominant Ontario varieties and cannot serve as a species-specific benchmark.
- The publication does not explicitly state whether the figure represents total or marketable yield; based on context and phrasing, it is interpreted here as total yield.

Photo 2. Replicate blocks at Trent Farm Research Centre

- Publication 839 describes conventional tillage-based systems. No species-specific yield benchmark for small-scale organic or ecological squash production in Ontario or comparable temperate climates was identified in the published literature. Matching or exceeding the benchmark under no-till conditions should be interpreted as a positive result.
- Given this context, for this benchmark, kg/m² was chosen in order to have a closer comparison to the scale of the farmers' plots.

FARMER-RESEARCHER OBSERVATIONS

- Alberto noted that cooler soil temperatures may have delayed the squash crop, but compared to other years, the yields were still comparable.
- Nathan shared the following nuanced observation "Before switching to mulch I had a few bad years on plastic. Yields were way better than crop failures on plastic, but perhaps not equal to a really good crop on plastic. [But] I think my definition of a good crop has evolved upwards in that time as well so I don't think I can compare."
- For Nathan, the benefits to soil health are the number one reason why he continues with this method.
- Weed control and soil moisture retention were the most commonly listed benefits amongst farmer-researchers. All five farmer-researchers planned on continuing to use this method and four out of five plan to participate in 2026 trials.

The no-till squash trial was challenged by the drought conditions of 2025. Although farmer-researchers believed their trial yields were impacted because of drought, they firmly attested that the mulching methods preserved soil moisture in a way that gave them enhanced climate resiliency in a challenging year. Duncan's trial faced the most severe impacts and therefore, his data wasn't included in the table as a comparison. He planted four rows but only one produced harvestable yield; the remaining three failed to establish. His data cannot be meaningfully compared to other sites. He suggested that lack of depth and spread of his mulch likely contributed to his challenges.

> ***I would sooner quit growing squash than use any other method.***
>
> - Nathan

Photo 3. Nathan loading woodchips into his manure spreader

Photo 4. Alberto's squash harvest curing

Photo 5. Farmer-researcher Sean Smith

Plot size and yield summary for 2025 no-till squash trials

Data is sorted by mulch category. All weights in kg. A benchmark of 2.0 kg/m² was used, as described in the text. Duncan's data was not included here because of low yields. See farmer-Researcher Observations for more details.

Mulch material	Depth (cm)	Species	Plot size (m²)	% marketable	Yield (kg/m²)	Meets benchmark	Farmer
Leaves							
Shredded leaves	5–8	*C. moschata — Butternut*	20.81	99%	2.65	✓	Alberto
		C. pepo — Acorn	20.81	92%	3.30	✓	
		C. pepo — Delicata	20.81	98%	2.66	✓	
		Total	**62.43**	**96%**	**2.87**	✓	
Woodchips							
Woodchips	10–13	*C. maxima — Buttercup*	**55.74**	**85%**	**0.38**	✗	Sean
Woodchips	13–15	*C. maxima — Maxima landrace*	**80.00**	**93%**	**1.85**	✗	Dillon
Woodchips	8	*C. maxima*	—	—	—	—	Nathan
		C. moschata	—	—	—	—	
		C. pepo	—	—	—	—	
		Total	**2,043.9**	**—**	**2.09**	✓	
Deep compost mulch							
Spent mushroom compost	13–15	*C. maxima — Maxima landrace*	**80.0**	**98%**	**2.10**	✓	Dillon

Plot size and yield summary for 2025 control plots

Mulch material	Depth (cm)	Species	Plot size (m²)	% marketable	Yield (kg/m²)	Meets benchmark	Farmer
No mulch (control)							
No mulch	—	*C. maxima — Maxima landrace*	80.0	98%	2.14	✓	Dillon

Ontario Ministry of Agriculture, Food and Rural Affairs. *Pumpkin and Squash Production*. Publication 839. https://www.ontario.ca/files/2024-02/omafra-guide-to-vegetable-production-in-ontario-en-2024-02-15.pdf. Retrieved May 14, 2026.

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