



**Science
Societies**

Can you really grow organic potatoes without tillage?

Three years of on-farm data show there's potential

By Ken Laing and Sarah Larsen

| October 21, 2026



Potato developing under rye/hairy vetch cover crop. Photo courtesy of EFAO.



For organic potato growers, tillage is often considered unavoidable. But a farmer-led research project in Ontario found that planting potatoes directly into a standing rye cover crop can work, provided growers choose the right varieties, start with clean fields,

and adapt their equipment to handle heavy residue.

Earn 1 CEU in Organic by reading this article and taking the quiz (coming soon).

Potatoes are one of the most tillage-intensive crops in organic production. Between primary tillage, hilling, cultivation for weed control, and harvest, a conventional organic potato crop can see half a dozen or more passes over bare soil in a single season. For growers trying to protect soil structure and build organic matter, there's a trade-off.

We started asking whether that trade-off was necessary in 2019, after a soil health benchmarking project run in cooperation with the Ecological Farmers Association of Ontario (EFAO) turned up an uncomfortable result for Ken Laing of Orchard Hill Farm in southern Ontario, a little under 4 miles from the north shore of Lake Erie. Ken's undisturbed fence rows had noticeably more organic matter than the cropped land

next to them—this on a farm with sandy loam soils that had been organic, with cover crops, since the 1990s.

That finding was the starting point for a multi-year, farmer-led research effort, run through the Living Lab–Ontario project (funded by Agriculture and Agri-Food Canada and led by the Ontario Soil and Crop Improvement Association) to see how far reduced tillage could be pushed in an organic vegetable operation. Specifically, the research sought to determine whether a no-till potato system was workable at a scale that would make sense to a mid-size grower.

What follows is a summary of that work including the system and the replicated trial results from 2021–2023.

The system

Ken's system evolved into one that relied on a stand of winter rye the year before the potato crop, and let the rye do the jobs that tillage, hilling, and cultivation normally do—suppress weeds and protect tubers from light. Specifically, this system started the year before potatoes, when Ken seeded a winter rye cover crop September 1 (Zone 6a) at 120 lb/ac. Letting the rye grow over winter, he planted the potatoes directly into the standing rye in late April to early May—about three weeks before rye's late bloom stage — using a modified no-till transplanter (see details below).



Potatoes were planted directly into the standing rye in late April to early May using a modified no-till transplanter. Photo courtesy of EFAO.

Then, at first potato emergence, he terminated the rye via flail mowing. Ken notes you could roll the rye cover crop, but he prefers mowing for its flexibility in timing and because it doesn't leave long rye straw that can interfere with harvest. From that point forward, there is no tillage, no hilling, and no hand or mechanical weeding for the rest of the season. He sidedressed the plots with 1200 lb/acre organic hen pellets and applied one application of the organic pesticide Entrust for Colorado potato beetles.



At first potato emergence, rye is terminated via flail mowing. Photo courtesy of EFAO.

This system required some equipment modification. Conventional no-till planters aren't built to handle the volume of residue a mature rye stand produces, so the opener and closing wheels needed adjustment to cut through the mat, get seed pieces into undisturbed soil, and close the trench without plugging. To deal with this, Ken modified and used an RJ Equipment no-till carousel plug planter and cut seed pieces smaller than optimal to feed through the opener shoe reliably.

What the replicated trials showed

The most rigorous test of the system came in 2023, when we ran a randomized, replicated comparison of no-till versus tilled (hilled) management across three varieties—Norland, Gemstar Russet, and SP327—with four replicate pairs of each. We evaluated management effects with ANOVA at a 95% confidence level, using least significant difference (LSD) to call treatments statistically different, and used a paired t-test to compare planting depths. Three results stood out:

Variety matters

Gemstar Russet and SP327 produced statistically similar total yield and marketable weight under both tilled and no-till management. Norland, by contrast, yielded significantly less under no-till. We don't have a confirmed mechanism, but tuber-set depth and vigor differences between varieties are the leading candidates, and this is a reason why variety trials specifically built around reduced-tillage systems would be useful.



Gemstar Russet and SP327 produced statistically similar total yield and marketable weight under both tilled and no-till management. Norland, by contrast, yielded significantly less under no-till. Photo courtesy of EFAO.

Delayed emergence for varieties tolerating no-till didn't translate into yield loss

No-till plots emerged roughly three weeks later than tilled plots across the trial years, almost certainly due to cooler soil temperature under the rye mulch. That delay showed up in maturity all season but did not significantly reduce final yield in Gemstar Russet or SP327. A grower looking at a no-till potato field in late May, next to a tilled field with visibly larger plants, may reasonably worry the crop is behind. Based on our data, that gap does not necessarily predict a yield deficit at harvest.

Planting depth had no effect on yield or greening within the range tested

In a separate 2023 trial planting Orchard Hill Rose (a leafhopper-resistant variety selected on-farm with the Bauta Family Initiative on Canadian Seed Security) at three- and five-inch depths, four replicate pairs showed no significant difference in yield, marketable weight, or greening. Greening was a real concern going into this system—hilling exists partly to bury tubers against light exposure—but in practice, marketable percentage stayed high (96–100%) across the variety trial, and depth didn't affect this. The rye residue mat appears to be doing the light-blocking job that hilling normally does.



The rye residue mat appeared to protect tubers from light exposure as the marketable percentage was high across the variety trial.

Screenshot of a [Soil Health Institute video](#) about the project.

Yields in the 2021 demonstration-scale plots (unreplicated, so descriptive rather than statistical) ranged from about 25,300 to 37,300 lb/ac, against a five-year Ontario average of 21,700 lb/ac, with a 58% reduction in field passes associated with tillage, cultivation, weeding, irrigation, spraying, and harvest. While this is encouraging, these numbers should be read as a proof of concept rather than a guaranteed outcome,

especially since the replicated 2022 trial was compromised by a pre-existing grass weed problem on the trial ground that suppressed no-till yields specifically. That result is worth flagging on its own: **the system's weed suppression depends entirely on cover crop biomass and a relatively clean starting field.** It is not a tool for fixing an already weedy field, and any perennial or persistent annual weed pressure needs to be dealt with before the rye goes in, not after.

The wider screening program: What else worked, and what didn't

The potato work sat inside a broader three-year screening effort testing more than 60 crop/cover crop combinations for reduced-tillage organic vegetable production. A few results are directly relevant to how growers might think about extending this approach beyond potatoes:

- **Weed control varied a great deal by cover crop in a clear order:** daikon radish < oats/barley/peas < sorghum sudangrass < winter rye < deep compost mulch (DCM, 2 inches of wood chips/spent mushroom compost). Rye's combination of biomass and allelopathic residue put it well ahead of the other winter-killed or seeded options, and it's the reason for its use in the potato no-till trial. Sorghum sudangrass was used in Ken's no-till garlic trial because of its high biomass and reliable winter kill.



Deep compost mulch gave the best weed control of any treatment and drove the highest yields in demonstration-scale winter squash

- **Deep compost mulch gave the best weed control of any treatment** and drove the highest yields in demonstration-scale winter squash trials (up to ~49,600 lb/ac vs. ~13,700 lb/ac in a straight rolled-rye treatment). But DCM is expensive—2 inches of quality mulch requires roughly 100 tons/ac—and carries its own risk of introducing weed seed if the compost source isn't clean. It's a tool for specific situations, not a default recommendation.

trials, shown here. Photo courtesy of EFAO.

- **Transplanted crops consistently established better into cover crop residue than direct-seeded crops.** In a 2021 trial, Ken planted garlic no-till with the RJ Equipment transplanter into mown sorghum sudangrass, seeded at 40 lb/ac in early June and mowed twice before fall planting. The yield was 11,000 lb/ac lb/ac in the best plots. Field tomatoes transplanted into rolled rye/hairy vetch also performed well, though with fewer replicated trials to confirm.
- **No-till soils became noticeably firmer**, Ken observed, which likely made it harder for crop plants to explore the soil for water and nutrients.
- **Fertility timing is non-negotiable and requires extra planning.** Because the cover crop isn't disturbed once established, essentially all fertility adjustment has to happen before cover crop planting, a full season ahead of the cash crop.

How to advise on no-till potatoes

If a farmer is considering a version of this system, our data point to a short list of go/no-go questions before rye ever goes in the ground:

1. **Is the field already clean of perennial and persistent weeds?** *This system manages weeds through smothering, not control, and it has no rescue option once established.*
2. **Can fertility be corrected the season before planting?** Sidedressing after planting is difficult because of all the residue and placing the amendments on the surface is less effective and the losses greater.
3. **Is the grower planting a variety with reasonable no-till tolerance?** Our data support Gemstar Russet and SP327; Norland underperformed. This is a short list from one farm's trials, not a comprehensive varietal screen, so on-farm strip trials before committing acreage are worth recommending.

This system manages weeds through smothering, not control, and it has no rescue option once established.

4. **Does the equipment lineup include something that can cut through a mature rye mat** and close a trench in fully rooted, undisturbed soil? Off-the-shelf no-till planters built for lighter conventional-tillage residue loads may need modification.

5. **Is a three-week emergence delay acceptable** for the farm's marketing window and rotation plan?

None of these are disqualifying on their own, but Ken's experience suggests that a grower who can't check most of these boxes is not a good candidate for a first-year conversion.

Where this goes next

The cumulative data across this project indicate that a no-till organic potato system is workable at a scale suited to mid-sized market gardens, using mechanized rather than hand labor, without agricultural plastics. The next step is demonstrating the system on larger acreage and across more soil types and regions than a single farm can cover. We'd also like to see replicated variety screening purpose-built for no-till tolerance since that single factor did more to separate success from failure in our trials than any other variable we tested.

Acknowledgments

Ken Laing farms at Orchard Hill Farm near St. Thomas, Ontario. Sarah Larsen holds a Ph.D. from Iowa State University in Soil Ecology and leads the Farmer-Led Research program at the Ecological Farmers Association of Ontario. This work was supported by the Brian and Joannah Lawson Family Foundation, the Robert and Moira Sansom Ideas Foundation, and Agriculture and Agri-Food Canada through the Living Lab-Ontario project.

Dig deeper

Full reports are available at efao.ca/research-library.

The Soil Health Institute created a video about the project, which you can view below!

Self-study CEU quiz

Earn 1 CEU in Organic by taking the quiz for the article (coming soon). For your convenience, the quiz is printed below. The CEU can be purchased individually, or you can access as part of your Online Classroom Subscription.

1. Which cover crop formed the foundation of the no-till potato system?

- a. Cereal rye.
- b. Crimson clover.
- c. Buckwheat.
- d. Sunn hemp.

2. When was the rye cover crop terminated in the no-till potato system?

- a. Immediately after potato planting.
- b. At first potato emergence.
- c. When the rye reached full seed maturity.
- d. After potato canopy closure.

3. Which method was used to terminate the rye cover crop in the reported no-till potato system?

- a. Glyphosate application.
- b. Moldboard plowing.
- c. Roller-crimping.
- d. Flail mowing.

4. In the replicated 2023 trial, which varieties maintained statistically similar yields under both tilled and no-till management?

- a. Norland and Yukon Gold.
- b. Norland and Gemstar Russet.
- c. Gemstar Russet and SP327.
- d. SP327 and Orchard Hill Rose.

5. Why was tuber greening less problematic than anticipated in the no-till system?

- a. Varieties with genetic greening resistance were used.
- b. Frequent cultivation re-covered exposed tubers.
- c. The rye residue mat effectively blocked light exposure.
- d. Potatoes were consistently planted deeper than 8 inches.

6. How did no-till management affect crop emergence?

- a. Emergence occurred approximately one week earlier.
- b. Emergence was unaffected across all years.
- c. Emergence was delayed about three weeks.
- d. Emergence was delayed until after rye residue decomposition.

7. What was the likely cause of delayed emergence in the no-till system?

- a. Reduced seed-piece vigor.
- b. Cooler soil temperatures beneath the rye mulch.
- c. Nitrogen immobilization from rye residue.
- d. Greater Colorado potato beetle pressure.

8. What effect did planting depth have in the Orchard Hill Rose trial?

- a. Deeper planting increased marketable yield.
- b. Shallower planting increased greening.
- c. Deeper planting reduced greening but lowered yield.
- d. No significant effect on yield or greening was detected.

9. Across the broader reduced-tillage screening program, which treatment provided the strongest weed control?

- a. Winter rye.
- b. Sorghum-sudangrass.
- c. Oats/barley/peas mixture.
- d. Deep compost mulch.

10. Which type of vegetable crop generally established most successfully into cover crop residue?

- a. Transplanted crops.
- b. Small-seeded direct-seeded crops.
- c. Root crops established from seed.
- d. Broadcast-seeded crops.

Take the quiz (coming soon)

Articles by region

Articles by CEU

Back to issue

Text © . The authors. CC BY-NC-ND 4.0. Except where otherwise noted, images are subject to copyright. Any reuse without express permission from the copyright owner is prohibited.