

Is no-till planting spring cereal grain into winter-killed cover crops worth it?



Farmer-Researcher

Ken Laing
Orchard Hill Farm - West

Project timeline:
Spring 2018 - Summer 2019



IN A NUTSHELL

Spring cereals are integral to diverse rotations; however, it is often hard to get them planted early enough. One strategy to get into the field early is to no-till plant into cover crop residue, which provides soil cover in the winter and generally helps improve soil health.

To investigate this approach, Ken no-till planted oats and barley into replicated plots of four different cover crops and plots that received fall tillage.

Key Findings

- Grain yield and relative net return were highest when no-till planted into daikon radish.
- Weed control was best with daikon radish and the fall tillage control.
- There was no soil erosion in the cover crop plots, and moderate rill erosion in the fall tillage plots.

BACKGROUND

Currently in Ontario, spring cereal production accounts for around 320,000 acres (1). Most spring cereals are planted into soil that is tilled in the fall, which means fields are susceptible to erosion and nutrient runoff (2, 3).

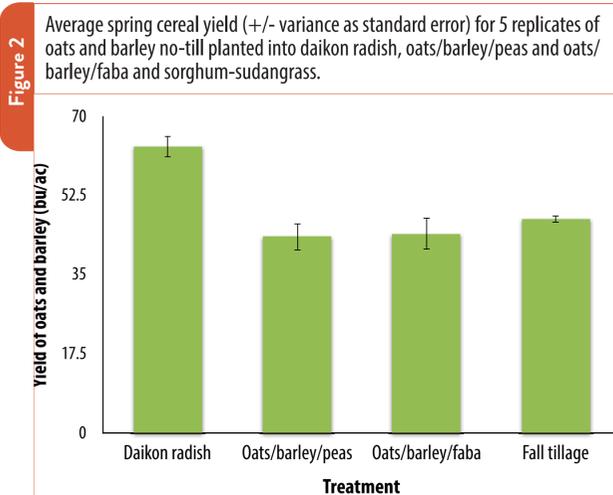
In contrast, planting no-till into a winter-killed cover crop protects the soil and allows for earlier planting, which is critical to yield. No-till planting into a cover crop may also result in higher yields and relative return; however, other studies have shown no economic benefit (3).

METHODS

Ken established a randomized complete block design with five replicate blocks to test the difference among four winter-killed cover crops and fall tillage, as outlined in Figure 1 and Tables 1 and 2 (page 2). Data was analyzed using analysis of variance (ANOVA).

RESULTS

Grain Yield and Weed Control



Grain yield varied dramatically by cover crop, with the highest and lowest yield observed in different species ($P < 0.001$). Overall grain yield was lower than expected likely because Ken had to use his own seed after the seed supplier delivered treated seed.

Compared to the fall tillage control, grain yield was 33% higher when planted into daikon radish residue ($P < 0.01$). This may be due to:

- Earlier planting and good fall weed control in daikon radish plots
- Increased phosphorus in daikon radish taproot holes, as reported in other studies (4)
- More lodging in the fall tillage plots

Even with an earlier planting date, yield from oats/barley/peas and oats/barley/faba cover crops was comparable to the fall tillage. This may be due to potential disease carry over from the oats and barley cover crop combined with better weed control in the fall tillage plots

Spring weed control in sorghum-sudangrass plots was very poor and grain from these plots was not harvestable. There were too many weeds to combine - they even plugged the swather!

Soil Health: Erosion

In the fall tillage plots, Ken observed moderate erosion in the spring. There was no erosion in any of the cover crop plots.

Interestingly, the daikon radish plots were almost as bare in spring as the fall tillage plots. Although not measured in this study, daikon radish tubers probably contributed positively to water infiltration, which protected the soil from erosion.

Profitability

The extra income and value over common expenses from oats and barley planted after daikon radish cover crop was \$47.90/acre compared to fall tillage (see Table 3 on page 2).

The relative return for daikon radish is not directly accounting for the cost of erosion in the fall tillage plots, benefit of improved soil health in the cover crop plots or the cost of equipment to no-till plant.



Photos: Cover crop residue compared to fall tillage in March 2019. (Clockwise from top left) Daikon radish, oats/peas/barley, oats/barley/faba, sorghum-sudan grass, and fall tillage. See page 2 for more photos.

TAKE HOME MESSAGE

Diversity is a key principle of ecological farming; and small grains, including spring cereals, are an integral part of a diverse crop rotation. In this study, Ken experimented with no-till planting oats and barley into cover crop residue as a way to protect the soil over winter, provide weed control and get into the field earlier.

No-till planting spring cereals into a cover crop is not only beneficial for the soil, but can also pay off for the pocket book.

Grain yield, relative return (i.e. profit potential) and soil health were highest when planted into daikon radish residue. As soil health continues to improve over time with cover crop use, Ken expects an even greater yield bump, which should be taken into account when thinking about the cost to invest in the equipment needed to no-till plant.

[Continued on page 2]



REFERENCES

1. OMAFRA website for field crop budgets
2. Thorne et al. 2003. <https://naldc.nal.usda.gov/download/48775/PDF>
3. Young et al. 2015. doi:10.2134/cftm2014.0089
4. Charles and Weil. 2011. doi:10.2136/sssaj2010.0095

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COVER CROPS



SOIL HEALTH



WEED CONTROL

METHODS continued

Table 1 Timeline for management of Ken's trial

Timeline	Action
Spring 2017	Red clover and annual ryegrass underseeded into a spelt crop.
May 2018	All plots mowed twice in May to control weeds and clover. Fertility applied to all plots at a rate of 5 ton/ac mushroom compost mixed with 1000 lb/ac gypsum and 1000lb/ac dolomitic lime, 50lb/ac 90% elemental sulphur and 20lb/ac 10% boron; and 129gr/ac molybdenum to west ¼ of plots based on soil tests.
Jul 2018	All plots ploughed except control to establish a randomized block design with 5 replicate blocks of 5 plots each (Figure 1). Secondary tillage pass before planting cover crops.
Jul 19, 2018	Sorghum-sudangrass cover crop planted (later than ideal because of wet weather)
Aug 25, 2018	Daikon radish cover crop planted
Aug 31, 2018	Oats/peas/barley cover crop planted Oats/peas/faba cover crop planted
Sep 5, 2018	Sorghum-sudangrass mowed
Apr 6, 2019	All no-till plots planted and fertilized 80 lb/ac oats/barley + 14 lb/ac grass seed (4lb/ac alfalfa, 4lb/ac timothy, 5lb/ac orchard grass and 1lb/ac white dutch) <ul style="list-style-type: none"> Ken was aiming for a higher seeding rate for the spring cereals. However, his seed supplier delivered treated seed so he had to use his own seed, which was in limited quantity and not as well cleaned. Liquid fertilizer applied in planting trench (2 gal/ac fish emulsion, 3 lb/ac molasses) <ul style="list-style-type: none"> Ken applied fertilizer at planting because of the wet spring
May 6, 2019	Control plots tilled and planted with the same drill and same seeding rates for grain and grass; and the same fertilizer rates.
Aug 1, 2019	Small grains crop of oats and barley swathed
Aug 3, 2019	Small grains crop of oats and barley combined

RESULTS continued

Table 3 Estimated relative return for grain crops planted into daikon radish residue or bare soil after fall tillage.

Profit and Loss Categories Per Acre	Daikon Radish Cover Crop	Fall Tillage
INCOME		
Average price of mixed grain per acre, assuming 40lb/bu and \$6.62/bu for organic grain	\$419.41	\$314.56
EXPENSES		
Fertilizer; grain seed	same	same
Cover crop seed price	\$37.50	\$0.00
Extra pass to plant cover crop	\$19.45*	-
Plough passes	July 2018	October 2018
Secondary tillage passes	Summer 2018	Spring 2019
TOTAL	\$362.46	\$314.56
RELATIVE RETURN	\$47.90 + soil health + reduced soil loss	\$0 - erosion

* Taken from OMAFRA website for field crop budgets



Photos: Looking down a plot of daikon radish in spring (top) and fall tillage (middle) in spring 2019. This is compared to the fall tillage plots, which had moderate rill erosion (bottom).

Table 2 Cover crop details for the winter-killed cover crops that Ken used to no-till plant oats and barley in the spring 2019.

Cover Crop	Rate (lb/ac)	Cost (/lb)	Cost (/ac)
Daikon radish	15	\$2.50	\$37.50
Oats	30	\$0.46	\$13.80
Barley	30	\$0.43	\$12.90
Faba	30	\$0.78	\$23.40
Total			\$50.10
Oats	25	\$0.46	\$11.50
Barley	25	\$0.43	\$10.75
Faba	75*	\$0.50	\$37.50
Total			\$59.75
Sorghum-sudangrass	40	\$1.40	\$56.00

* Ken pushed the rate of faba bean high, due to prior experience getting a good stand.



Photos: Oats and barley growing in the plots (top); Ken and Martha harvesting and weighing grain from the plots (bottom).

REFERENCES

1. OMAFRA website for field crop budgets
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