

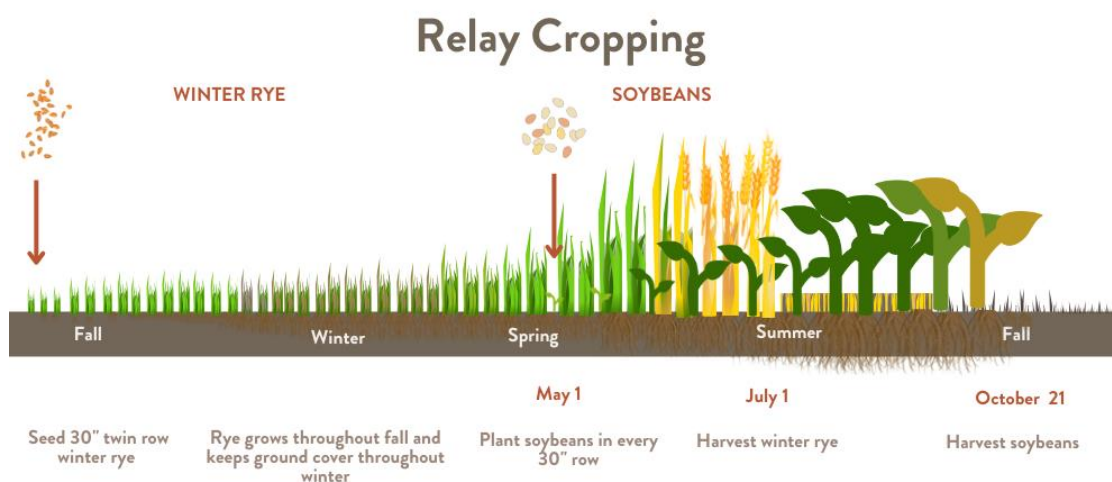
Relay vs Double Cropping Trial Van Meer Farms Inc.

Purpose: Greg Vermeersch farms with his multigenerational family. They farm approximately 5000 acres cash crop in a multirotational cropping program, with their main commodities being corn, Soybeans, Winter Wheat, Winter Barley. They are very conscious of soil erosion particularly on their sand soils to the north. They are also very conscious of soil compaction in their clay based soils to the south.

Greg has a strong interest in finding better ways to do things on the farm. He had tried double cropping, but he wondered if relay cropping might be better. So, his Living Labs trial is a side-by-side, field-scale comparison of double cropping and relay cropping, using winter barley and soybeans. The question he would like answered are is the relay cropping or the double cropping scenario able to be scaled to larger fields and incorporated into a regularized rotation. Planting dates, planting population, timing of planting and harvest are all variables that need to be explored with the best combination tested.

He also wishes to improve his soil health. His objective is to have something growing in the soil most of the year, just in different ways. Greg recognizes the benefits of including cereals in his rotation. By adding relay soybeans into the cereals rotation it offered the potential for extra profit from the same cereal acre.

Below is a visual portrayal of how relay cropping keeps living roots in the ground approximately 365 days a year.



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Methods:

In 2021 there were two treatments on the Lambert Farm:

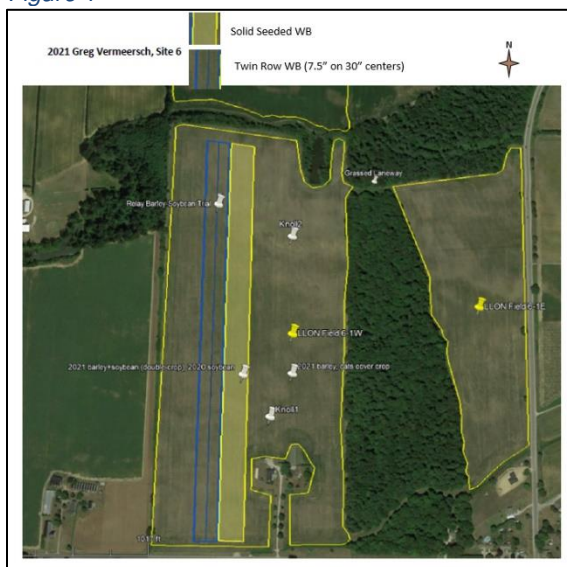
1. Double Cropping: Winter Barley (WB) followed up with Soybeans planted after immediately after the WB harvest
2. Relay Cropping: Winter Barley (30" twin row) followed up with Soybeans (single 30") planted at normal soybean planting timing.

In 2022 cropping year he wanted to determine which were better partners on his very droughty soils, so he included Cereal rye as an alternate relay partner vs. Winter Barley. This was located on the Jack White Farm, which is located just north of the Lambert Farm:

1. Double Cropping: Winter Cereal Rye (WCR) followed up with soybeans planted immediately after the WCR harvest
2. Relay Cropping: Winter Cereal Rye (30" twin row) followed up with Soybeans (single 30") planted at normal soybean planting timing
3. Relay Cropping: Winter Barley (30" twin row) followed up with Soybeans (single 30") planted at normal soybean planting timing.

2021 Cropping year:

WB side by side treatments were planted on Oct 8, 2021, in the Lambert field. (See [Figure 1](#))



Treatment #1 WB was planted "solid seed" in 7.5" row spacing at a target rate of 1,350,000 seeds per acre, using bin run common #1 Winter Barley.

Treatment #2 WB was planted in a Twin Row 30" fashion at 90% of the solid seeded WB (1,215,000 seeds per acre)

At planting both treatments received a starter blend of 154 lbs. of "Mez" phosphorus fertilizer (12%N-40%P-10%S-1%Zn) in furrow.

On April 27, 2021, a single 30" soybean row was planted at directly in the middle of the open Twin Row WB to complete the second part of the Relay Cropping Treatment #2. (See [Figure 2](#)). They were planted at a target rate of 120,000 seeds per acre, using Pioneer variety P27A25X (3250 CHU RR +Xtend).

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Soybean seed used in Treatments 1 & 2, were treated with Lumivia fungicide and insecticide, and were pre-inoculated with Rhizobium inoculant. All seed treatments were applied at the seed supplier prior to planting.

The weed control used on both treatments to control annual broadleaf weeds was Buctril M, applied April 29, 2021, prior to treatment #2 soybean emergence.

Harvest of the WB was completed on July 15 and the double crop soybeans were planted the same day, (Pioneer P05A35X, 2675 CHU RR+Xtend) at a seeding rate of 184,000 seeds/ac in 7.5" rows.

Prior to emergence of the Double crop soybeans, it was sprayed with glyphosate using 10 gal/ac of 28% UAN as a carrier to address any volunteer WB and weeds.

The Lambert farm is a sandy loam, so all the planting was done in a no-tillage fashion to conserve moisture and to prevent erosion. Only one comparison was made this year.

Figure 2 -Planting 30" soybeans into Twin Row 30" WB



The economic drivers will be gross yield from both crops offset by the extra costs and efforts of the second crop of soybeans.

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2022 Cropping Year:

Similar to 2021, the treatments in 2022 were relatively the same, but an alternate cereal partner of Winter Cereal Rye (WCR) was added to compare to WB. The layout is full field strips alternating WB and WCR in 40' strips planting in twin 30" rows. (Figure 3)



The 4 treatment plot was planted similarly as in the 2021 described previously except that an additional cereal partner of Winter Cereal Rye (WCR) was introduced with WB.

Both WB and WCR were planted on Oct 20, 2021. Both received the same starter fertilizer of 139 lbs of MAP.

On April 12 133 lbs of nitrogen was applied to the WB & WCR sprayer streamer bars

On April 29 herbicide Butril M was sprayed on the WB & WCR at a rate of 0.40 l/ac; Growth regulator Modus was added as a tank mix at a rate of 0.42 l/ac to the twin Row WCR in an effort to shorten the WCR and not shade the soybeans.

The single 30" row of soybeans was planted on April 30, 2022 at a seeding rate of 122,000 seeds/ac using Pioneer variety Pioneer P24A80X treated with Lumivia fungicide and insecticide seed treatment, and pre-inoculated with Rhizobium inoculant.

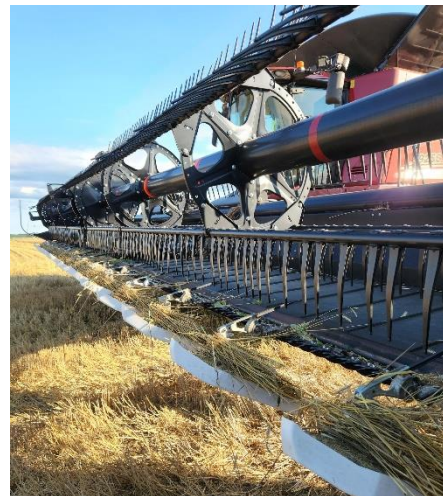


Figure 4 "Pushers" attached to combine cutter bar

Figure 3 2022 Plot layout

The WB & WCR on July 25 using "pushers" (see figure 4) attached to the cutter bar to push down the soybeans, while the WB & WCR were being harvested. The results are shown under the 2022 Results section of this report.

The double crop soybeans were planted after the solid stand WB & WCR. Pioneer variety P07A18X was planted at 210,000 seeds/ac on July 25. Both the Twin Row Soybeans as well as the double crop soybeans were sprayed with Glyphosate at 540 gms/ac.

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2021 Results:

Yield:

The size of the plots was slightly different for the Double Cropping vs. Relay Cropping at 9.5 ac vs. 8.1 ac respectively. This is due to the differences in 30" row offsets while harvesting. Both sizes are similar, so we do not view this as an issue in comparing the two scenarios.

The Solid Seeded WB in Treatment #1 out yielded the Twin 30" WB in Treatment #2 by 3.3 bu./ac. As well the Solid Seeded soybeans in the Double Crop Treatment #1 outyielded the single row 30" soybeans in the Relay Cropping Treatment #2 by 2.8 bu/ac.

The Gross Income from both the Double cropping Scenario and the Relay Cropping scenario were greater than the Solid Seeded WB alone by \$576.81 and \$534.63 respectively. (See Table 1)

A full economic analysis will follow in a separate report from Dr. Mohamad Kahkbazan, AAFC.

Table 1 2021 Results

	Acres	Soybean yield		Barley Yield		soybean income	barley income	total income	Gross/ac
		lbs	bu/ac	lbs	bu/ac	@\$14/bu	@\$315/tonne		
Double Cropping	9.5	24300	42.6	25203	55.3	\$ 5,670.00	\$ 3,602.06	\$ 9,272.06	\$ 976.01
Relay Cropping	8.1	19350	39.8	20200	52.0	\$ 4,515.00	\$ 2,887.02	\$ 7,402.02	\$ 913.83
Solid Barley	114	-	-	302463	55.3	-	\$ 43,228.60	\$ 43,228.60	\$ 379.20

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2022 Results:

Harvest day was on July 26. It was a little late, but that was the date that mother nature would allow. Below are the results of the WB and WCR twin row strips (Table 1). As well as the soybean harvest results comparing WB & WCR relay partners (Table 2).

Table 2 2022 Cereal Harvest Results

Harvest Results Relay Cereals 2022 - Jack White farm									
RYE									
1 Solid Seeded Rye	6850 lbs =	122.321 bu	1.9 ac =	64.380 bu/ ac					
2 Twin Row Rye	12700 lbs =	226.786 bu	3.5 ac =	64.796 bu/ ac	Ave Rye	64.286			
3 2nd Twin Row Rye	12500 lbs =	223.214 bu	3.5 ac =	63.776 bu/ ac					
			8.9						
BARLEY									
4 Twin Row Barley with Relay	10850 lbs =	226.042 bu	3.4 ac =	66.483 bu/ ac	Ave Barley	58.863			
5 Twin Row Barley Relay	11000 lbs =	229.167 bu	4.1 ac =	55.894 bu/ ac					
6 Twin Row Barley Relay	11000 lbs =	229.167 bu	3.4 ac =	67.402 bu/ ac					
7 Twin Row Barley Relay	9450 lbs =	196.875 bu	3.4 ac =	57.904 bu/ ac					
8 Twin Row Barley Relay	9100 lbs =	189.583 bu	3.5 ac =	54.167 bu/ ac					
9 Twin Row Barley w/out Relay	13550 lbs =	282.292 bu	5.5 ac =	51.326 bu/ ac					

Table 3 2022 Soybean Harvest Results

Harvest Results for Relay Soybeans 2022 - Jack White Farm									
SOYBEANS IN SOLID SEEDED RYE									
Did not harvest - no beans in pods	0 lbs =	0.000 bu	0 ac =	0.0 bu/ ac					
RELAY CROP SOYBEANS									
Twin Row Soy on Barley	2400 lbs =	40.00 bu	3.3 ac =	12.1 bu/ ac					
Twin Row Soy on Rye	550 lbs =	9.167 bu	3.5 ac =	2.6 bu/ ac					
Twin Row Soy on Barley	1900 lbs =	31.667 bu	3.5 ac =	9.0 bu/ ac					
Twin Row Soy on Rye	350 lbs =	5.833 bu	3.5 ac =	1.7 bu/ ac	Ave soy on WB	10.0 Bu/ac			
Twin Row Soy on Barley	6250 lbs =	130.208 bu	14.7 ac =	8.9 bu/ ac	Ave soy on WCR	2.1 Bu/ac			



As can be seen by some of the in-crop photographs above the soil in the Lambert farm was extremely variable (Figure 5). On the left-hand photo is on areas where the organic matter was reasonable higher. However, on the right-hand photo was taken the same day, but on the very dry eroded knolls.

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The Good, the Bad and the Dead

Figure 5 Extreme Conditions

Soil Sampling:

There has been base soil sampling completed in the fall of 2020, measuring the chemical components as well as the soil microbiology within this sandy loam soils. Dr. Ian Scott, AAFC is conducting a trial of the effectiveness of various cover crops on the nematode component of the soil microbiology population. These results require several years of study and have not yet been compiled at this time.

Malaise Studies: Dr. Lauren Des Marteaux, AAFC has been working on the Lambert farm to identify the main habitat requirements of our native pollinators, with the aim to

Figure 1 - Location of Malaise Traps



improve the agricultural landscape design for better pollination services and sustainability. These studies are still being compiled and will be presented in a separate report at the end of the cropping year 2022.

On June 8, 2021, it was noted by Samantha Reynolds, UofG Masters student working on the pollinator study, found one of the malaise traps installed near a road was damaged. The trap had been ripped up and tent pegs were cut in half. Greg Vermeersch thought that it was aimless vandalism by people with too much time on their hands. Dr. Des Marteaux moved it to a different site less conspicuous. It just goes to show that many things can go wrong when doing field research.

being compiled.

These studies continued into 2022 and the results are still

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Summary and Discussion:

The theory in Relay Cropping is to allow one crop to get started (WB) while allowing another crop to be planted (soybeans) into existing canopy that will finish after the first crop is harvested. Once the WB is harvested, the soybeans will experience a flush of resources, particularly sunlight that will allow the soybeans to flourish for the balance of the growing season.

The soil health goal of keeping something growing continually in the soil, as long as possible was accomplished in both treatments. However, the relay cropping does do a better job of continuous roots in the ground; During both years, living roots were visible from planting time of the Winter cereal partner in mid-October to the harvest of the soybeans in Nov 10.

At the outset in 2021 the climatic and abiotic factors favoured the double solid planted winter barley/solid seeded soybeans over the Relay Twin-row barley/30" soybean scenario. There was simply lots of heat and moisture that allowed quick germination and growth for the double cropped soybeans. The 2021 growing season allowed ample heat and rainfall which would tend to favour the double planted scenario. However, in 2022 the season turned dryer and crop development was delayed and the soybeans did not finish at all in the double crop scenario.

Yet in 2022 the abiotic factors differed in so far that the dry knolls did not yield at all. As can be seen in the center picture on Figure 5, the right photo showed that both the WCR and the relay planted soybeans succumbed to the very droughty conditions. These types of soils cannot support two crops.

In 2021, we would likely expect the solid seeded barley in Treatment #1 to outyield the twin 30" barley in Treatment #2 because of reduced light interception in the Twin 30" WB scenario. As well, the other factor to be considered is that the Twin 30" WB in Treatment #2 was planted at 90% seeding rate of the solid seeded WB, and simply had less plants in the row. Future studies should likely include population trials on the Twin 30" WB as well as the relay Soybeans.

It could be argued that the UAN applied to the double crop soybeans in Treatment #1 created an advantage as it helped the double crop soybeans. There was, however, very good nodulation all soybean roots in both treatments.

On June 8 of the 2021 cropping season, both treatments had experienced a late spring season frost, damaging some of the relay soybeans in Treatment #2. It is difficult to assess the impact of this abiotic stress, but there was defined damage where there was more residue on the soil, thus preventing the soil heat from warming the growing crop and preventing frost damage.

In 2022, the comparison of the WB to the WCR showed not just small yield differences, but also shown some differences in agronomic comparisons. WCR's ability to provide an allelopathic affect to deter the growth of glyphosate tolerant weeds has been speculated and documented through many scientific documents. In figure 5 the center photo shows that ability quite clearly. On the left side of the center photo, WB had

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been used as the cereal partner, whereas WCR was used on the right hand side. Note the infestation of glyphosate resistant fleabane on the left.

Key Learnings/Conclusions:

1. The relative difference in yield between the Twin Row WCR and the Solid seeded WCR is essentially zero.
2. There is a slight yield advantage for Twin Row WCR over Twin Row WB.
3. The soybeans grown in relay with WB had a significant yield advantage over the soybeans grown in relay with WCR. This is likely due to the shading effect of WCR over WB.
4. The significance of WCR's ability to suppress glyphosate tolerant weeds is highly significant and will be the major deciding factor in choosing WCR over WB in the future.

Next Steps:

- Greg will continue the relay cropping with different outside of the LL-ON framework. Currently he is working with Eric Page, AAFC to explore Winter Canola as a relay partner..

Acknowledgements:

- Thank you to the Mississauga's of the Credits First Nation, Haudenosaunee, Attiwonderonk and Anishinakewaki First Nations People for originally caring for the land upon which these plots have been grown.
- Funding for this project was provided by Agriculture and Agri-food Canada (AAFC) and in collaboration with Environment and Climate Change Canada (ECCC).
- Photo credits in this report are to Mel Luymes.

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