Shared Learning Call: Value of Small Grain Crop in Rotation

August 2, 2019

Presenter: Dr. David Hooker, University of Guelph

- Integrated crop conference
- Farms with his dad who's 86 – slowing down quite a bit but loves farming as much as he does. He just loves farming, it's in my blood! Farm 600 acres of corn-soybean-wheat. As I got more involved in more research and teaching we had to downsize acres.
- Synergy with my job in agronomy and the practicality of the farm itself. I just love that. I love my job.
- Ridgetown Ontario, satellite campus of the University of Guelph. Ridgetown is about an hour East of Detroit. Not that far north – same latitude as Cedar Rapids?
- We grow about 105-110 day corn, Ontario grows 2 million acres, 2.5 million acres of soybeans, 600,000-1 million acres wheat.
- Corn 160 bu/ac, soybean upper 40 bu/ac → same increases in corn and bean yields as the U.S.
- Can yield increases be sustainable 10-20 years into the future
- We can predict if yield increases will be sustainable in long term.
- The productivity limits of conservation in agriculture. "Soil health and sustainable productivity" has been trending. Lots of research has been invested in these concepts. Underlying focus is crop rotation/diversity. Seems to be the key to productivity and soil health – diverse crop rotation. Unfortunately, in Ontario, MN, WI and IA we're trending towards more simple, less diverse rotations. Lots of reasons, marketing, weather, focus on one or two or three crops that have higher profitability.
- This is concerning for us, as a researcher I've looked at many long-term studies and we cannot determine the effect of long term consequences without long-term research. Need long-term experiments to answer.
- I manage a long-term research trial. In Ontario we have several, the one that I manage has 7 different crop rotations, 4 nitrogen rate and 2 tillage systems in 4 reps. All repeated in 1995.
- Main question is what kind of impact does crop rotation diversity have on corn yields. Very similar to other crop rotations – continuous corn, soy-soy, corn-soy, corn-soy-wheat with underseeded red clover into the winter wheat. We usually harvest winter wheat in the 3rd week of July. August, September, October for that clover to grow. Red clover is the most common cover crop in Ontario.
- When we include wheat into a corn soybean rotation, our corn yields compared to a corn-soybean are 15 bu/ac higher. When we eventually look at the economics. Having a small grain/cereal in our operation we have to determine the profitability of the small grain cereal has in itself but what effect that it has in the rotation. It's very commonly overlooked in looking at enterprise analysis for small grain cereals.
- On the soybean side we have 5 bu/ac more soybean in 3 yr vs 2 yr. Another thing that wheat brings to the system is that it allows us to underseed or plant a cover crop after the wheat crop.

Cover crops are difficult to integrate into a corn-corn or corn-soy rotation. Especially in Ontario, there's not a lot of season left for a cover crop to grow.

- After wheat, we get several more months for biomass to grow, harvest carbon.
- When we have red clover, the following corn yields are 10 bu/ac. All plots are fertilized to the same level so that nitrogen isn't limiting and then the whatever the clover provides is additional to that. If we decide on underseeding red clover to wheat, then we get that addition 10 bu/ac in addition to the 15 bu/ac from just the three-year rotation.
- We determined or showed that corn-soybean rotation is more reliant on fertilizer than 3 yr rotation. Wheat supports soil structure, better organic matter, better aggregate stability. Better environment and less of a need for fertilizer nitrogen. We can reduce economic optimum by 15 lbs/ac with just wheat, no red clover. If we have red clover we get 70-90 lbs of nitrogen credit to that corn crop. Bringing small grains into the rotation is bringing a tremendous number of benefits.

How sustainable are these yields?

- Higher the corn yields or higher the soybean yields, the more evapotranspiration takes place. Higher yield needs more water. And mother nature might not provide more water. We should be building our soils to hold more water. Plant breeders are doing an incredible job, but we need more resiliency.
- Yield increases are highest in years where there's a drought. Yield differences between 2-yr and 3-yr are even wider in drought years. +1 journal published. Corn and beans respond to cereals, especially in hot and dry years. Our yields are becoming more and more drought susceptible as they increase, and can hit a ceiling with moisture retention in the soil. Crop rotation are building more resiliency to handle this stress.
- We can't change soil overnight, it's a long-term process. Need to consider these factors when we're choosing what crops to grow, using cover crops, tillage. We'll need it even more into the future.

Economics:

- When economics majors don't see the whole systems approach. Wheat yields this and market price is this – it doesn't come close to the revenues from corn and soybeans. It's common for growers to say "I'm not growing it because it's no where near the returns of corn and soybean."
- If I was a wheat crop, hey I'm giving the corn and soybean these increases in yields, it's not fair that they get the credit.
- 15 bu/ac increase in corn is $3/bushel = $45/ac increase in corn enterprise
- 5 bu/ac increase in soybean is $13/bushel = $65/ac increase in soybean enterprise
- Red clover provides corn yield increase and nitrogen credit, cut nitrogen cost $35/acre
- Marginal revenue increases are $145/ac to the corn and soybean enterprises. Wheat needs to be accounted for providing that $145/ac
- Wheat yields $5.50/bu → it's like increasing your wheat yield by 26 bu/ac to assign the $145 to wheat
- $1.61 premium on the bushel of wheat
- And it's building resiliency in corn and soybean yields as well, especially in dry years.
- Six effects shown in long-term trials in MI and WI and Ontario:

    - Corn-soybean rotations – reduced yield and greater yield instability
    - Corn-soybean rotations – lower SOM, poorer soil structure
    - Increases N requirement for corn
    - Reduces opportunity for cover crops and biomass removal
    - Reduces profitability
- 12 references that support these claims – well supported. Every farm would have different economics, so a grower should look at a systems approach instead of an enterprise approach.
- High heat in grain fill causes less yield.
- We need to reconsider some of these effects of the small grains cereal looking with a systems approach.

What rate interseeding red clover?

- 8-9 lbs/ac, broadcast in March on frozen ground and freeze thaw establishes the red clover.

Could you substitute rye or another cereal for wheat?

- I think so, but I don't have a lot of data. My colleague has oat and barley data and he's showing the same effect as wheat. Rye would also improve the soil and see corn and soy increases. Red clover would not do well beneath a rye crop, I'm almost certain of that.
- Tom Frantzen has a trial out red clover under rye vs. without. On Margaret's farm, they have frost seeded clover in rye but at 15 lbs/ac
- Hazlett rye and had success with red clover, planted the rye at 45 lbs/ac

Yield:

- In Ontario, average yield is 80s, some growers get as high 130-140
- Yield is limited by heat and water stress
- Wheat responds the most to management.
- What we've learned – our yield is higher if fertilizer is applied and fungicide is applied at flowering. Nitrogen rates is probably 120-140 lbs/ac. 80% of growers are applying fungicide at flowering. Fungicides increase economic optimum nitrogen rate. Splitting nitrogen? Never in the fall. No wheat yield response if it's applied in the fall. A little applied as starter MAP placed with the seed, in-furrow.

Nitrogen credit from red clover, how dependant is that credit on doing a tillage pass or turning that red clover under prior to planting the corn crop? As opposed to going and no-tilling corn.

- Nitrogen credit does not vary a lot. It's a little bit less in a no-till situation versus plowed. Like 20 lbs/ac less. Like 70 lbs → 50 so it's not a lot.

Are you familiar with Dr. Yang? His data would suggest that he doubles his N credit by incorporating the top of the plant with the root via moldboard plow.

- Some varied results. But only seen a small reduction. From the data that he's seen. I need to look at his data.

When is wheat following soybeans planted?

- Soybeans are usually harvested in last week of sept – first week of Oct. Then there's tremendous planting date response so most growers plant wheat right behind the combine. Last year we had a lot of wet weather and wheat didn't get planted until the 3rd week of October.

Do you change N rate based on planting date?

- Most early planted wheat, you have to keep pencils sharp regarding nitrogen management. If you apply too much, too early you can get too big of a canopy and it can lodge. So in the ultra early planted wheat we would split apply nitrogen to avoid too much lodging. 30-40 lbs at green up and the balance on at jointing.

Do your growers use tram rows or just drive over the wheat?

- 80% is grown without tram lines. But Dave does on his farm. If growers are doing multiple fertilizer or fungicide applications, those are the growers

Weed populations?

- Worse weed problems are associated with corn-soybeans. Then you have more modes of action. Then with the cereal and the cover crop you're limiting weeds for the seedbank.

With wheat in the rotation – you can time planting of corn and soybeans more precisely to optimize.

Do you know of any producers in your area that companion crop with the wheat at planting such as tillage radish?

- Some tried planting radish with wheat to increase soil structure in the rows

Have you tried other clovers besides red clover?

- Red clover seems to be the most hardy. We've tried crimson clover, wheat clover. Sweet clover is OK, not as compatible with herbicides. More herbicides can be applied to wheat + red clover than the other clovers. Red clover seems to be the most robust. Quite a few growers still aren't satisfied with red clover. Stands tend to be variable, the more competitive the wheat is it puts a huge stress on the red clover. But it still seems to be the most tolerant.
- Many growers are fed up with underseeding and then seed a cover crop mix after the wheat is harvested.
- Lance Hansen at ISU seeded red clover with triticale – seeded a high rate of clover than 8-9 lbs. Some growers go as high as 12-13 lbs/ac but it gets expensive. Some as low as 5-6 lbs.
- In Canada they can insure the red clover in their crop insurance. The premium is $5/acre.