Agronomy Report

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Climate Change and Crop Production

Edmonton Journal (Sept 30, 2019) ***Photo by David Bloom***

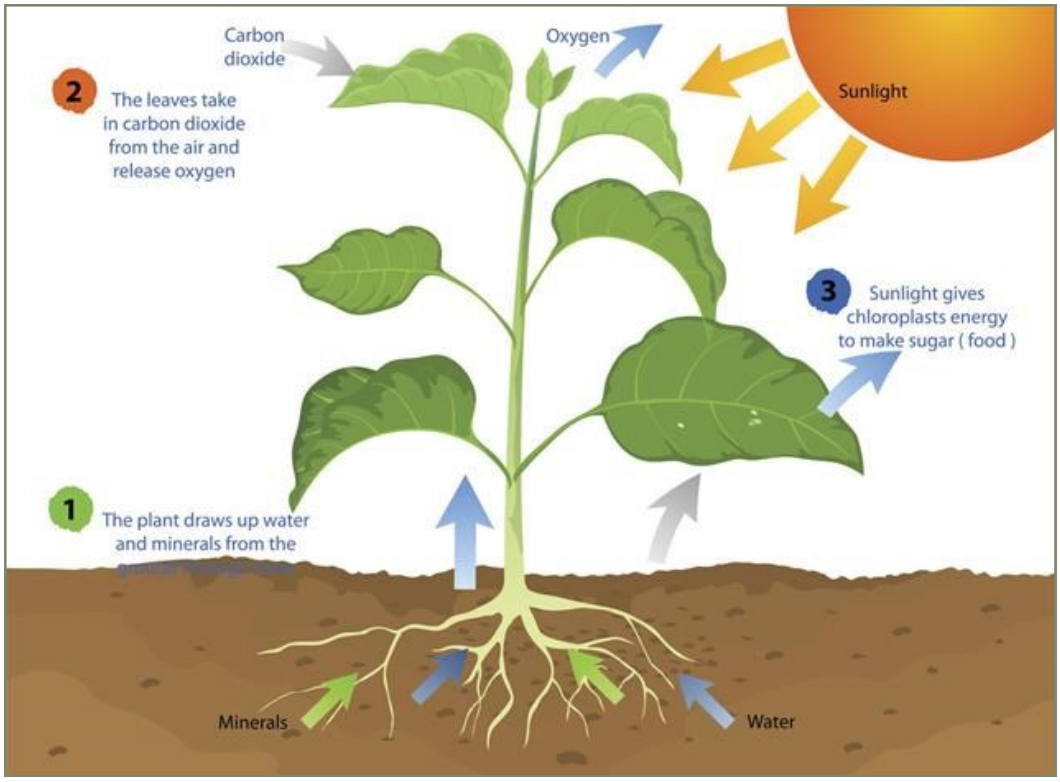
A very interesting billboard was put up in Edmonton last September as part of a "Truth Matters" initiative by the University of Alberta. It proposed that climate change is actually going to boost barley production in Alberta, which caused quite a stir in the local press. The billboard was based on a study headed up by Dr. Monireh Faramarzi at the University of Alberta. This study concluded that central Alberta is going to become warmer and wetter over the coming decades. At the same time, increasing CO2 levels will decrease the water demands for crop production. These factors should lead to more favourable conditions for barley production. Ironically, it appears that "Truth Doesn't Matter" as much as you might hope, because after facing significant pushback from climate change activists who felt this was sending the wrong message to the public, the University not only removed the billboard, they fired the VP of University Relations who had OK'd it.

I'm not trying to start a political debate here, but I do want to talk about a scientific reality. **"Climate change will boost Alberta's barley yield"** deserves a little more conversation, because I believe we are already seeing an impact of climate change; not just on our barley production, but on all of our crop yields. Maybe nowhere has this impact been more startling to me than in wheat. Most people I talk to have been very pleased with their wheat production over the past several years.

Wheat doesn't even seem to need exceptional moisture to produce great crops, which fits right in with Dr. Faramarzi's projections

At Battle River Implements, we have been doing demonstrations, trials, and staff training on a field near Killam for several years now. The poorest wheat crop we have grown on this Training Field was close to 70 bushels per acre. Not once in the last 3 wheat crops we have grown on the field have we exceeded the long term normal for rainfall – not even this last growing season, when many people saw a lot of extra moisture. This now seems to be our new normal - on a field that was producing 55 bushels of wheat in a good year less than 15 years ago.

When I hear producers talk about their own experiences with high wheat yields in recent years, they generally split the credit between improved genetics and improved agronomic practices. While those two factors certainly have a major impact on the yields we are seeing, there is another factor that researchers say have as much of an impact. That is our rising CO2 level. Since 1970, atmospheric CO2 levels have increased from around 370 ppm to over 410 ppm. Since CO2 is a critical ingredient for photosynthesis, it makes sense that more CO2 in the air would have an impact on crop production.



Smithsonian Science Education Center (CREDIT: mapichai/Shutterstock.com)

Researchers have acknowledged this reality for several years. In fact, it was almost 5 years ago that I attended a cereal crop production seminar where plant breeders were discussing the impact that rising CO2 levels were having on wheat yields.

How this works is actually very straight forward. Carbon dioxide cannot pass through the cuticle, which is the waxy layer that protects the plant leaf. Instead all gases move in and out of leaves through openings called stomata (stoma = "hole"). Guard cells control the opening and closing of stomata. When the stomata are open, they can take in CO2 for use in photosynthesis. However when they are open, they are also losing water to the air through transpiration. A certain amount of transpiration is necessary to pull nutrients and water from the roots to the upper leaves, but water loss to the atmosphere is always an important issue for crop production in our area, where we often run out of soil water before the growing season is over.

So what happens when the concentration of CO2 in the air increases? A plant is able to absorb the CO2 it needs more quickly and the stomata don't have to remain open as long, cutting down on water loss. This is what the billboard message meant when it said **"boost Alberta's barley yield with less water"** We are quite literally using less water to produce the more bushels. If you think of water use efficiency for a crop as the number of bushels you can grow with an inch of water, we have gone from about 4 bushels of wheat per inch of moisture in 1970 to between 7 and 8 bushels today.

There have been enormous changes in how we farm since 1970 and we have made considerable advancements in plant breeding, so its hard to say how much of our increased yield can be attributed to genetics,how much to farming practices, and how much to increasing CO2 levels. From a practical standpoint, I suppose it really doesn't matter. What matters is that I can reasonably expect to grow over 70 bushels of wheat on our company Training Field as long as I get anywhere close to average rainfall. That was not true even 10 years ago and it's changing the way I have to think about my fertility program.

These yields are drawing down soil nutrient reserves much more quickly than we have seen in the past. Almost 100 lbs of N, 39 lbs of P2O5, 31 lbs of K and 7 lbs of S gets hauled to the elevator along with that 70 bushels of wheat. I have increased my P2O5 application rates and started adding potash to the cereal blend to reflect that reality. I also need to have a better plan for feeding this crop. The traditional Killam area blend from not that many years ago of 75-25-0 looks pretty anemic when you consider that I now need roughly 140 lbs of N and 70 lbs of P2O5 available for crop use to hit my target yield and protein. Unless you have exceptional soil reserves, that can be a lot of fertilizer. Add that to the wheat seed being loaded in the cart at seeding time, and you are looking a lot of material to put through the machine and not much time to do it in.

In the Red River Valley of Manitoba, where they expect 90 bushel yields and sometimes see well over 100 bushels, they are struggling with putting around 500 lbs/acre of seed and fertilizer down in one pass. When wheat takes almost the same amount of fertilizer to reach its yield potential as canola does, and you also have to deal with somewhere between 110 to 135 lbs/acre of seed, it can quickly become a logistics headache. This has led producers and researchers to ask if applying all that fertilizer at seeding time is the best way to go? Is there an efficient way to get the needed fertility package to the crop without investing heavily in bigger carts or having increased fill times bogging down seeding operations?

There are several interesting studies going on right now as researchers look into different ways to get fertility to wheat in high production systems. Fall banding of fertilizer is a tried and true method, but we have several examples in recent years where fall rains have made getting the harvest completed an ordeal all on its own. Very few producers have been in a position to do any fall work, let alone fertilizer banding. So a lot of the new work revolves around top dressing nitrogen in-crop as the easiest way to reduce fertilizer volume at seeding. Nitrogen is mobile in the soil, making it easier to deliver to a standing crop than phosphate or potash. Also the highest demand for nitrogen in a cereal crop does not occur until the tillering stage and beyond, allowing delayed applications without impacting yield potential. There have been studies done using different forms of nitrogen, different rates of nitrogen, different nitrogen stabilizers, and different application timing in-crop, to see if post emergent fertilizer applications can be effectively used as a supplement to fertilizer banded at seeding. The results have been very promising for the most part.

There are also people hard at work to develop tools that can help make the in-season management decisions on what to apply, how much to apply , and when to apply it easier. I think the most interesting of these are the efforts to measure soil available moisture, which tells us how much water we can count of for the crop. By using soil water measurements to model the likely yield for the field well in advance of harvest, we can adjust input levels to match the amount of water available for the crop, which should lead to more efficient use of available water and nutrient resources. And that should help the bottom line.

The big crops we have been growing over the past few years come at a cost to our soil fertility. Many producers have been removing nutrients from the fields at a faster rate than they are adding them, depleting the reserves and leaving the crops less able to take advantage of favourable environmental conditions. Unless we have a plan to address the fertility needs of the large wheat crops we are capable of growing, we will continue to come up short on protein and falling numbers whenever we hit good growing conditions.

WAYNE SPURRILL, P.AG

Cell: 780 761-1616

Office: 780 672-4463