DO YOU C WHAT I C?

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Managing Carbon: Carbon chemistry is the basis of life as we know it. The search for life on other planets begins with a search for water and carbon containing compounds. Carbon is the chemical element taken up in largest quantities by plants. Until the issue of global warming was raised, almost no attention was paid to understanding the factors that impact carbon cycling in agriculture.

Scientists attempting to quantify the impact that rising atmospheric carbon dioxide partial pressures might have on plant growth accumulated a wealth of information. These data suggest that plants have higher water use efficiencies when grown under elevated carbon dioxide levels. This result was expected. The phenomenon is attributed to the fact that these plants do not have to open their stomata as widely to attain the carbon dioxide they need. Consequently, less water vapor “leaks” out. Plants in these conditions are also better able to attain adequate carbon under water stress conditions when stomatal closure occurs for substantial periods of time during the day.

At first blush, most practicing farmers probably think this has little to do with their operations today. That may not be true for no-till farmers. It is conceivable that C cycling could be manipulated through rotation choice, residue management techniques, nitrogen application methods, etc., with the goal of raising carbon dioxide partial pressures in the crop canopy This may sound silly until you consider that it is possible (probable) that C cycling effects are partially responsible for the fact that soils with high organic matter content normally produce higher yields than those with less organic matter Similarly, fields that have recently been converted from perennial crops or from sod into crop production might produce superior yields for the same reason. Almost every seasoned no-till farmer has had instances where a crop yielded much better than expected based on the water saving aspects of no-till alone. Something else had made a contribution.

Perhaps no-till and crop rotations are not ends but rather the best means or tools we have available to manage the carbon cycle in our cropping systems. Carbon cycling is largely out of our control in tilled systems since much of the carbon dioxide cycling (loss from the soil and plant residue) occurs within days of tillage events.

Very few people, scientists included, think of carbon as an essential plant nutrient to be managed as such. Cycling nutrients is nothing new, but almost everyone forgot about the most important nutrient, carbon. Maybe that was because little could be done about it in tilled systems. Times have changed.

If C cycling is to be controlled, low-disturbance no-till now becomes the only option in terms of tillage choice. The focus then turns to optimizing that system. It can be managed for C cycling but that will do little good if other problems develop that interfere with the ability of the crop to express it potential yield. Managing crop rotations in a manner that prevents weed and disease problems and optimizes C cycling is much more involved than looking at either of the factors alone.

An Emphasis on Rotations

Determining what to grow as rotational crop(s) and how they will be sequenced can be a complex process. There are however some general guidelines that can be extremely helpful in beginning the process. Consider this to be Beck’s **TOP 10 LIST**. The order they appear does not denote their importance.

1. Reduced and no-till systems favor the inclusion of alternative crops. Tilled systems may not.
2. A two season interval between growing a given crop or crop type is preferred. Some broadleaf crops require more time.
3. Chemical fallow is not as effective at breaking weed, disease, and insect cycles as are black fallow, green fallow, or production of a properly chosen crop.
4. Rotations should be sequenced to make it easy to prevent volunteer plants of the previous crop from becoming a weed problem.

5. Producers with livestock enterprises find it less difficult to introduce diversity into rotations.
    a. Use of forage or flexible forage/grain crops and green fallow enhance the ability to tailor rotational intensity.
6. Crops destined for direct human food use pose the highest risk and offer the highest potential returns.
7. The desire to increase diversity and intensity needs to be balanced with profitability.
8. Soil moisture storage is affected by surface residue amounts, inter-crop period, snow catch ability of stubble, rooting depth characteristics, soil characteristics, precipitation patterns, and other factors.
9. Seedbed conditions at the desired seeding time can be controlled through use of crops with differing characteristics in regard to residue color, level, distribution, and architecture.
10. Rotations that are not consistent in either crop sequence or crop interval guard against pest species shifts and minimize the probability of developing resistant, tolerant, or adapted pest species.

Classification of Rotation Types

It is sometimes easier to discuss concepts if they are placed into categories of some sort. We have developed the following scheme with this in mind. This classification is totally arbitrary and is meant to serve only as a tool to help understand rotation planning.

SIMPLE ROTATIONS: Rotations with only one crop of each crop type used in a set sequence. This is the most common type.

EXAMPLES: Winter Wheat-Corn-Fallow; Wheat-Canola;
S. Wheat-W. Wheat-Corn-Sunflower; Corn-Soybean; Winter Wheat-Corn-Pea

SIMPLE ROTATIONS WITH PERENNIAL SEQUENCES: Simple rotations that are diversified by adding a sequence of numerous years of a perennial crop.

EXAMPLES: C-Sb-C-Sb-C-Sb-Alf-Alf-Alf-Alf and many others.

COMPOUND ROTATIONS: Combination of two or more simple rotations in sequence to create a longer more diverse system.

EXAMPLE: S. Wheat-W. Wheat-Corn-Soybean-Corn-Soybean.

COMPLEX ROTATIONS: Rotations where crops within the same crop type vary.

EXAMPLE: Barley-W.Wheat-Corn-Sunflower-Sorghum-Soybean or Barley-Canola-Wheat-Pea. This is similar to the example cited for compound rotations. Barley has been substituted for one of the wheat crops; sorghum for one corn; and sunflowers for one soybean.

STACKED ROTATIONS: One of the less well-known approaches is one we call stacked rotations. This includes rotations where crops or crops within the same crop type are grown in succession (normally twice) followed by a long break.

EXAMPLE: Wheat-Wheat-Corn-Corn-Sb-Sb; Barley-Wheat-Pea-Canola

Stacked Rotation Concepts: This should not be an unfamiliar concept because it is the way that plants sequence in nature. The concept behind stacked rotations (as with some of the other types of rotations as well) is to keep both crop sequence and crop interval diverse.

ROTATIONS UTILIZING BOTH STACKED AND NORMAL SEQUENCES:

Examples include Canola-W.Wheat-Soybean-Corn-Corn and S.Wheat-W.Wheat-Pea-Corn-Millet-Sunflower.

It is hoped that the above discussion has been helpful. It is meant to be an overview of some rotations strategies that will allow producers and those working with them to better understand the “art” of rotation planning.

The following are some statements concerning rotations:

Government programs provide economic disincentives for inclusion of alternative and cover crops. This includes programs such as crop insurance. Bankers will not allow producers to grow crops that do not have a crop insurance program and loan rates associated with them.

I have no better chance of designing the best rotation for you than I have of choosing the best spouse for you. There are things in life that you have to do on your own. I can point out some factors you should consider when choosing a rotation.

There is no "BEST" rotation. No one can design a rotation that will work every year under every circumstance. It is a probability game. There are bad rotations that work well for a while. There are good rotations that fail at times due to weather or other uncontrollable factors. Poor gamblers make money at times; good gamblers lose money at times.

Rotations can be designed that work well in dry years but they fail to take advantage of good years. Or even worse, they fail badly in good to wetter than normal years.

Producers with more risk tolerance (financially and psychologically) will be more comfortable with riskier rotations. Properly designed "risky" rotations can make more money in the long run but can result in substantial losses over the short-term.

The best approach to spreading risks is to use more than one rotation (preferably sequentially to make an even longer complex rotation).

Rotations used may differ depending on the soils involved. In other words, some of your land may require a different rotational approach than other land you farm. Some of the reasons for this include inherent soil characteristics, past history, weed spectrum, distance from the farmstead, landlord, etc.

Most farmers are good at designing rotations once they start trying.

The rotations used may have to change as market, soil, climate, and enterprise, conditions change. That is to be expected. When designing a rotation, be thinking of ways you could change it.

Don't be afraid to ask for advice, but accept no recipes from others. DO YOUR OWN COOKING.