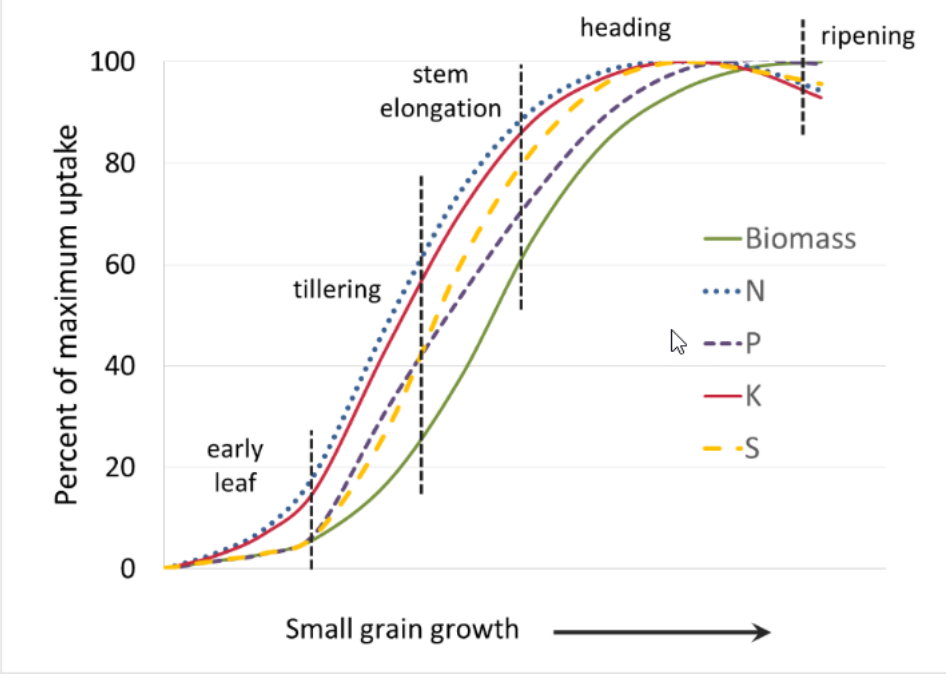
Hello All,

Again, what an amazing moisture event 1 inch plus in the month of February. I am glad it was rain, or we would still be digging out. While the soil temperatures are still cold, I am seeing some shallow seed emerging and this will continue to be the case as these temperatures warm.

I have talked to several growers this week and the sentiment in the country has improved a great deal as a result of this rain. This will be the best profile we have had in early spring for several years and this is very important in this country. On another note, with the warmer temperatures in the top two inches we are seeing some kochia emergence. This is quite early and yes these will probably succumb to the colder nights we have forecast. This suggests that we may have some challenges concerning weeds in this thinner wheat. We will learn more in the coming weeks. I will now move back to our discussion and start by discussing overall fertility/nutrition in winter wheat.

To start this discussion, it would be appropriate to look at a nutrient uptake curve. While this is only for 4 major nutrients this does illustrate when most of the nutrients are needed in the plant.



In fact, as you may anticipate nutrient demands increase dramatically as the plant progresses physiologically. Our goal is to have the nutrient in solution for the plant to absorb before peak demand. While I talked about

nitrogen and soil interactions last week, I wanted to take a deeper dive inside the wheat plant this week as it pertains to this physiological development and ultimately how that translates to dry matter yield.

As with last week I will start with Nitrogen. This nutrient plays a key role in most of the metabolic functions in the plant. In essence, this nutrient is essential in all cells.

1. A major component is chlorophyll the compound the transfers light energy into sugars.
2. A major component in amino acid formation, the building blocks of protein and essential for survival.
3. Component of ATP or energy storage and transfer in the plant.
4. Significant component in the nucleic acid or genetic material of the plant.
5. Essential in pigment compounds.

Simply put this nutrient is responsible to build the plant.

The second nutrient we will look at Phosphorus which is essential in numerous metabolic functions.

1. Energy accumulation and transmission.
2. Key component in photosynthesis.
3. Cellular respiration.
4. Cellular division and differentiation.

While nitrogen is key for cell and protein building this compound is central component in metabolism. This as I am sure you know is like the engine providing the energy to drive the train.

Potassium is our next nutrient to discuss. This nutrient is critical driver in the plant metabolism due to its influence on plant water.

1. Influences osmoregulation. (water uptake)
2. Regulates water in plant, maintains turgor.
3. Reduces respiration and energy loss.

4. Stimulates enzymes proteins, cellulose, lipids.

This nutrient is key for a plant to manage through moisture stress. It stimulates 40 different enzymes in the plant as well.

Sulfur is now in many conversations would now be considered a 1 A macronutrient. While it is not as plentiful as the macronutrients it is no less essential in metabolic function.

1. Building block of proteins.
2. Essential for chlorophyll.

I will now mention a few micronutrients of concern.

1. Boron- cell division and seed and pollen formation.
2. Zinc- Essential for n transformation and vigor.
3. Manganese- Essential for N reduction.
4. Chloride- Osmotic regulation some leaf health properties.
5. Copper- Oxidation reduction and leaf health.
6. Iron- Essential component of chlorophyll.

As you well know there all the nutrients above have associated with them a charge. These charges play a huge role in how plants function. This leads me to a term many are not familiar with. This would be *stoichiometry* which is defined as the proportion is which these elements react with one another. This is scientific jargon to say that their reactions between elements and a plant prescribed balance. In essence, nutrient interactions take place when a nutrient supply influences the absorption, dispersion or utilization of another nutrient. See the list below which lists the consequences of an excess of one nutrient to other nutrients uptake and efficiency.

1. Nitrogen – potassium and calcium.
2. Potassium – nitrogen, calcium, magnesium.
3. Phosphorus- zinc, copper, iron.

4. Iron- manganese.
5. Magnesium- calcium, potassium.
6. Sodium- potassium, magnesium, calcium.
7. Copper-molybdenum, manganese, zinc, iron.
8. Calcium-phosphorus, magnesium, boron.
9. Molybdenum- iron, copper.
10. Zinc- manganese, iron.
11. Sulfur-zinc, manganese, iron and molybdenum.

Now understand these are plant-based reactions and have nothing to do with soil.

Taking this a step further there are ratios I focus on when considering macronutrients. The two most important ones I focus on are the N:P ratio and the N:S ratio. In starting with the nitrogen to phosphorus piece they are the two most important nutrients in the plant and as noticed above there is a reason why. So many times, in yield limiting years we may cut back on one or the other. Understand that they work hand in glove in fact the ratio is tight 5.6:1. Practically this means if we limit one of these two fertilizer products, we will impact the efficiency and use of the other when applied. There is a lot of data that will support that optimal P levels will have a positive impact on nitrogen use efficiency. I know many people have seen this in the past well here is the reason why. The N:S ratio is vitally important as well. The ideal ratio in the plant is 15:1 on wheat. If we do not have sulfur in the plant in this ratio, then the plant cannot fully optimize nitrogen. A major source of sulfur in the soil is mineralized S. When dealing with winter wheat we cannot rely on this source a great deal since most of the sulfur demands are required earlier than mineralized s is plant available. As with P the sulfur availability at optimal rates will enhance the NUE. The same is true for sulfur with adequate N the SUE is enhanced.

Micronutrients make up a very small portion of the stoichiometry however the impacts are significant. Some are enzymatic others photosynthetic, and others will stimulate or downregulate phytohormones.

I want to focus a little time on phytohormones because they are the hormones involved in responding to abiotic stress. For sake of time, I will not go into each. Suffice it to say they are the intrinsic hormones that help the wheat plants respond to the abiotic stress events. Micronutrients such as B and Mn will help in activating or downregulating these hormones. These being physiological responses, to work properly the plant needs to be growing optimally. In the spring this can be particularly challenging in our area which can lead to some delay in the response to a given stress event. This is why early spring can be ideal timing for the placement of a Bio-stimulant on wheat. I have had tremendous success with **Kelpene** over the past several years as a result. It has terpenes which are aromatic enzymes the very enzymes needed to stimulate the phytohormone response.

Now for the most part with a few tweaks the information I discussed today would fit for all crops. My reasoning for going through this is to illustrate the importance of nutrition and how it can and will differ from soil fertility. I understand that plant physiology was not at the top of the list of things you wanted to do. I just am trying to provide the why or even why not of many different treatments out there. Understanding the plant physiologically can help make us better managers.

With this information and the soil reactions we discussed earlier one can determine some strategies especially in high yield situations. When looking for a healthy crop consideration of nutrition and the principles discussed are of great importance. With nutrition many times it's not as simple as adding one nutrient you must consider all nutrients. I am by no

means implying we start adding a lot of products we do not need. Consideration of how the plant grows and the nutrition it needs will help us be able to diagnose a problem or potential problem before it happens. If you need any help with this, feel free to reach out.

We are a few short weeks from some things happening in these wheat fields. Nitrogen availability in the soil solution will be critical to help optimize the genetic potential of the plant to create tillers. The stands that are acceptable now I would plan on doing first. These stands that are filling in we have some time. I will discuss weed control and abiotic stress response next week. The most pressing issue would be plant nutrition as this crop comes out of dormancy. In conclusion, we are finalizing the planning stages of both the wheat and spring crop. Remember we have a clean slate and efficiency is our goal and a must in this economy. My purpose has been to give you some tools to achieve this goal. I hope this was of some value. If you have any questions, feel free to reach out.

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