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5Rs of Nutrient Stewardship

Systems Approach Delivers the Breadth and Depth of Farming Responsibly

Farmers are, without doubt, a critically important resource needed to feed a rapidly growing global population. However, those same producers face a challenging paradox: balancing environmental concerns while maintaining soil productivity and still earning an income.

As advocates for sustainable farming practices, growers attempt to minimize agricultural run-off, reduce nutrient loss in fields, and maximize nutrient uptake. Farmers with tightened budgets are beginning to reexamine their approach to soil and plant health. Many are taking a close look at the 4Rs of Nutrient Stewardship (right source, right place, right rate, right time) which have led to success in the past.

However, Ag Spectrum challenges growers to think beyond the promoted 4Rs and consider the best approach for their crop's health. Rather than compromising the true needs of soil and plant health to satisfy convenience, adopt a strategy that will develop a better environment for future generations' success.

The Maximum Farming System is designed to address the 5Rs by applying the ***right product***, in the ***right form***, in the ***right amount***, at the ***right time***, and in the ***right place*** to achieve the highest efficiency possible. This systematic approach leads to improved soil health and strong yields. Delving deeper into this concept, we examine the various growth stages of a corn plant and address the necessity for enhanced nutrient stewardship.

It Starts with the Soil

In order for a corn plant to achieve maximum potential, it needs a nurturing seed bed and rooting environment that meets basic soil requirements. There are many factors that must be considered and evaluated to arrive at Maximum Farming recommendations including, but not limited to, soil tests, field history and specific nutrient needs of the chosen hybrid or crop variety.

The texture and structure of soil, plus the organic matter present, influences the plant's ability to use the available water and nutrients in the soil solution. Soil texture and structure influence water movement and retention, soil temperature and soil fertility. For example, clay soils absorb and retain water but not all of the moisture is available to the growing plant. By altering the exchangeable minerals on the surface of the clays, we can alter the way that chemistry affects the structure within specific textures of soil. Increasing calcium as a percent of base exchange improves soil structure, while increasing magnesium or sodium causes soil structure to deteriorate.

Pre-Planting

When nutrients are applied in late fall or early spring, the likelihood of snow or rain causing run-off, leaching or denitrification increases. During years when there is an early spring and soil temperatures rise rapidly, nutrients become available more rapidly and the microbial community is active, releasing additional nutrients. Be warned, however, that warmer soil temperatures may cause more insects to be present and soil test readings may be higher than typically expected. Timely and precise application of nutrients in the proper form and amount ensures minimal impact to the environment, maximizes production efficiencies, and enhances the cost savings associated with applying less fertilizer.

Planting

Prior to planting corn, it is beneficial to stimulate the soil's microbiological activity to ensure that the new seedling has optimum nutrient availability and access to hormones that stimulate growth of the plant's architecture (roots, stem and leaves). Providing phosphorus and the right micronutrients, such as zinc, iron and sulfur, at planting will assist with vegetative growth and allow the plant to maximize photosynthesis throughout the entire growing season. Precise application at planting allows these nutrients to be accessible during the early growth stages.

Seed and nutrient placement at planting are critical as they relate to fulfilling a farmer's key priorities of establishing a healthy root system and stand and promoting even emergence. This proper nutrient placement, along with increased microbial activity allows the plant to exert less energy while accessing and transforming nutrients into a usable form, while allowing it to focus more on root establishment and plant structure. Even and plentiful stands give a field its best chance to produce optimal yields when all plants develop at the same rate.

In order to achieve this consistency it is critical to make nitrogen, phosphorus and potassium available at planting. As with all applications throughout the growing season, the right form and placement of nutrients used is critical. Many conventional farmers apply anhydrous ammonia during pre-plant, however, nitrate nitrogen is the form of nitrogen that a plant needs to engender cell division and subsequent development.

Nitrate nitrogen is necessary to trigger the cell's DNA to enable zein proteins to be stored in the vacuole during grain fill.

Optimal placement and form of this nutrient is absolutely critical to achieve the consistency and early plant growth that is desired. The Maximum Farming System suggests that nitrogen should be banded 4-6" from the seed and should contain both ammonium and nitrate nitrogen.

Additionally, the Maximum Farming System places a food-grade phosphorus directly under the seed at planting where it can then be easily accessed during the emergence stage. This phosphorus is precisely designed to be readily accessible in a usable form while causing as little damage as possible to the environment.

Emergence to V6

The Maximum Farming System's application strategy allows for lower amounts of phosphorus to be used because it is applied at the right time of peak demand, in the location where it is easily accessible, and in the right form necessary for uptake. The right product, in the right form, is critical because any alternative form of phosphorus must be altered by an outside source of energy before it can be taken up by the plant. Conventional broadcast applications require greater amounts of phosphorus to achieve the same level of nutrient concentration, availability and absorption into the plant.

Phosphorus is naturally immobile in the soil, so placement is a critical component of optimum phosphorus nutrition. By placing the nutrient in a usable form in furrow, the nutrient is readily available and contributes to optimizing the number of kernels formed and sets the stage for optimum yield.

At this stage of the growing season, it is also imperative that the plant has access to nitrate nitrogen. The rate at which the nitrogen should be applied is based upon several factors, including plant population, the nitrogen response pattern of the hybrid, and the available nitrogen in the soil's organic matter. A reduced form of nitrogen (NHx) should be side-dressed during the V4-V6 stages so that application equipment can still navigate the field and apply the nitrogen to the soil. Since this form of nitrogen is not needed until the reproductive stage, it must be applied in a stabilized form so that it can maintain its reduced form as long as possible. Again, right form matters. Waiting until the reproductive stage to apply nitrogen is unrealistic because it isn't possible to fulfill the needs of the plant without causing serious injury to the plant's leaves.

V6 to Rapid Growth

If a plant is experiencing stress during the V6 to rapid growth stages, the Maximum Farming System recommends foliar feeding nitrogen in the form of urea during the vegetative stage, along with a micronutrient package including zinc, iron and sulfur to ensure optimum yield potential (maximum fillable kernels on each ear). This improves the health of the plant, allows it to continue focusing on grain fill, and produces maximum yields, rather than fighting stress.

Pre-Silk/Pollination

During this stage, the plant is preparing for pollination which spurs additional root growth. The plant is also preparing for the reproductive stage so minerals with a shorter period of need, such as copper, cobalt, zinc, and boron, are in high demand. Additional applications of these nutrients spur flower, pedicel, and pollen development.

Grain Fill

As corn nears its final growth stage, its natural tendency is to shut down. However, supplying additional key nutrients at this stage spurs late-season root growth that accesses and carries more water and nutrients to the kernel. Oftentimes, a conventionally-grown plant is worn out and dying by this stage, but with adequate and precise nutrition placed throughout the entire growth cycle, increased kernel quality and test weights can be achieved. For example, the nitrogen applied during V4-V6, if applied in the stabilized form, should be readily available for the plant to access at this stage of development. This contributes to continued development of the plant's architecture. A healthy root system will help a plant fight stress from heat and water deficiencies during grain fill.

Larger and stronger leaves, as a result from proper nutrition throughout the entire growing season, will support continued photosynthetic activity. Root exudates will return to the soil and provide energy to mineralize nutrients for next year's crop. Ultimately, if the plant has the nutrients necessary to maximize production, any remaining energy and nutrients are then returned to the soil as the plant matures. This is imperative so that soil test nutrient values are not reduced, allowing nutrients to be available for future crops.

While the basic philosophy behind the 4Rs is valid, it fails to address the real needs of plants and soil. Details regarding how the Maximum Farming System addresses these key variables in crop production are fundamentally different than the 4Rs, and we must prioritize the crop and soil's needs before our own convenience in order to be most effective. Ultimately, we must ensure that recommendations make "business sense," while also doing what is best for the plant and the soil.