Drought protection through tillage and a comprehensive fertility program.

Joe Bastardi, a meteorologist from WeatherBell Analytics, says that the weather cycle is starting to look like the 1950s and that we should look for drier than normal conditions especially throughout the heart of the corn belt. I am certainly no meteorologist but what if Joe is correct. Is there anything that we farmers can do to reduce the impact of dry weather? The answer is a resounding yes.

The first and probably the most important thing we can do to weatherproof our fields is minimize compaction first with tillage and, secondly, through soil balance. Removing compaction layers in our fields with the use of deep tillage is the first place to start. The last two falls in Ohio and Indiana were a challenge just to get the crops out of the field without cutting big ruts. The value of tile drainage has been demonstrated time and time again. Preparing for drought tolerance starts by getting the crops out of the fields the previous fall with minimum compaction. Often times this is easier said than done. The size of combines and grain carts has only gotten bigger and so too has the level of compaction.

Freezing and thawing will not remove compaction on a short-term basis. The reason why we have compaction is the loss of pore space. Without pore space, the water content is reduced, and it is the freezing of water that expands the soil and removes compaction. In fact, water that is perched on top of a compacted layer when frozen will exert pressure in all directions, and, with the top of the soil frozen, there will be a lot of downward pressure, re-enforcing the compacted layer. Getting the water below the compaction zone through deep tillage will not only drain the surface, but also put water to work lifting the compaction as it freezes. Remember to always deep-till just an inch below the zone of compaction. Going deeper only disrupts existing soil structure and increases your fuel and horsepower requirement.

Balancing the standard soil test using the Base Saturation Cation Ratio will help to minimize compaction on the soil chemistry side. Many universities have a hard time accepting this idea, but I, and more importantly, my clients have seen improvement in their soils-drainage and workability when we can balance the soil's base saturation to approximately 65% calcium and 15% magnesium. This balance does not work on the very light exchange capacity soils, say under 10 milli-equivalents. These light soils are generally sandy, and, although they can be compacted, it is not related to a structural breakdown since they really don't have a structure. The combination of balancing the higher exchange capacity soils and performing deep tillage will open up the soils to optimum root development. It is a big, deep root mass that is key to withstanding droughty conditions.

When it comes to calcium and magnesium, balancing doesn't stop with the standard test. I personally feel that you need to look at soil paste analysis to see if there is enough calcium in the soil solution to provide roots with enough calcium at the growing points. Calcium is critical to cell wall strength and helping to push the root cap through the soil profile. In the area behind the root cap and the area of cell differentiation, calcium is absorbed into the cell wall for strength, and, as the cells expand by filling with water, the root cap is pushed through the soil. The lack of adequate calcium will cause the cells to buckle when hitting resistance. Ultimately, this reduces root mass and the plant's ability to withstand droughty conditions. This also hinders roots from picking up other nutrients like phosphorus and potassium, which are critical in drought protection. The fact that most soil labs have switched to the Mehlich III extracting solution with a pH of 2.5 and the continual use of minimum and no-till, the chances dramatically increase that the standard soil test is overstating the calcium levels. Calcium and boron are primarily moved through the water transport system known as the xylem; therefore, calcium cannot be moved from the surface down to the roots deeper in the soil. If calcium is not at the growing point, shortages may occur minimizing root mass. Over time calcium at the surface will move deeper into the soil through mass flow. One of the problems that occurs during lime applications left on the top couple inches is that the pH in that area goes up and reduces the solubility of the lime, slowing the downward movement. Lime on the surface may be dissolved by the low pH extracting solutions, which might overstate the available calcium in the soil.

Ideal base saturations and pH levels still do not guarantee that there is enough calcium in the soil solution for maximum root development. The paste test or nutrient solubility will indicate whether there is an adequate amount of calcium coming into solution from the colloids or dissolution of free carbonates in the soil. The best crop yields seem to come from soils that have around 30ppm of calcium in the paste analysis. Once root mass is pretty well set, the solubility would not need to remain at that level, but I seriously doubt whether we could control calcium to that degree without irrigation. Liming low pH soils with the correct lime and using small amounts of lime generally in the 2000-3000 pound rate can be the cheapest way to improve calcium solubility. When the balance of calcium is close to the 65% base saturation and pH is 6.2-6.5, but the soluble calcium is low, an application of calcium sulfate known as gypsum may be in order. Remember, any application of calcium can precipitate phosphorus and reduce availability; however, by improving soil structure with the proper tillage and soil chemistry, the enhancement of biological activity will help to offset phosphorus precipitation.

Besides calcium, phosphorus and potassium are two other nutrients that need to be considered as drought stress reducers. Phosphorus is critical for root development among other things. It controls the energy in the plant and can move upward or downward in the plant depending upon need. Phosphorus is becoming stratified at the surface of our minimum and no till fields. This is not a problem as long as there is root activity and moisture at the surface. When the surface soil dries out and root activity stops, so too the availability of phosphorus. In long-term no-till farms I have seen as much as 66% of all the phosphorus in the top 3 inches. In the last few years because of the high cost of poly-phosphates, many farmers have reduced their row applications for corn and have elected to broadcast the balance of the phosphorus as MAP or DAP. This practice has potentially exacerbated phosphorus deficiencies in a drought situation. Mixing calcium sources with the stratified phosphorus also reduces availability. The bottom line, much to many people's chagrin, is to moldboard plow every 5 or 6 years. This should be done following wheat or early beans so the fields can be worked down and planted to a cover crop in order to minimize wind and water erosion. Additional studies might show that plowing may be stretched out to longer intervals. Deep placement of phosphorus is another option, but an expensive one at that.

Another nutrient critical for plant drought protection is potassium. It is a nutrient that wears many hats when it comes to its activity within a plant. One of its more important jobs in the plant is to regulate water usage. It does this by controlling the osmotic pressure in the stomata on the underside of the leaf. These small openings regulate the gaseous exchange between the plant and the atmosphere. As potassium becomes deficient in the plant, the stomata fail to open and close properly, causing the plant to lose water. Plants deficient in potassium require more water to produce the same yield as those with adequate levels. Tissue data collected on soybeans in Northwest Ohio for the last two growing seasons averaged 83% below the desired levels at R-1 & 2. 2012 produced some excellent yields for the conditions, but timely rains and the fact that it seems soybeans with their smaller plant size compared to corn, seem to do better under drier conditions. I attribute this to a higher nutrient concentration in soil solution when dry conditions exist. An occasional half to one-inch rain provides enough moisture for the beans without diluting the soil nutrient-rich solution.

Potassium is picked up by the roots primarily through diffusion, which requires good nutrient levels in the soil and a big root mass. As populations for corn are increased, the root masses tend to get smaller. Conversely, available potassium needs to be increased through higher application rates and/or solubility. Because corn picks up most of its potassium in the first half of its life cycle, dry weather early in the season can seriously impact yield. Soil compaction will significantly exacerbate this problem. Tissue analysis is the only way to know if plants are getting enough potassium as well as other nutrients. Soybean tissues should be collected during the flowering stage and corn should be collected at 5-collar stage and again after pollination. Deficiencies in potassium at the 5-collar stage for corn will generally not get better as time goes on.

I have mentioned three nutrients—calcium, phosphorus and potassium—which significantly impact plants for root development and water utilization. This is not to say that the other nutrients should not be taken seriously. Boron and zinc deficiencies impact calcium and phosphorus uptake respectively. Copper, which affects xylem formation in the plant can indirectly effect calcium and boron since those nutrients are primarily xylem mobile. The bottom line is paying attention to details. As with any business, the company that pays attention to the most details generally succeeds. If you have ever been to Disney World and seen how much they

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pay attention to details, it is no wonder they have been so successful. Control those things you can control, and you will be successful.