Better soil health creates healthier, higher-tonnage alfalfa

Ron Chamberlain for *Progressive Forage Grower*

Healthy, high-yielding, long-lasting stands of alfalfa need a healthy soil, with a good balance of nutrients, moisture and oxygen, as well as active soil biology in the soil profile.

Using gypsum in alfalfa is relatively new, but there's increasing interest in it, not only in the Midwest, but also in the South, the West and the Atlantic Coast states.

Gypsum is calcium sulfate dihydrate ($CaSO_4 \cdot 2H_2O$), and it comes from various sources: synthetic gypsum, processed drywall gypsum and mined gypsum. Synthetic gypsum can be derived from the process of cleaning sulfur from the flue gases of coal-fired utilities and from fermenting corn for food products.

Due to the increased use of flue-gas scrubbers, as well as the production of gypsum from other industrial processes, gypsum is now more economical to use than in the past.

Typically, one pound of sulfur is removed from the soil with every 10 pounds of nitrogen used to build protein in alfalfa. As a result, it's quite critical to replace the sulfur that's been removed, since most soils no longer receive adequate sulfur deposited from the air.

Researchers at the University of Wisconsin (UW) demonstrated the growing issue of sulfur depletion in 2010 when they collected 39 alfalfa plant tissue samples across 19 Wisconsin counties. They found that 64 percent of the samples were considered low in sulfur (0.25 percent or less). In the majority of the fields where the samples were drawn, the crop appeared normal. Of the total samples collected, 37 were collected prior to first cutting and two were collected prior to second cutting.

Compare that to what UW researchers found just a decade ago. In a similar survey of alfalfa samples, they determined that 38 percent of samples were considered low in sulfur. This represents a 68 percent increase in alfalfa samples showing sulfur deficiency versus 10 years ago.

Excellent sulfur source

Alfalfa growers in Wisconsin who have used gypsum report results that include healthier, greener stands, higher tonnage and better quality forage.

In 2010, Wisconsin alfalfa growers who applied gypsum after the first or subsequent cuttings reported having much taller, greener plants, higher tonnage and higher quality. One farmer said, "The alfalfa was so much greener it looked like spinach!"

That same farmer reported the alfalfa where gypsum was applied after the first cutting was 19 inches or taller at the next cutting, while untreated alfalfa was just 12 inches tall. A dollar value for a difference of seven inches in stand height is difficult to pinpoint, but with the nearly 60 percent taller hay stands, the difference in tonnage and returns are bound to be significant.

Science supports gypsum

While these results might seem magical, hard science explains why using gypsum can make such a positive difference. According to 2005 research by Ohio State University near Wooster, Ohio, growth of a new planting of alfalfa (*Medicago sativa L.*) rose 10 to 40 percent when gypsum treatments were applied to supply rates of 14 or 60 pounds of sulfur per acre in silt loam soil.

Compacted soils reduce biological activity

Gypsum is also used as a soil amendment. Over time, soils with clay and silt tend to become compacted. Little oxygen gets into the soil and there is either too much or too little water, which reduces biological activity.

Oxygen is needed in the soil for the biology to work efficiently. When soils are waterlogged in the spring, the biology shifts from aerobic to anaerobic. This reduces the activity of aerobic

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In 2010 Alan Dornacker applied 1,500 pounds per acre of gypsum to alfalfa ground at his West Bend, Wisconsin, farm. He inadvertently left a small strip in one field untreated and decided not to fix his mistake so he could compare results with or without gypsum. These photos were taken in early June 2011.

The top photo shows Dornacker in the gypsum-treated alfalfa while the bottom photo shows the untreated strip. Note the alfalfa in the treated area was taller (waist height) and very lush and had very few weeds. In the bottom photo, where gypsum was not applied, the alfalfa is not as lush or tall and there was an outbreak of weeds. Photos courtesy of Gypsoil.

soil microorganisms and significantly slows the decay of organic residues. Also, there is not optimal mineralization of nutrients from the soil parent material.

Conversely, when soils are "droughty" and deficient in water, the soil biology can't function efficiently either. In soils like these, an imbalance between low calcium and high magnesium levels leads to the compaction. Unfortunately, liming materials with too much magnesium and not enough calcium make the imbalance even worse.

Virgin soils are very active biologically – ripe with soil microorganisms and earthworms – but tillage breaks down the soil structure and, together with erosion, reduces organic matter. In soil that has less-than-optimum biological activity, the crop production system is not very efficient.

Farmers are gaining some yield increase through improved genetics in the crops grown in soils that do not have optimum biological activity. But once these soils are balanced and biologically efficient, they can support the new crop genetics to a greater degree of their high yield potential.

Solutions exist for healthier soils

The calcium in gypsum helps reduce compaction in soils by creating a chemical shift that balances the calcium, magnesium, aluminum and sodium levels. The balance between calcium and magnesium increases the stability of soil particles and improves soil aggregation. This allows more water to move down through the soil profile more quickly.

A USDA study on a common Midwest clay-loam soil that was out of balance and compacted showed that rain could infiltrate at only 0.1 of an inch an hour. After balancing the calcium and magnesium levels, up to 1.8 inches of water per hour was absorbed into the soil – that's 18 times faster infiltration with gypsum.

Improving soil health with gypsum

Alfalfa growers can apply gypsum to fields whenever the fields will hold machinery without damaging the soil or the crop. That's typically when alfalfa comes out of winter dormancy or after cuttings. Just be sure not to damage the crowns.

To determine where gypsum should be used, start with a soil test and look at soil types. Silt and clay-containing soils are good candidates for benefiting from gypsum.

It's also good to know the cation exchange capacity (CEC) of the soil, which indicates how much nutrients can be held by the soil. The more organic matter and clay in the soil, the greater the CEC and the more nutrients can be held in it.

If the the soil is tight and the CEC is less than 10, we recommend 1,000 pounds of gypsum per acre per year as a soil amendment. If the CEC is between 10 and 15, apply 2,000 pounds per acre. Use 4,000 pounds per acre if the CEC is more than 15. If gypsum is being used as a nutrient source only, apply 300 to 500 pounds per acre.

Alfalfa plant samples taken in 2011 at Alan Dornacker's farm. The sample on the top was grown in a field section that received no gypsum. The sample on the bottom was grown where 1,500 pounds per acre of gypsum was applied. Photo courtesy of Gypsoil.

Investing in the future

Balancing soils with gypsum does take time, but it's a positive investment for a future with healthier alfalfa stands that may last longer, too.

Alfalfa needs a nice, deep soil profile for the deep tap roots to develop. This allows the crop to recover more quickly after it is cut. Growers can keep alfalfa stands for more years when the soil is healthy, stable and not compacted and there's a balance of calcium, magnesium and other nutrients. **FG**

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References omitted due to space but are available upon request.

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