The demise of acid rain: Managing sulfur in a new world

Dustin Sawyer for *Progressive Forage*

AT A GLANCE

Find out what effects the reduction of acid rain has had on your forages in the last decade.

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Soil sulfur is something we never used to pay much attention to. It was generally available in adequate supply and was seldom a limiting factor in yields or forage quality. That has changed over the past several years. Soil sulfur is decreasing and can become limiting. Why has this been happening, and will it change back anytime soon? While it's probably not going to go back to the way it was, the reason is actually pretty well understood.

When is the last time you heard about acid rain? It's been awhile, hasn't it? I can clearly remember hearing about acid rain when I was growing up. It's such a terrifying name that it's kind of hard to forget. My young mind reeled at the thought of liquid death raining down to the earth, melting buildings and destroying entire civilizations. Certainly it was something that must be stopped! Now that I'm older and have experienced the great benefit of my many science and chemistry teachers and courses, I have a much more realistic understanding of the threat that was facing us.

No buildings melted, civilizations stayed largely intact and the world has not yet ended. The damaging impacts of acid rain were very real, though. There was an economic cost as the rain wore through paint and corroded metal a little faster than it should. There was also an ecological cost to sensitive ecosystems. Some species of plants and animals simply aren't very tolerant to changes in pH and were in danger of disappearing from the landscape.

You'll notice that I speak of acid rain in the past tense. That's because environmental regulations (whether we agree with them or not) had a significant impact on reducing the air pollution that was the cause of acid rain. Primary among these was the reduction of sulfur emissions from diesel exhaust and power plants. The Acid Rain Program, initiated in 1990, set out to reduce these emissions to 50 percent of what they were in 1980, with the final cap on sulfur emissions being set in 2010.

As you may have guessed, acid rain was the reason sulfur was never really a consideration in our cropping systems. The cycle is actually pretty simple. Sulfur would be released into the atmosphere as sulfur dioxide, a particularly nasty-smelling compound. Once in the atmosphere, sulfur dioxide would combine with water vapor, creating one form of acid rain. The rain would then fall on our fields and provide beneficial sulfur to the crops. Not all of the sulfur would convert to acid rain. Some of it would have deposited on the field in its sulfur dioxide form. Even still, since the Acid Rain Program took effect, we've seen a steady decline in the amount of sulfur in the air, leading to a decrease in available sulfur in our soils.

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Illustration by Corey Lewis.

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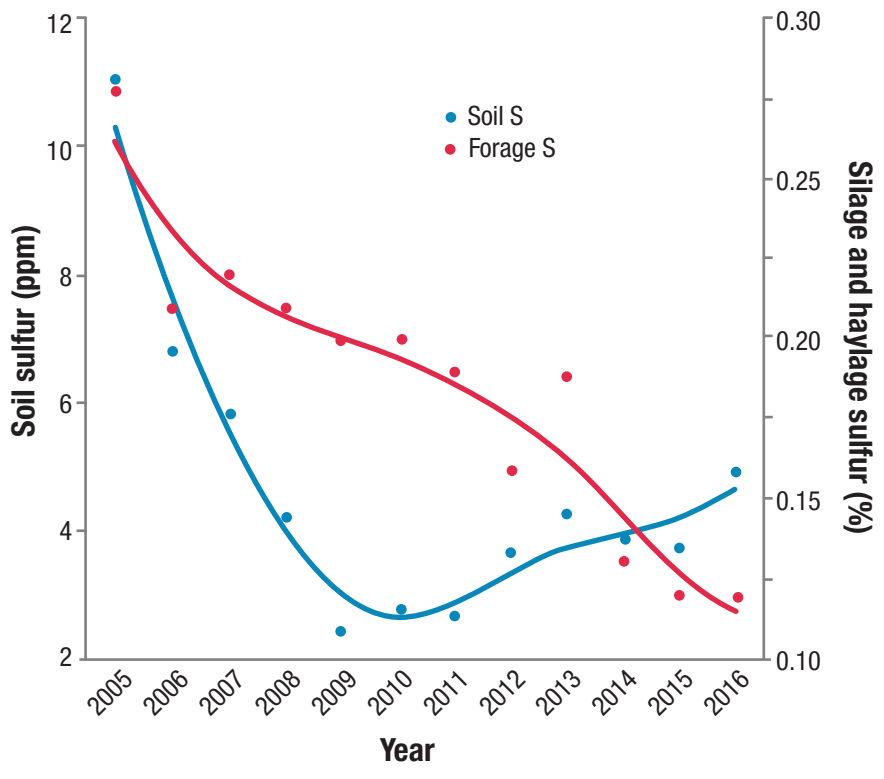
FIGURE 1 Median soil and forage sulfur contents, 2005-2016



A query of more than 950,000 soil samples and nearly 550,000 forage samples analyzed at Rock River Laboratory clearly illustrates this decline (**Figure 1**). The soil data shown here represent the median soil test sulfur values from across the Midwest, from 2005 through 2016. Looking at these data, you will notice that soil sulfur levels plummeted during 2005 to 2009, where they appear to have reached a minimum. In discussions with agronomists, I've found the need for supplemental sulfur was discovered around that time. Sulfur additions are common practice in most operations now. This likely accounts for the slight upswing soil test values have seen since 2009.

It's no real surprise that forage sulfur content has followed the same trend as soil. The data shown represent the median sulfur content of corn silage and haylage samples from across the Midwest as well as the Central Valley of California, and the Northeast, analyzed between 2005 and 2016. Of particular interest is that the forage doesn't seem to follow the same upswing the soil is seeing. There isn't enough information here to try to determine the reason, but it's possible that our soil tests can detect the additional sulfur even though the plant cannot take it up. It could simply be a delayed reaction since synthetic fertilizers are not always immediately available to the plant. Forage sulfur may begin to take an upswing in the next year or two, but time will tell.

Sulfur is an essential element for plant growth and animal health. Our days of taking it for granted are past, so now we need to actively manage it just as we manage our nitrogen, phosphorus and potassium. As with any of these other nutrients, measurement is key. Soil sulfur analysis should be part of routine operations. To get the most of fertilizer applications, the soil test should be paired with plant analysis during the growing season. This will help determine whether the sulfur is actually getting in.

In the end, we can debate whether reducing atmospheric sulfur is worth the cost of having to actively manage sulfur. There's one thing that I think we can all agree on, though: Acid rain is still a scary name.