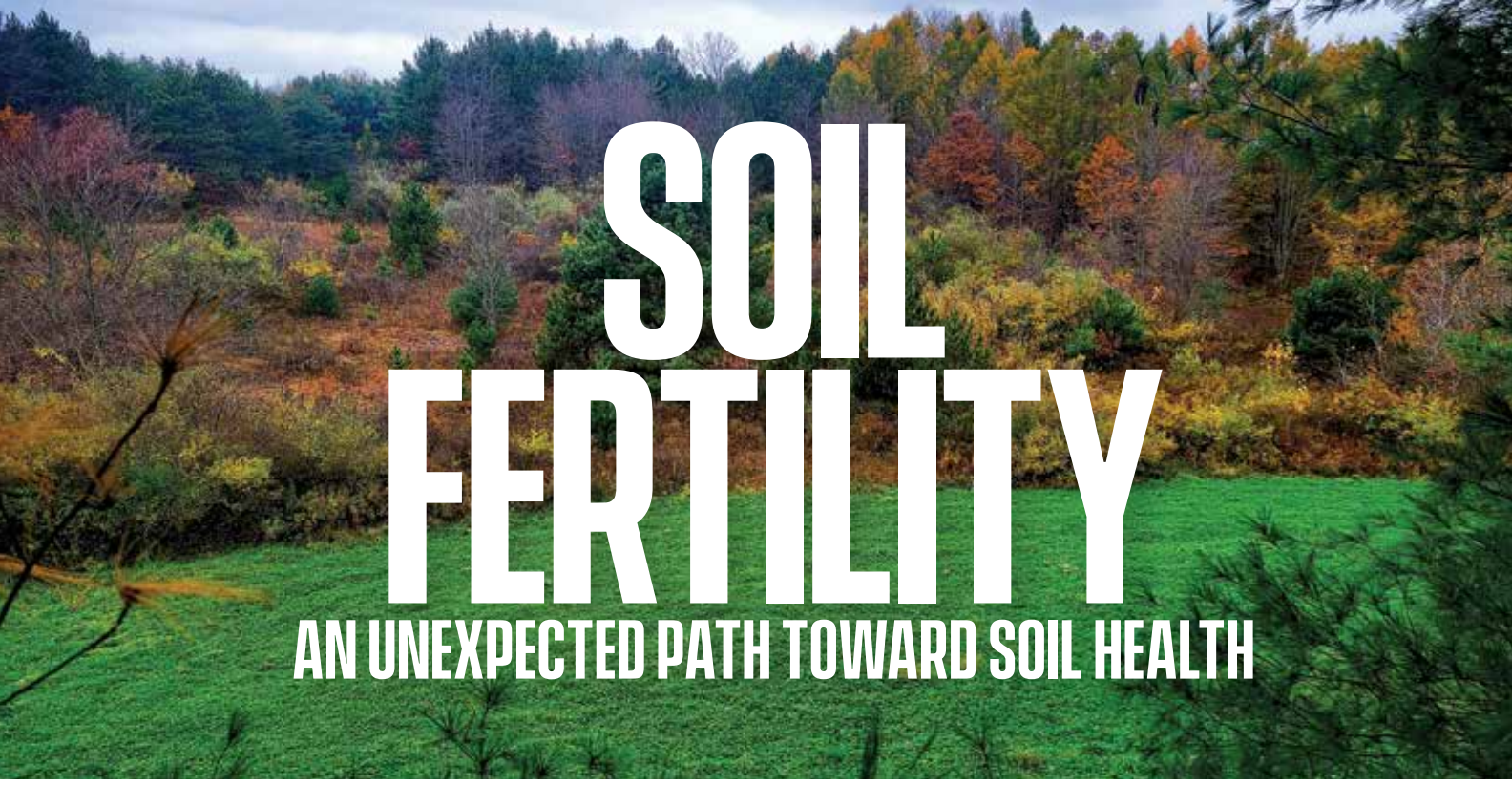

SOIL FERTILITY

AN UNEXPECTED PATH TOWARD SOIL HEALTH

Consistent management supported by routine testing can be a long-term investment in your land and the ecosystem it supports. Auburn University has 113 years of research data to prove that point.

by *Anna Johnson*

In recent years, soil health and quality have been brought to the attention of the public in popular press and media.

Attention to soil health has basically coincided with increased recognition from government agencies and advocacy groups. Naturally, hunters have begun to express interest in soil health and how it can relate to food plot management. As a soil scientist, this uptick in interest is exciting.

Soil is not just the medium in which you grow crops. It's a complex living ecosystem with billions of microorganisms occupying one handful of soil. This newfound attention has also brought sensationalized information and claims, in addition to an influx of products marketed for soil health. The abundance of information and products can be overwhelming to the public. However, soil health and sustainability does not necessarily mean a complicated food plot management system. In many cases, vigilant soil fertility and pH management will suffice.

TESTING, PH MANAGEMENT AND MORE

The importance of soil testing cannot be overstated. Annual pre-plant soil testing provides growers with science-backed fertility and liming guidance that can help them sufficiently nourish their crops and achieve their goals. When crops have nutrient requirements met, growers will have a more robust, nutritious forage stand. Above-ground plant growth corresponds with enhanced below-ground root growth and the return of decomposing crop residue to the soil, which can through time increase soil organic matter — one of the most notable soil health indicators.

Many soil health indicators are connected and thus influence other parameters. For example, soil organic matter can improve nutrient availability and retention because the chemical structure of organic matter allows the soil to retain certain plant nutrients, including calcium, magnesium, potassium and ammonium. That allows such nutrients to remain in the soil rather than potentially leaching away with water as part of the soil solution. The chemical structure of organic matter also promotes soil aggregation, which can improve soil structure, water holding capacity and aeration. Such improvements in physical soil health indicators can make the soil easier to work with, improve root penetration and provide a habitat for soil organisms. Organic matter also serves as an energy source for soil microorganisms, some of which can promote the bioavailability of plant nutrients, convert nitrogen into plant-available forms and improve soil structure. Thus, fertility management and building soil organic matter can lead to a slow snowball effect of improved soil health.

The importance of soil pH management also must not be overlooked, as it can affect nutrient availability and plant growth. For example, in a highly acidic (low pH) soil, aluminum and manganese toxicity can occur and limit growth of some plant species and cultivars. Low pH can also lead to the deficiency of plant macronutrients calcium, magnesium, phosphorus, potassium and even nitrogen. High soil pH can also lead to deficiency of phosphorus and various micronutrients, such as manganese, iron and zinc. In addition to nutrient deficiencies and corresponding yield reductions, extreme soil pH — high and low — can negatively affect beneficial microbial communities and be detrimental to overall ecosystem health.

AUBURN DATA

Careful soil pH and fertility management can yield visible results in food plots within a growing season. However, food plotters will not necessarily see improvements in all or even most soil health indicators within that period. Substantial soil health improvements might take years, depending on the local environment, land management practices and baseline soil characteristics. For example, where I work in central Alabama, the land is highly eroded and naturally acidic, and often has initially low soil organic matter. Therefore, I would expect soil health and productivity to improve through many years. That does not mean that land stewardship through soil fertility and pH management is an exercise in futility. This is demonstrated at a historic site in Alabama's eroded, acidic, low-organic-matter soils.

The influence of soil fertility on long-term crop production and soil health is clearly displayed at Auburn University's Cullars Rotation, an experiment established in 1911 and listed on the National Register of Historic Places. The Cullars Rotation tests soil fertility variables in a three-year summer cash crop rotation, which includes cool-season forages crimson clover and winter wheat. Variables include major macronutrients such as nitrogen, potassium, phosphorus, and sulfur, in addition to limestone (calcium carbonate) and micronutrients. An important component of this experiment is the initially degraded state of the site because of historically intensive land management and local geology, which is why the area has initially low soil organic matter. Because of those factors, the Cullars Rotation demonstrates the long-term consequences of sufficient and insufficient soil fertility.

THE CULLARS ROTATION, AUBURN UNIVERSITY COLLEGE OF AGRICULTURE

Some plots at the Cullars Rotation have not received limestone since 1911, and other plots have received no limestone or fertilizers during that time. These treatments have had pH measurements from 4.5 to 5.0 in recent years, but other limestone-receiving treatments have a pH higher than 6.0. Ten-year average winter wheat yields are also substantially lower for the no-limestone and no-limestone-or-fertilizer plots (4 and 1 bushels per acre, respectively) compared to the complete fertility treatment (40 bushels per acre). It's also notable that cash crop yields for the complete fertility treatments with and without micronutrients have been similar for most of the duration of the experiment. That indicates that micronutrients, although essential, do not necessarily need to be applied annually.

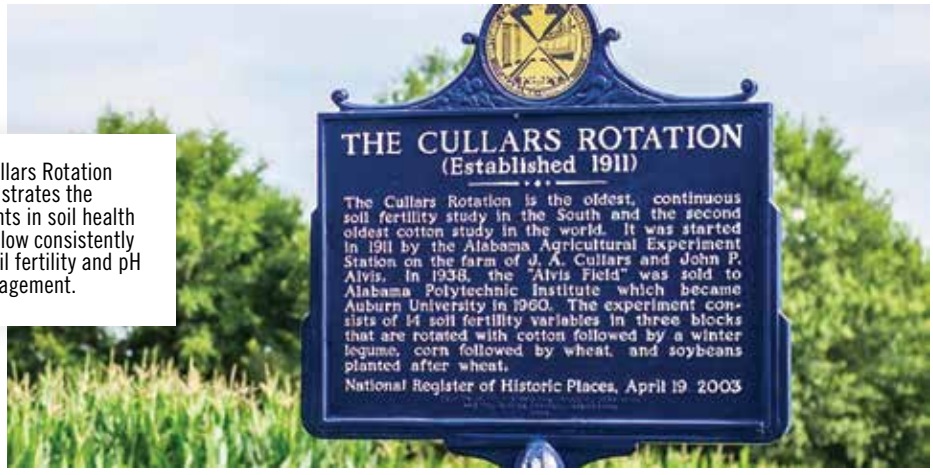

PHOTO COURTESY OF THE AUBURN UNIVERSITY COLLEGE OF AGRICULTURE

■ The Cullars Rotation demonstrates the improvements in soil health that can follow consistently adequate soil fertility and pH management.

A master's thesis from Auburn University (Decker, 2021) measured a variety of soil health indicators and microbial communities at the Cullars Rotation. The research found that research plots without limestone or fertilizer since 1911 had less soil organic matter and were thus less able to hold onto soil nutrients than other treatments. The low-pH research plots also had less ecologically beneficial soil microbial activity compared to the other plots. These plots received little to no carbon returns to soil because of severely reduced crop growth and yield. These low yields are because of soil acidity and poor soil fertility. Research plots with the complete soil nutrient package typically had improved soil health, which was largely because of an increase in decomposing plant residue from crops.

Although the Cullars Rotation evaluates cash crops, it demonstrates the improvements in soil health that can follow consistently adequate soil fertility and pH management, and that it does not need to be overly complicated. Many products are marketed for soil health or to benefit soil microbial communities. Some might be effective, but ensuring a successful forage stand through soil fertility management is sufficient and has been thoroughly tested in the short and long term. Following soil test reports and fertilizing according to your planned forages can contribute to successful crop growth and gradually improve soil health. Successful crop growth leads to the return of above- and below-ground plant residues to the soil, which will feed soil microorganisms and through time improve soil health.

CONCLUSION

Soil fertility is at the very least a seasonal investment in your food plots, but consistent management supported by routine testing can be a long-term investment in your land and the vast ecosystem it supports. In my opinion, that gets to the heart of sustainability. Auburn University has 113 years of research data to prove that point.

CITATION:

Decker, H. (2021). Influence of Cover Crops and Fertility Management on Soil Health and Soil Microbial Community [Master's thesis, Auburn University]. Auburn University Electronic Theses and Dissertations. https://etd.auburn.edu//handle/10415/7971.

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