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FACT SHEET

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An Alternative Buffer Solution to SMP for Determining Lime Recommendations

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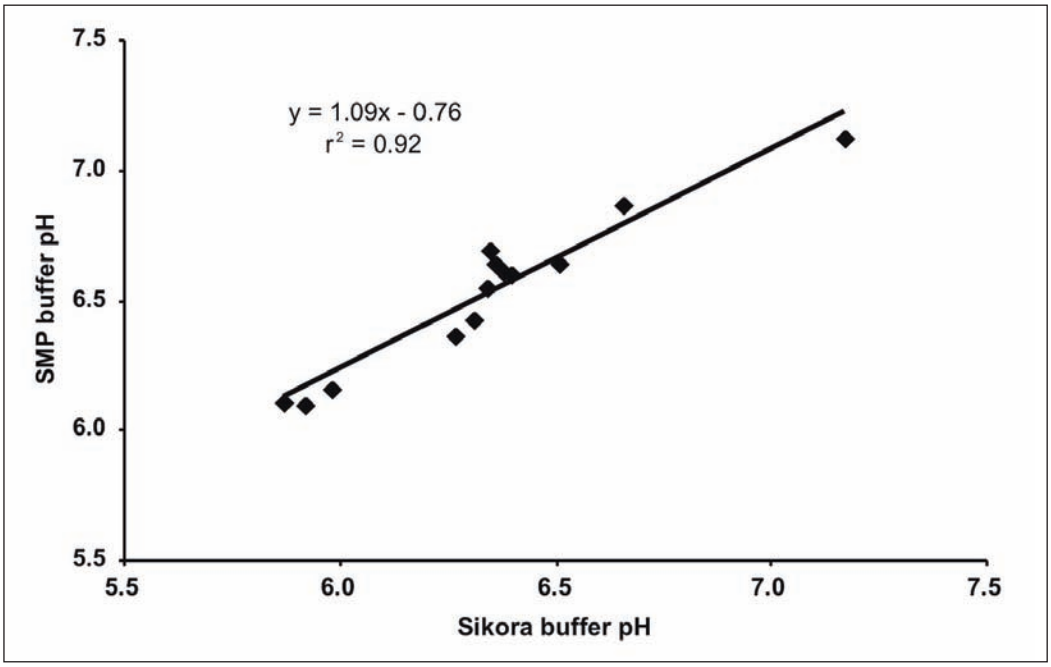
To determine soil lime requirements, Ohio State University—in accordance with accepted North Central Regional Lab practices (Watson and Brown, 1998)—has historically utilized the Shoemaker, McLean, and Pratt (SMP) buffer solution (Shoemaker et al., 1961). Unfortunately, the SMP buffer solution contains chromium (VI) and *p*-nitrophenol, which are considered hazardous materials and require special disposal techniques. Some labs have switched from using the SMP buffer to Sikora, a "cleaner" buffer solution, to provide lime recommendations (Sikora, 2006). Until recently, Ohio State University did not have recommendations for the Sikora buffer solution. The goal of this fact sheet is to provide guidelines for using this new buffer solution based on a lab incubation study.

The concentration of hydrogen ions in solution forms the basis of pH measurements; as the number of hydrogen ions in solution increases, the pH decreases. These "free" hydrogen ions represent the active acidity in a soil solution and are what is measured in a soil pH test. Buffer solutions contain chemicals that bond with hydrogen ions in the soil solution. As the binding reactions occur, more hydrogen ions enter the solution, primarily from the soil cation exchange complex (CEC) and organic matter, until a state of equilibrium is reached. The hydrogen ions released from the soil exchange sites are called potential or reserve acidity. The new point of equilibrium is reflected by a change in the buffer solution's pH, which is used to make liming recommendations. The more potential or reserve acidity the soil has, the more the buffer solution's pH will decrease during the reaction, and the higher the liming recommendation will be. For more information on soil pH, see OSU Extension fact sheet AGF-505-07 (Mullen et al., 2007).

The SMP buffer contains four chemicals that react with the hydrogen ions in a soil solution: triethanolamine, *p*-nitrophenol, potassium chromate, and calcium acetate (Shoemaker et al., 1961). Each buffer chemical has a different ideal pH range for reacting with the hydrogen in solution. Together, the buffer chemicals create a linear relationship between the changes in soil pH with the amount of buffer neutralized, thus creating an estimation of the soil's reserve acidity upon which a liming recommendation is made. As mentioned before, *p*-nitrophenol and chromium in the SMP buffer are considered hazardous wastes, and the chromium has been found to be carcinogenic (Sikora, 2006). For these reasons, most laboratories have sought out alternative buffer solutions, and some have adopted the Sikora buffer.

A study was conducted at Ohio State University to determine if the Sikora buffer would be a viable replacement for the SMP buffer (Viswakumar et al., 2009). A one-month incubation test was conducted on 13 soil materials collected throughout Ohio to

Figure 1. Correlation between the buffer pH values of the Sikora and SMP buffers.



determine the correlation between the SMP and the Sikora buffers, and to determine the subsequent liming requirements from each. This study found that the Sikora buffer provides similar estimates of buffer pH to the SMP (Figure 1). Therefore, it was concluded that the same recommendations could be used for both the SMP and the Sikora buffers. The SMP buffer can safely be replaced with the Sikora buffer, and liming recommendations for Ohio soils will not be affected.

References

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