Soil Sample No-till Acid Soils at the 0-7.6 cm Depth

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Introduction

Soil pH greatly influences soil chemistry and biological activity. Soil pH less than 5.5 can reduce bacteria activity and increase nitrogen deficiencies[3]. Ammonium-based fertilizers acidify soil from the release of hydrogen during the mineralization process. No-till soils are particularly susceptible to acidification from the lack of mixing subsurface alkaline products and the tendency to apply fertilizers at or near the soil surface. As a result, the zone of acidification is at the depth of fertilizer placement[1,2].

Phosphorus (P) and aluminum (Al) are two elements that greatly impact crop production and are dependent on soil pH. Phosphorus is most readily plant available when the soil pH is approximately six to seven. When soil pH is less than 5.5, Al becomes soluble, binds to P, and renders P unavailable to plants. Additionally, Al has a toxic effect to plants that stunt and deform root growth and reduces seed germination. Free Al in the soil solution hydrolyzes water which further acidifies the soil[6].

Calcium-carbonate (lime) neutralizes acidity and is a common liming amendment. However, lime requirement recommendations have not been developed for North Dakota[10] as soil acidity is a new and growing soil health issue. Soil testing guidelines are needed to assist with pinpointing the troublesome acres and to develop lime recommendations. This project compared various soil sampling depths.

Methodology

Twelve acidic soil sites across North Dakota (Figure 1) were soil sampled with a hydraulic soil probe with a 5cm diameter tube. Soil was divided in to the 0-5.1, 5.1-10.2, 10.2-15.2, 0-7.6, 7.6-15.2, and 0-15.2 cm depths. Replication locations were approximately 50 m apart. Soils collected inside a replication were within 1 m of each other. Three cores were collected from each depth and composited for replication.

All collaborating farmers practiced no-till for five or more years and used ammonia-based fertilizer when not growing a legume. Collaborating producers reported that field acidity increased with in the past five years.

Soil pH was determined from a 1:1 slurry of deionized water and soil. The probe was calibrated with pH buffer solutions of 4.0 and 7.0[7]. Soil pH was measured with a FIELD SCOUT pH 600 pH meter[11].

Comparison of means was conducted through the PROC GLM procedure of SAS software[9]. Difference of means was determined by the Fisher's least square difference procedure at the 0.05 level.

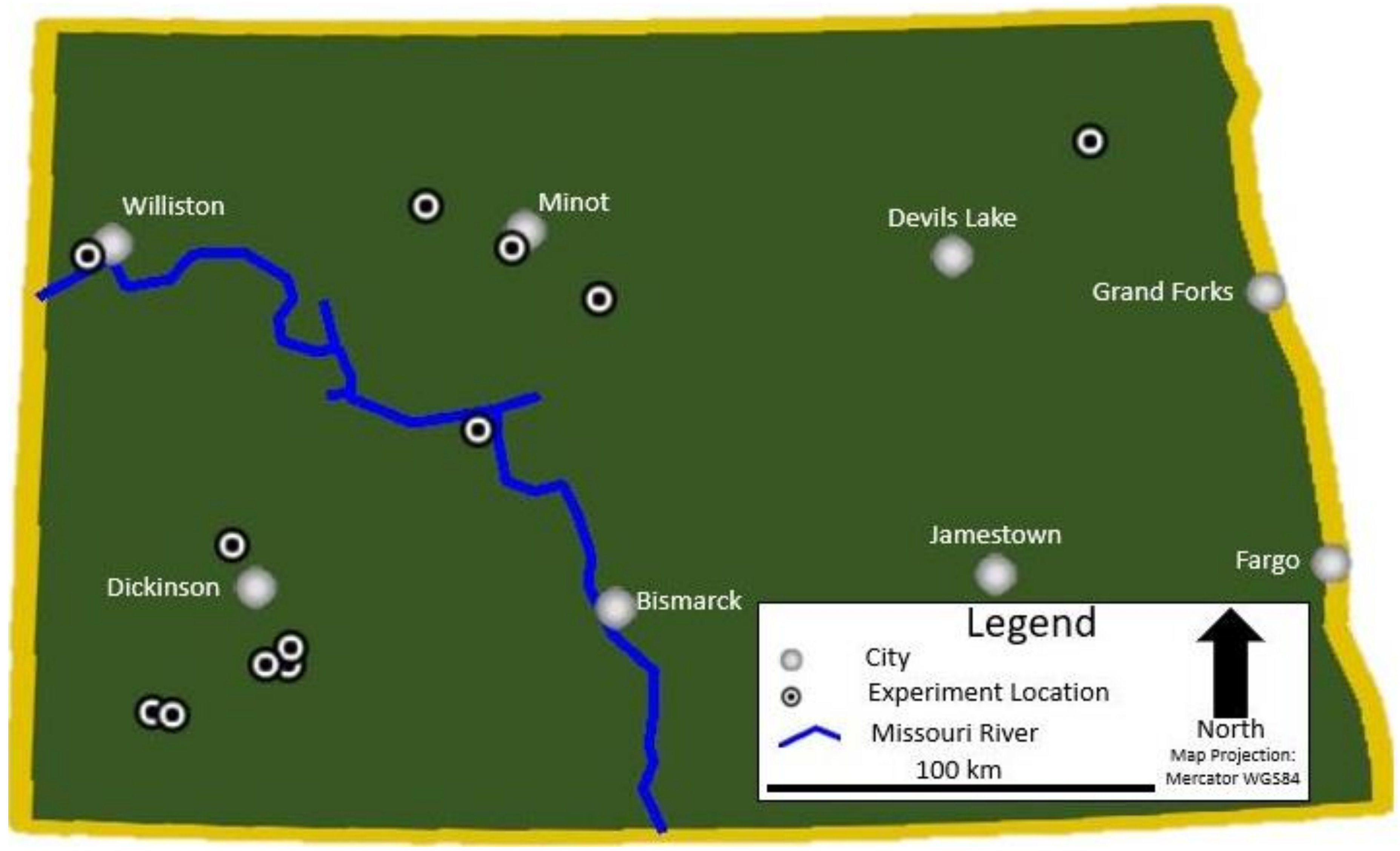

Figure 1. Map of soil sample locations[4].

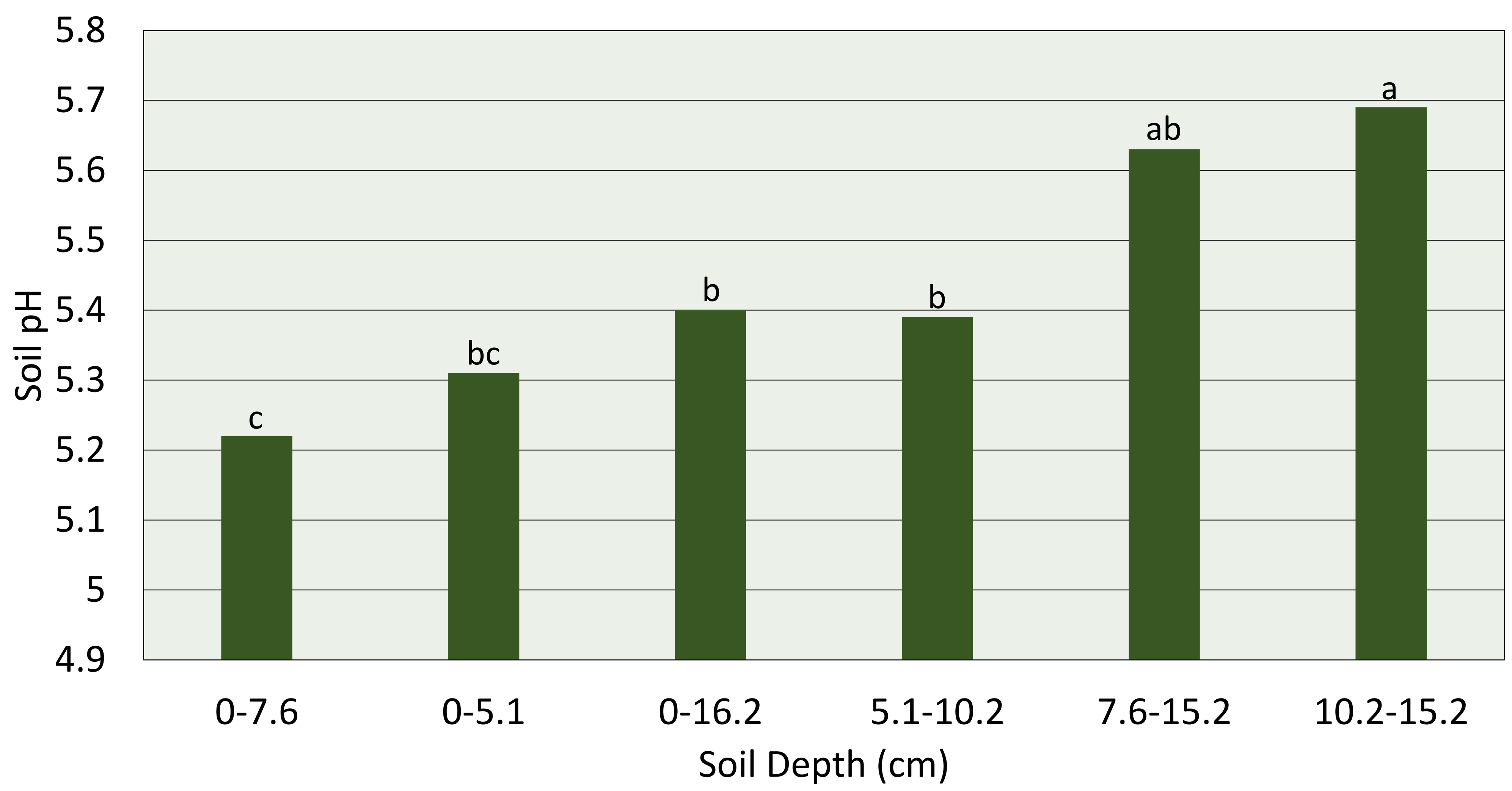

Figure 2. The impacts of soil sampling depth on soil tested pH. Similar letters indicate similar statistical values at the 0.05 level.

Results

Soil sampling depth did not impact soil pH at seven of the twelve individual environments at the 0.05 level (Not Reported. Please refer to QR code for data). However, when all sites were combined, a difference was observed at the 0.001 level (Figure 2). The 0-7.6 and 0-5.1 cm depths had the lowest soil pH of 5.22 and 5.31 respectively. The 0-5.1 (5.31 pH), 0-15.2 (5.40 pH), 5.1-10.2 (5.39 pH) soil pH's were similar. The highest soil pH was 5.63 and 5.69 were similar and observed at the 7.6-15.2 and 10.2-15.2 cm depths respectively (Figure 2).

Conclusions & Implications

This data suggests that soil sampling to identify soil acidity caused from ammonia-based fertilizer acidification occurring under no-till systems should be conducted at the 0-7.6 or the 0-5.1 cm depth as those soil pH results were similar and most acidic (Figure 2). However, utilizing the 0-7.6cm depth offers the following benefits:

1. Collecting less samples than the 0-5.1 cm depth to fill a standard soil sample bag.
2. The 2.5 cm deeper soil sample accounts for the soil environment of crops sown deeper than 5 cm (i.e. sunflower *Helianthus annuus*[5], and corn *Zea mays*[8]) and young roots at the 5.1 to 7.5 cm depth.

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