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Accelerated Incubation Protocols for Aglime Requirement Calibration

Mary S. Stewart[1], Zachary Smith[1], Carol R. McFarland[1], David R. Huggins[2] and Wayne H. Thompson[3]. (1) Crop and Soil Sciences Washington State University, Pullman, WA. (2) USDA-ARS, Pullman, WA. (3) Crop and Soil Sciences, Washington State University Extension, Walla Walla, WA.

INTRODUCTION

Soil acidification is an emerging issue in the Inland Pacific Northwest (IPNW). Aglime requirement calibrations using three-month incubations require significant time and lab space. To accelerate the process, we are developing a rapid incubation method that requires less lab space and only a few days for incubation. We present findings for two methods: (i) $CaCO_3$ in DI H_2O; (ii) $CaCO_3$ in 0.01 M $CaCl_2$. Preliminary data for two IPNW soils from our four-day incubations are contrasted with results from the 3-month incubation method.

PROTOCOL

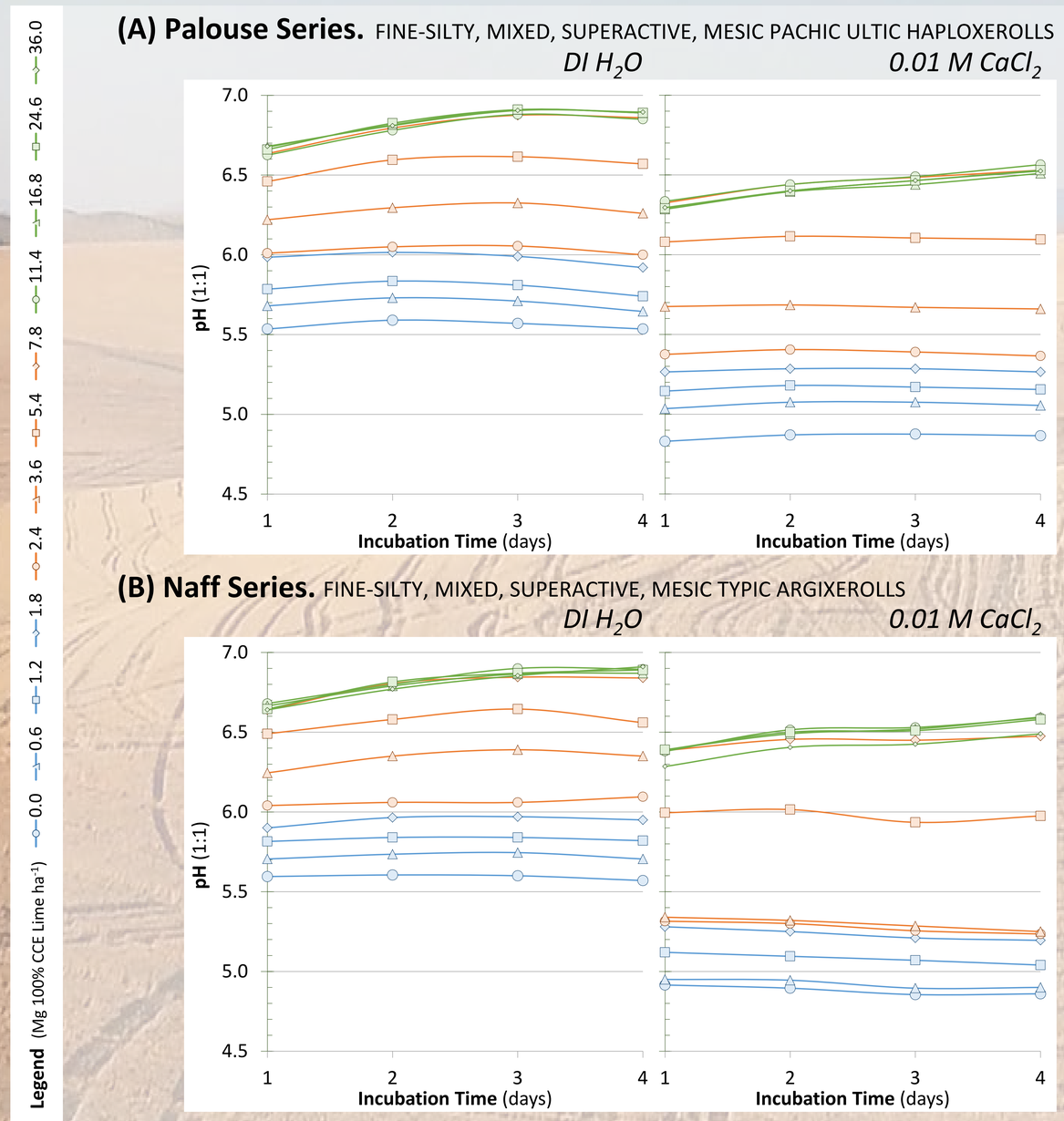
1. Prepare selected soil samples: sieve (2 mm), mix and air dry (36° C).
2. Transfer 100 g soil to baffled 250 mL Nalgene Erlenmyer Flasks.
   - for $CaCO_3$ dilution series (see Figure 1. Legend), transfer liming agent to flask and shake at 300 rpm for 24 h at 9°C.
3. Add 100 mL DI H_2O or 0.01 M $CaCl_2$ to flask-soil-agent mixture.
   - for $Ca(OH)_2$ dilution series, transfer agent directly to soil/water solution mixture.
4. Shake at 300 rpm and incubate at 9°C for 24 h.

At 24 h intervals record the following for each dilution:

1. Collect 25 mL headspace sample for CO_2 analysis.
2. Record pH of each dilution, in triplicate.

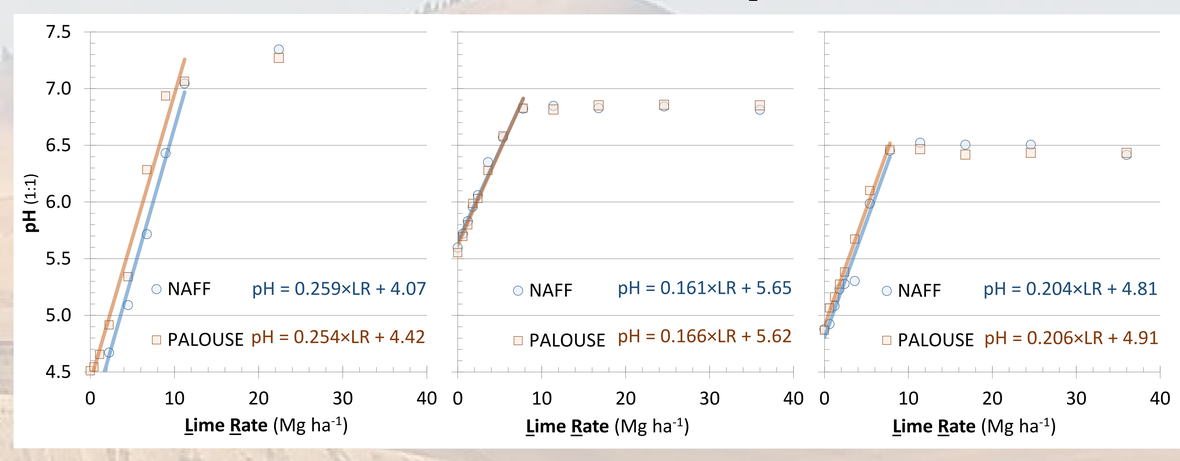
After 4th measurement:

1. Dry samples and archive for additional testing: CEC, %BS, pH



Observations. ΔpH with time (days)

Figure 1. Equilibrium between exchangeable acid-forming cations and base-forming cations was achieved with both H_2O and $CaCl_2$ solutions, reaching a plateau in three days or less with lime rates below 3.6 Mg ha^{-1}, and in four days with rates from 3.6 to 7.8 Mg ha^{-1}. To further evaluate this system, we will replace $CaCO_3$ which is relatively insoluble in water with $Ca(OH)_2$. Time to achieve equalibrium should decrease even further because $Ca(OH)_2$ reacts more rapidly and is soluble in water. We will continue to compare the performance of H_2O solutions to those of 0.01 M $CaCl_2$ by replicating this work on seven more IPNW soils.



Response. ΔpH as a function of lime rate

Figure 2. The 3-mo method produced a steeper response rate and higher plateau pH than B and C. Both rapid methods (4-day) produced a stable linear increase in pH to plateaus at 6.8 in DI H_2O and 6.5 in 0.01 M $CaCl_2$ solutions. P-value for each equation < 0.01.

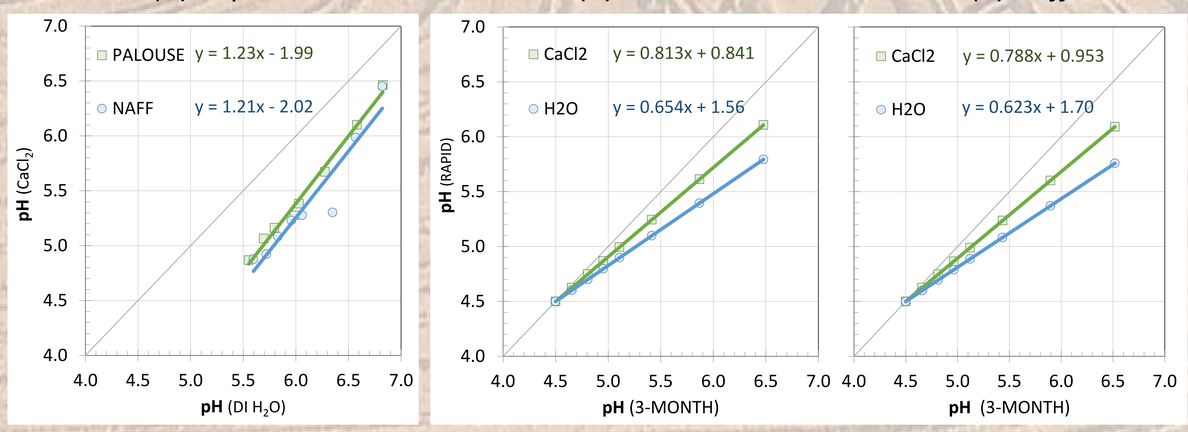


Table 1. Lime rate to eleveate pH by one unit (Mg ha^{-1}).

	3-mo	H_2O	$CaCl_2$
NAFF	0.26	0.16	0.20
PALOUSE	0.25	0.17	0.21

Summary. Cross-Comparison Plots

Figure 3. (A) Solution pH of $CaCl_2$ averaged 0.60 and 0.71 pH units lower than H_2O with near identical response rates (slope coef). (B, C) Rapid incubation preparations yielded lower response rates (0.62 to 0.81) relative to the 3-month method (Table 1).

Citation. Coto, B., C. Martos, J.L. Peña, R. Rodríguez, and G. Pastor. 2011. Effects in the Solubility of $CaCO_3$: Experimental Study and Model Description. Fluid Phase Equilibria 324:1-7.

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Background image courtesy of Scott Thompson