Measurement of Potassium Fixation Potential On Air-Dried Vs. Field-Moist Soil Material

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INTRODUCTION

Potassium fixation has been identified as a possible source of concern for managing fertility in granitic soils in the San Joaquin Valley of California. Previous work in our lab has demonstrated that vermiculite in the silt and fine sand fraction is predominantly responsible for observed K fixation in these soils, and that air-drying of soil materials after the application of K in solution results in an increase in K fixation potential relative to samples maintained moist. It has also been observed that less exchangeable K is usually extracted from field-moist samples than from air-dried samples.[1]

In order to better understand the effects of drying on K fixation potential, we measured K fixation potential (Kfix) and ammonium acetate-extractable K (NH_4OAc –K) on field-moist and air-dried soil material representing a range of K-fixing and non-K-fixing soils.

METHODS

Soils

- 29 soil samples collected from 15 locations in wine grape vineyards and almond orchards in the Central Valley of California
- At collection, field-moist soil samples sealed in Ziploc bags followed by storage under refrigeration
- Subsamples removed and air dried
- NH_4OAc-K and Kfix measured on field-moist and air-dried samples

Ammonium acetate-extractable K[2] (NH_4OAc-K)

- 2.5 g soil saturated and extracted overnight with 1 M NH_4OAc (pH 7) using a mechanical vacuum extractor
- K determined by flame emission spectrometry

K fixation potential[3] (Kfix)

- 3 g soil shaken in 30 mL of 2 mM KCl for 1 h
- Extracted for 30 minutes with 10 mL 4 M NH_4Cl, and centrifuged
- K measured by flame emission spectrometry
- K fixation potential was calculated as the difference between a blank and the measured K solution concentrations
- Values less than or equal to zero indicate no K fixation potential.

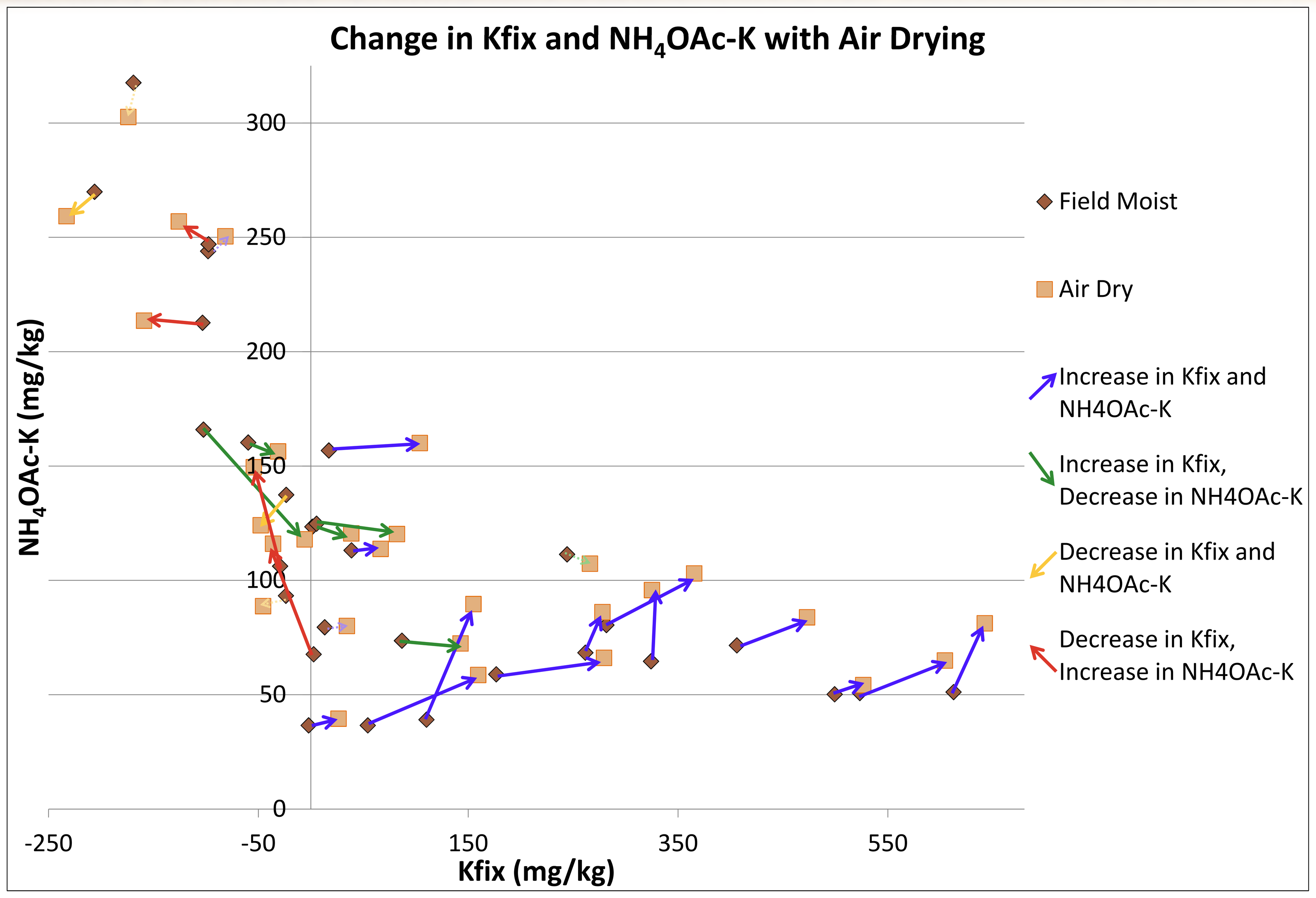

Fig. 1 Relationship between NH_4OAc-K and Kfix for field-moist and air-dried samples, with arrows representing the direction and magnitude of change in both values with drying. (Faded, dashed arrows indicate no significant change with drying for either variable)

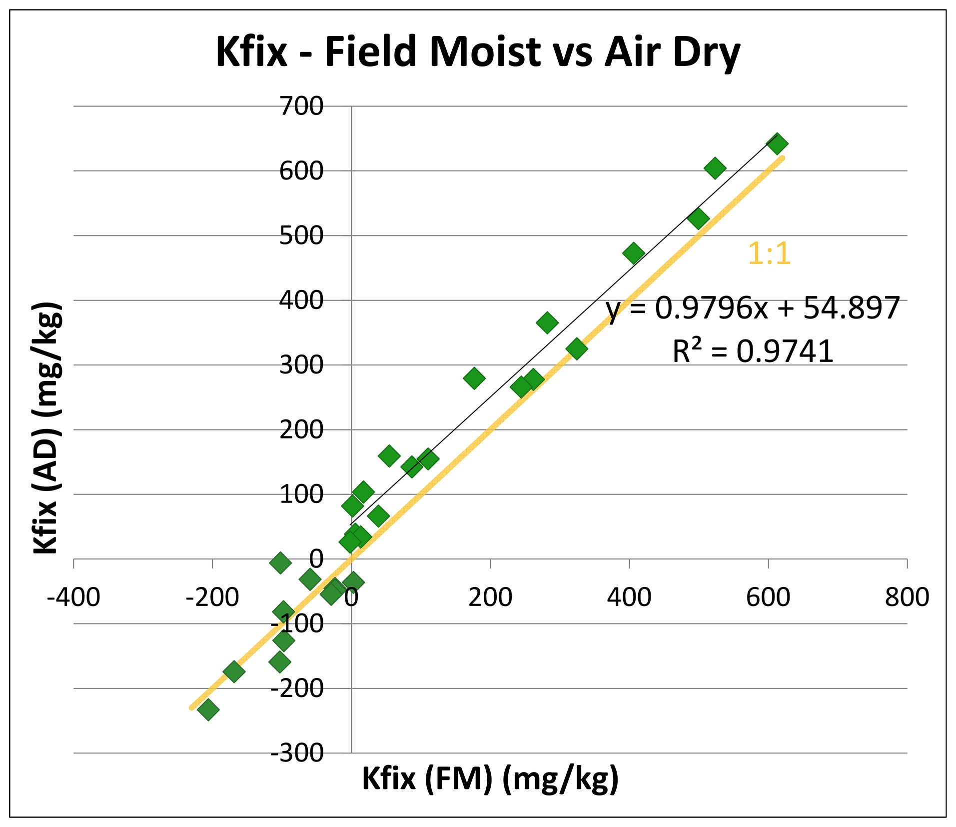

Fig. 2 Air-dried (AD) vs field-moist (FM) Kfix values. Regression for Kfix>0 only.

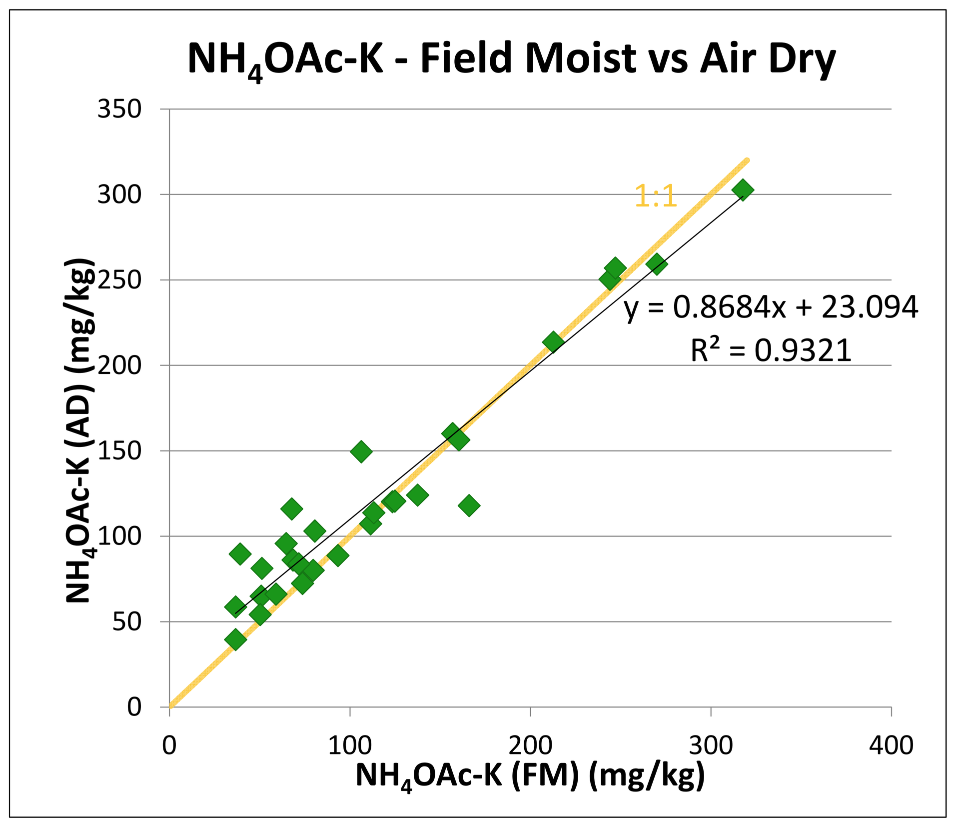

Fig. 3 Air-dried (AD) vs field-moist (FM) NH_4OAc-K values

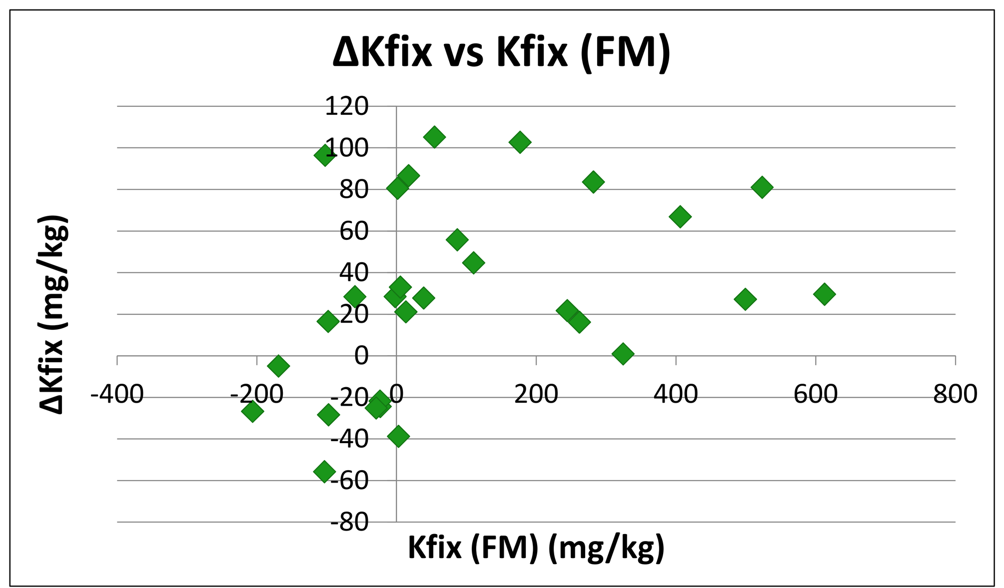

Fig. 4 Change in Kfix with drying as a function Kfix. K-fixing soils uniformly showed an increase in Kfix.

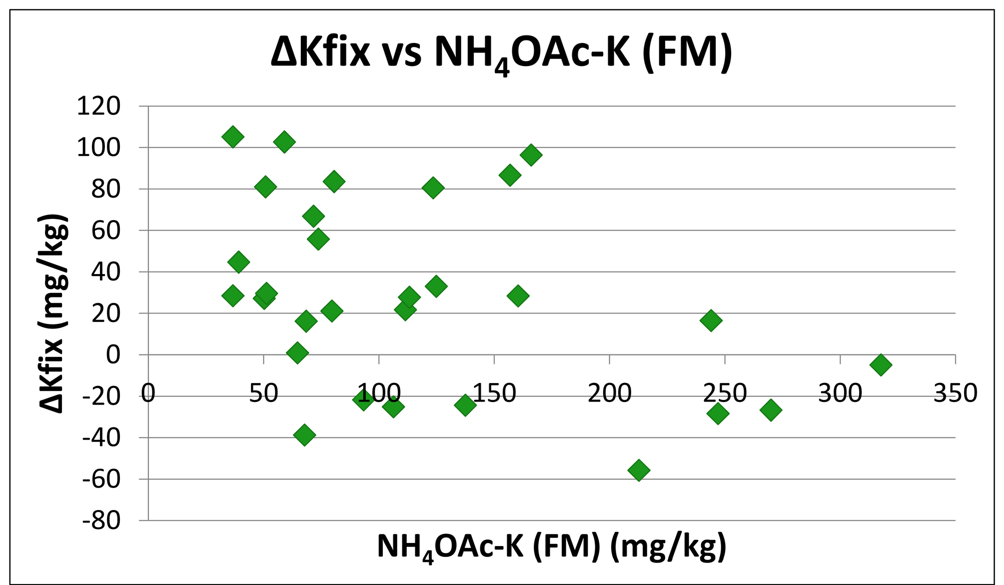

Fig. 5 Change in Kfix with drying as a function of NH_4OAc-K

Table 1. Soil properties

Code	Soil/Classification	Depth (cm)	Kfix Field Moist (mg kg-1)	Kfix Air Dry (mg kg-1)	NH4OAc-K Field Moist (mg kg-1)	NH4OAc-K Air Dry (mg kg-1)
VSS E	*San Joaquin silt loam*	0-20	177	279	59	66
	Abruptic Durixeralf	100-120	613	642	51	81
KTR B	*Columbia sandy loam*	0-20	1	82	123	120
	Aquic Xerofluvent	120-140	523	604	51	65
VSN C	*Redding gravelly loam*	0-20	87	143	74	72
	Abruptic Durixeralf	40-60	499	526	50	54
KTR H	*Sailboat silt loam*	0-20	39	67	113	114
	Aquic Xerofluvent	40-60	406	473	72	84
DH 2	*Guard clay loam*	0-20	17	104	157	160
	Duric Haplaquoll	40-60	282	365	81	103
KTR C	*Sailboat silt loam*	0-20	5	38	125	121
	Aquic Xerofluvent	120-140	324	325	65	96
KIMB 219	*Kimberlina fine sandy loam*	0-20	-103	-159	213	214
	Typic Torriorthent	40-60	262	278	68	86
KTR A	*Columbia sandy loam*	0-20	-60	-31	160	156
	Aquic Xerofluvent	40-60	244	266	111	107
CM F	*Montpelier-Cometa complex*	0-20	13	34	80	80
	Xeralfs	40-60	54	159	37	59
DON A	*Archerdale clay loam*	0-20	-98	-81	244	250
	Pachic Haploxeroll	40-60	110	155	39	90
RM X	*Redding gravelly loam*	0-20	-24	-46	93	89
	Abruptic Durixeralf	40-60	-2	26	37	40
CM N	*Montpelier-Cometa complex*	0-20	-24	-48	137	124
	Xeralfs	40-60	-102	-6	166	118
Dougan	*Vina fine sandy loam*	0-20	-98	-126	247	257
	Pachic Haploxeroll	40-60	3	-36	68	116
KIMB 198	*Kimberlina sandy loam*	0-20	-169	-174	318	303
	Typic Torriorthent	40-60	-29	-54	106	149
RVB	*Nord fine sandy loam*	0-10	-206	-233	270	259
	Cumulic Haploxeroll					

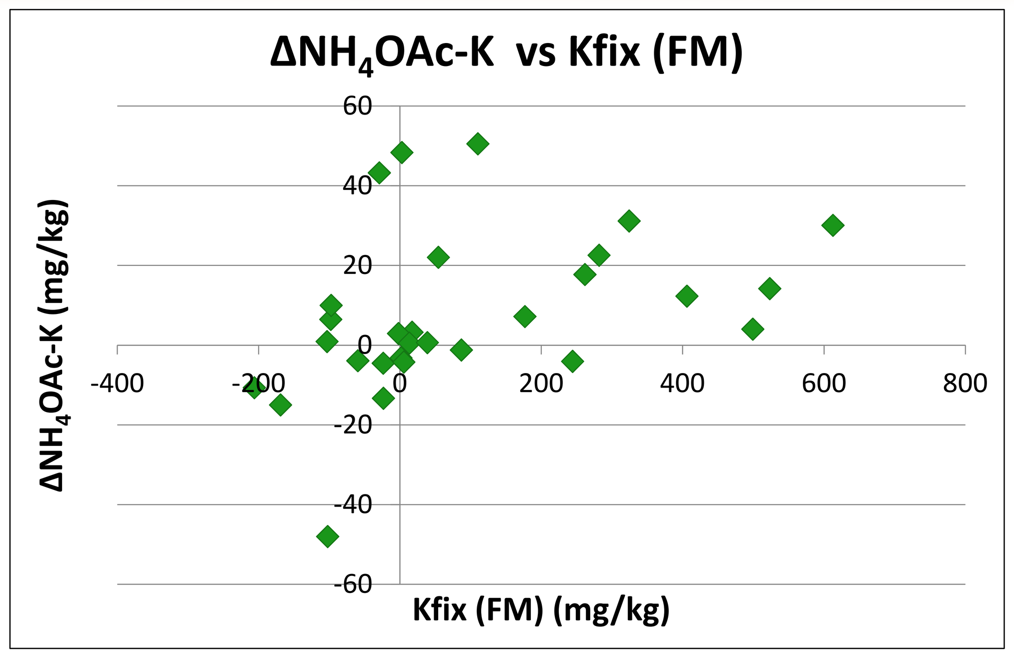

Fig. 6 Change in NH_4OAc-K with drying as a function of Kfix. NH_4OAc-K increase for most K-fixing soils.

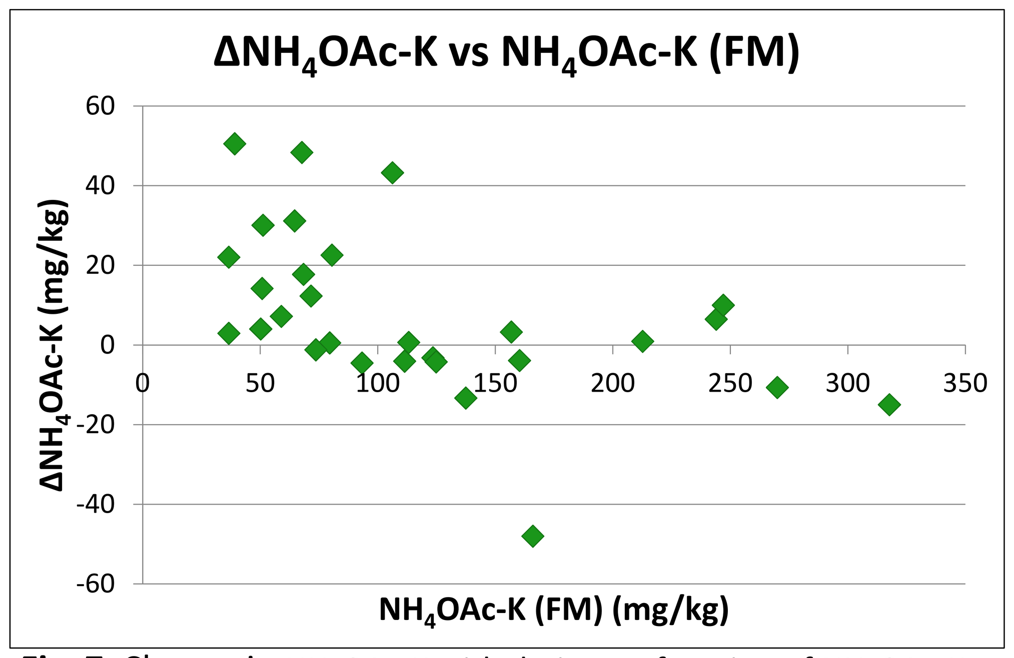

Fig. 7 Change in NH_4OAc-K with drying as function of NH_4OAc-K

DISCUSSION & SUMMARY

1. Effect of drying on Kfix (Figs. 2, 4, 5)
   - Kfix increased with drying for all K-fixing soils
   - Average increase was about 55 ppm
   - For non-K-fixing soils, change in Kfix was not consistent
   - There was no discernible relationship between Kfix values and the magnitude of change
   - Change in Kfix did not correlate with NH_4OAc-K values
   - Effect of drying may be a function of mineralogy (vermiculite in K fixing soils)
2. Effect of drying on NH_4OAc-K (Figs. 3, 6, 7)
   - Change in NH_4OAc-K was small (less than 20 ppm) for most samples
   - High NH_4OAc-K samples were less likely to show a large change
   - Drying increased NH_4OAc-K for most low NH_4OAc-K soils and most K-fixing soils
   - Change in NH_4OAc-K was less consistent for non-K-fixing soils

REFERENCES

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