Soil quality indicators across major agricultural land resources area in New Mexico.

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INTRODUCTION

- Soil quality assessments provide tools for evaluating soil performance under different land uses and environmental gradients [1, 2].
- Soil functions may vary from a field to a larger regional scale and are influenced by both intrinsic factors such as soil formation factors and extrinsic factors including soil and crop management practices [3, 4].
- In the United States, there are over 200 Major Land Resource Areas (MLRAs) characterized by a particular pattern of soils, climate, land uses, type of farming and water resources [5].
- Around 16 of these MLRAs are located in New Mexico, but there has been no soil quality assessment conducted at the regional scale in these arid and semi-arid regions [6].
- Certainly, soil quality assessments beyond the field scale will help in understanding the impact of other environmental and geographical factors on soil quality for better land use and sustainability.

OBJECTIVES

- To assess the range and variation of soil quality indicator measurements in some agricultural, Major Land Resource Areas in New Mexico.
- To assess the impacts of cropping practices on soil quality indicators across the Major Land Resource Areas in New Mexico.

METHODS

- **Major Land Resource Areas (MLRAs)** [Plate 1]
  - 6 agricultural MLRAs were sampled:
    - i. Colorado Plateau (Area 35)
    - ii. Southwestern Plateaus, Mesas, and Foothills (Area 36)
    - iii. Southern Desert Basins, Plains, and Mountains (Area 42)
    - iv. Central New Mexico Highlands (Area 70c)
    - v. Upper Pecos River Valley (Area 70b)
    - vi. Southern High Plains, Southern Part (Area 77c)
- Agricultural Land Use
  - Three cropping practices (CP) were sampled:
    - i. Tree Crops
    - ii. Field Crops
    - iii. Vegetable Crops
- Soil Sampling
  - Four fields per CP were sampled (12 samples per MLRA)
  - Soil sampled at two depths (0-0.15 and 0.15 – 0.30 m) in the fall of 2016 within six agricultural MLRAs (only data from 0-0.15 m presented here).
  - Soils were analyzed for multiple soil physical, chemical and biological indicators according to standard protocols.
- **Statistical analysis**
  - Statistical method included the analysis of variance and mean separation to assess how indicators differ with MLRAs and cropping practices.

RESULTS

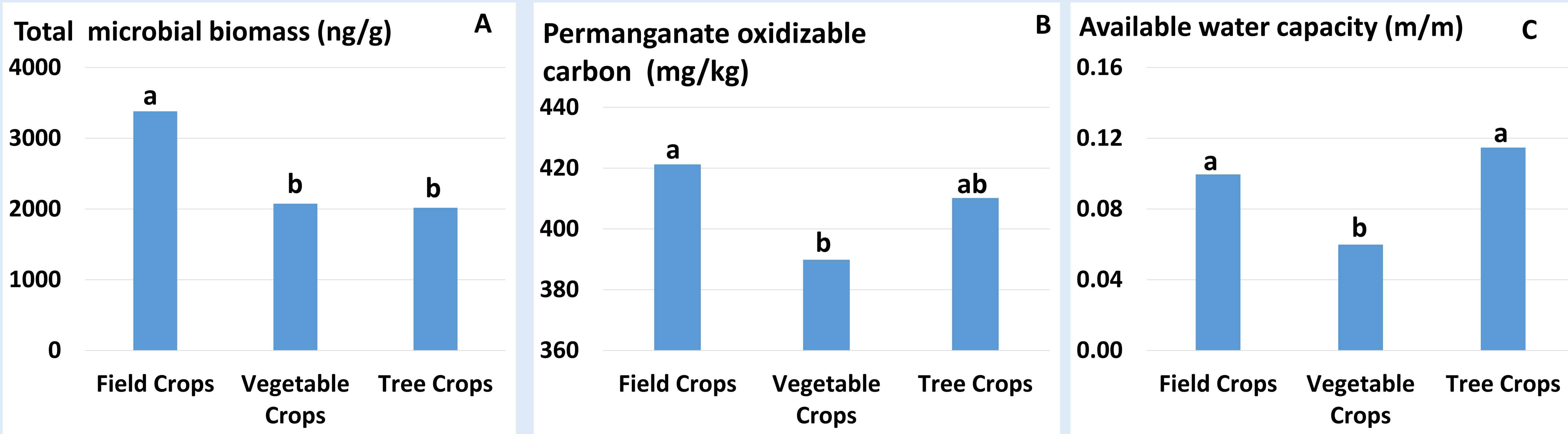

Figure 1. Total microbial biomass (A), permanganate oxidizable carbon (B) and available water capacity, (C) under different cropping practices across selected MLRAs in New Mexico.

Table 1. Means separation, range and coefficient of variability of selected soil quality indicator measurements in selected MLRAs

	Area 35			Area 42			Area 70b			Area 36			Area 70c			Area 77c		
Physical Indicators	Mean	Range	*CV	Mean	Range	CV(%)	Mean	Range	CV	Mean	Range	CV	Mean	Range	CV	Mean	Range	CV
[1]Mean weight diameter (mm)	0.71b	1.23	52	1.03a	1.58	41	0.66b	0.62	24	0.75b	0.74	42	0.54c	0.78	60	0.22c	0.52	73
Available Water Content (m/m)	0.08	0.13	42	0.06	0.1	67	0.1	0.12	46	0.1	0.14	49	0.1	0.19	74	0.1	0.27	82
Wet aggregates stability (%)	72a	45	18	52cd	56	32	47d	42	23	59bc	35	21	64ab	25	12	49cd	40	27
Bulk density (Mg/m^3)	1.44ab	0.61	13	1.38b	0.47	10	1.46ab	0.32	6	1.45ab	0.82	14	1.42ab	0.42	9	1.55a	0.24	5
Penetration Resistance (kPa)	3916a	4206	35	1468b	1468	33	1572ab	1054	22	2433ab	4178	53	1592ab	524	13	1778ab	379	6
Clay (%)	20b	20	26	27a	30	37	26a	16	18	15c	10	22	17bc	16	31	11c	14	48
Chemical Indicators																		
pH	7.4b	0.7	3	7.6a	0.5	2	7.5a	0.7	3	7.5ab	0.3	2	7.5ab	0.5	3	7.5a	1	4
Electrical conductivity (dS/m)	1.1b	2.03	50	3.1a	7.01	35	3.3a	7.43	68	0.6b	0.27	13	1.8b	2.48	49	1.2b	4.56	102
Sodium adsorption ratio	0.9c	1.29	37	4.8a	6.6	44	4.4ab	16	117	0.7c	0.8	32	1.5c	2.08	44	2.3bc	8.7	129
Phosphorus (mg/kg)	17bc	52	83	31b	70	72	5a	88	42	8.1c	34	139	25bc	36	49	32b	105	97
Nitrate nitrogen (mg/kg)	11.5	38	105	11.9	81	192	20.1	118	164	4.7	10	73	18.4	72	137	10	38	125
Potassium (mg/kg)	28ab	40	44	44a	134	82	25b	59	79	20b	36	52	30ab	72	95	30ab	52	52
Biological Indicators																		
[2]POXC (mg/kg)	435a	140	9	414ab	99	7	409abc	113	8	405bc	113	9	386bc	103	9	384c	151	10
Soil organic matter(%)	2.2a	4.43	62	1.5ab	2.25	41	2.0a	2.7	41	1.8ab	2.74	42	1.1b	2.06	54	1.2b	2.98	68
Total Microbial Biomass (ng/g)	4331a	10325	68	2088bc	1107	17	1950bc	4037	60	3089ab	6501	56	2583b	3491	53	1093c	1984	55
Diversity Index	1.51ab	0.44	9	1.41bc	0.38	10	1.42bc	0.44	9	1.59a	0.26	6	1.35cd	0.3	10	1.28d	0.55	11
[3]AMF Biomass (ng/g)	170a	405	80	36b	63	61	53b	199	97	155a	308	55	42b	89	77	18b	79	138
Fungi:Bacteria	0.24ab	0.33	38	0.20abc	0.3	42	0.16cd	0.2	45	0.26a	0.19	23	0.19bc	0.23	48	0.11d	0.17	52

a, b, c, d: means within a row followed by the same letter are not significantly; ns: not significant; *Coefficient of variability (%); [1]Dry aggregates; [2]Permanganate Oxidizable Carbon; [3]Arbuscular Mycorrhizal Fungi

RESULTS

- All the selected soil indicators vary significantly across the MLRAs (Table 1).
- Area 35, which is Colorado Plateau, had significantly higher soil biological indicator measurements including soil organic matter, permanganate oxidizable carbon, total microbial biomass and also higher wet aggregate stability (Table 1).
- The lowest CV across MLRAs were observed for POXC, pH and bulk density, while mean dry aggregate weight diameter, available water content, nitrate-N, potassium, and phosphorus had the highest CV.
- Many of the measured soil quality indicators did not show significant difference (p=0.05) with cropping practices except for total microbial biomass, permanganate oxidizable carbon, available water content and calcium content (Figure 1).

CONCLUSION

- While most of the measured soil indicators differed significantly between the MLRAs, cropping practices on the other hand was only significant for a few measurements, indicating the strong influence of climate, topography and parent materials on the measured soil indicators.
- To develop effective regional soil quality assessment within the study region, there is a need to consider the MLRA in the design of any assessment framework.

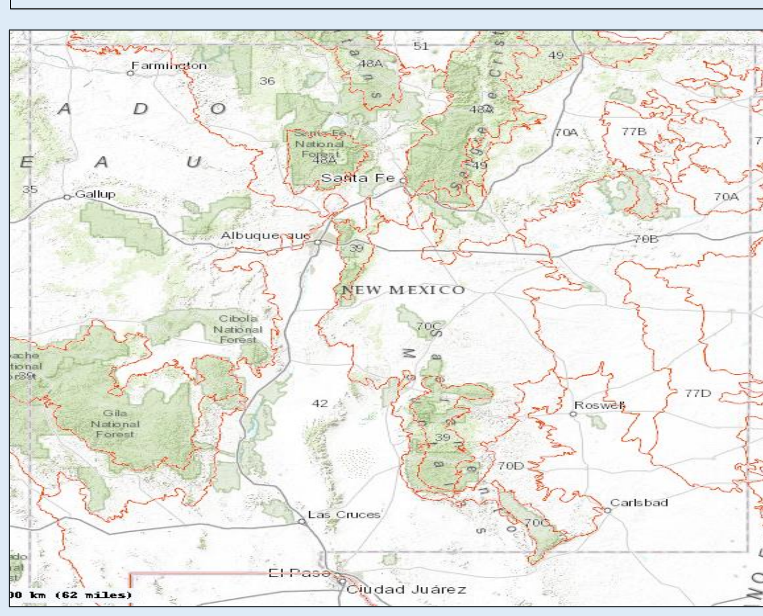

Plate 1. Major Land Resource Areas of New Mexico

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