**Supplementary Material

Citation:** Fortuna, A., J.J. Steiner, D.N. Moriasi, B.K. Northup and P.J. Starks. 2021. Linking geospatial information and effects of land management to edaphic properties. Journal of Soil and Water Conservation. https://doi.org/10.2489/jswc.2022.00160.

Supplementary Table 1. United States Department of Agriculture soil texture designations for soil samples taken from three water shed units and sampling depths of the Water Resources Erosion Units as determined by the soil hydrometer method (Huluka and Miller, 2014) at the tread, landscape position.

|  |  |
| --- | --- |
| **Watershed Treatment Description** | **Landscape Position and Slope - Tread** |
|  | **Plot 1** | **Plot 2** | **Plot 3** | **Plot 4** |
| **Southern tall grass prairie - Unit 1 (STGP)** |   |   |   |   |
| **Depth 0-5-cm** | silt loam | silt loam | silt loam | silt loam |
| **5-15-cm** | silt loam | silt loam | silt loam | silt loam |
| **15-30-cm** | silty clay loam | silty clay loam | silt loam | silt loam |
| **Winter wheat, periodic summer forage,**  |  |  |  |  |
| **Minimal disturbance - Unit 5 (WWMT)** |  |  |  |  |
| **Depth 0-5-cm** | silt loam | silt loam | silt loam | silt loam |
| **5-15-cm** | silt loam | silt loam | silt loam | silt loam |
| **15-30-cm** | silt loam | silt loam | silt loam | silt loam |
| **Winter wheat, tilled - Unit 8 (WWCT)** |  |  |  |  |
| **Depth 0-5-cm** | silty clay loam | silt loam | silt loam | silt loam |
| **5-15-cm** | silty clay loam | silt loam | loam | silt loam |
| **15-30-cm** | silty clay loam | clay loam | loam | loam |

Supplementary Table 2. United States Department of Agriculture soil texture designations for soil samples taken from three water shed units and sampling depths of the Water Resources Erosion Units as determined by the soil hydrometer method (Huluka and Miller, 2014) at the riser, landscape position.

|  |  |
| --- | --- |
| **Watershed Treatment Description** | **Landscape Position and Slope - Riser** |
|  | **Plot 1** | **Plot 2** | **Plot 3** | **Plot 4** |
| **Southern tall grass prairie - Unit 1 (STGP)** |   |   |   |   |
| **Depth 0-5-cm** | silt loam | silt loam | silt loam | silt loam |
| **5-15-cm** | silt loam | silt loam | silt loam | silt loam |
| **15-30-cm** | silt loam | silt loam | silt loam | silty clay loam |
| **Winter wheat, periodic summer forage,**  |  |  |  |  |
| **Minimal disturbance - Unit 5 (WWMT)** |  |  |  |  |
| **Depth 0-5-cm** | silt loam | silt loam | silt loam | loam |
| **5-15-cm** | loam | silt loam | silt loam | loam |
| **15-30-cm** | loam | loam | loam | silt loam |
| **Winter wheat, tilled - Unit 8 (WWCT)** |  |  |  |  |
| **Depth 0-5-cm** | silt loam | silt loam | silt loam | silt loam |
| **5-15-cm** | silt loam | silt loam | silty clay loam | silt loam |
| **15-30-cm** | clay loam | silt clay loam | clay loam | clay loam |

Supplementary Table 3. United States Department of Agriculture soil texture designations for soil samples taken from three water shed units and sampling depths of the Water Resources Erosion Units as determined by the soil hydrometer method (Huluka and Miller, 2014) at the toe, landscape position.

|  |  |
| --- | --- |
| **Watershed Treatment Description** | **Landscape Position and Slope - Toe** |
|  | **Plot 1** | **Plot 2** | **Plot 3** | **Plot 4** |
| **Southern tall grass prairie - Unit 1 (STGP)** |   |   |   |   |
| **Depth 0-5-cm** | loam | silt loam | loam | silt loam |
| **5-15-cm** | loam | silty clay loam | silt loam | silt loam |
| **15-30-cm** | clay loam | clay loam | clay loam | silty clay loam |
| **Winter wheat, periodic summer forage,**  |  |  |  |  |
| **Minimal disturbance - Unit 5 (WWMT)** |  |  |  |  |
| **Depth 0-5-cm** | loam | silt loam | silt loam | silt loam |
| **5-15-cm** | loam | loam | silt loam | silt loam |
| **15-30-cm** | loam | loam | loam | silt loam |
| **Winter wheat, tilled - Unit 8 (WWCT)** |  |  |  |  |
| **Depth 0-5-cm** | silt loam | loam | loam | silt loam |
| **5-15-cm** | loam | silt loam | silt loam | loam |
| **15-30-cm** | silt loam | silt loam | loam | clay loam |

Supplementary Table 4. The interactive effects of watershed by landscape position by depth on the spatial variability of Total Soil Organic and Total Soil Nitrogen (TSN, g kg-1) as measured by means (Aver.), standard deviations (St. Dev.) and coefficients of variation (CV).

|  |  |  |
| --- | --- | --- |
| **Watershed Treatments** |  | **Total Soil Organic Carbon (TSOC, g kg-1)** |
|  | **Depth** | **Tread** |  | **Riser** |  | **Toe** |
|  | **(cm)** | **CV** | **Aver.** | **St. Dev.** |  | **CV** | **Aver.** | **St. Dev.** |  | **CV** | **Aver.** | **St. Dev.** |
| **Southern tall grass prairie -**  |  |   |   |   |  |   |  |  |  |  |  |  |
| **Unit 1 (STGP)** |  **0-5** | **5.86** | 29.5 | 1.72 |  | **4.21** | 28.6 | 1.20 |  | **8.61** | 31.4 | 2.70 |
|  | **5-15** | **1.69** | 15.0 | 0.25 |  | **2.02** | 14.9 | 0.30 |  | **2.52** | 16.2 | 0.41 |
|  | **15-30** | **2.35** | 11.0 | 0.26 |  | **5.09** | 11.2 | 0.57 |  | **2.89** | 11.9 | 0.34 |
| **Winter wheat, periodic summer**  |  |  |  |  |  |  |  |  |  |  |  |  |
| **forage, Minimal disturbance -**  |  **0-5** | **4.84** | 29.3 | 1.42 |  | *20.61* | 28.0 | 5.78 |  | 21.50 | 31.6 | 6.80 |
| **Unit 5 (WWMT)** | **5-15** | **7.64** | 15.2 | 1.16 |  | **6.66** | 15.3 | 1.02 |  | **2.82** | 16.3 | 0.46 |
|  | **15-30** | **3.37** | 10.9 | 0.37 |  | **6.57** | 11.1 | 0.73 |  | **1.85** | 11.5 | 0.21 |
| **Winter wheat, tilled -**  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Unit 8 (WWCT)** |  **0-5** | **7.27** | 20.8 | 1.52 |  | **9.11** | 22.9 | 2.08 |  | **4.31** | 20.8 | 0.90 |
|  | **5-15** | **3.15** | 11.8 | 0.37 |  | **2.41** | 12.8 | 0.31 |  | **3.94** | 12.0 | 0.47 |
|  | **15-30** | **3.53** | 11.0 | 0.39 |   | **5.12** | 11.7 | 0.60 |   | **7.99** | 11.3 | 0.91 |
| **Watershed Treatments** |  | **Total Soil Nitrogen (TSN, g kg-1)** |
|  | **Depth** | **Tread** |  | **Riser** |  | **Toe** |
|  | **(cm)** | **CV** | **Aver.** | **St. Dev.** |  | **CV** | **Aver.** | **St. Dev.** |  | **CV** | **Aver.** | **St. Dev.** |
| **Southern tall grass prairie -**  |  |   |   |   |  |   |  |  |  |  |  |  |
| **Unit 1 (STGP)** |  **0-5** | **5.58** | 2.63 | 0.15 |  | **5.06** | 2.5 | 0.13 |  | **3.52** | 2.6 | 0.09 |
|  | **5-15** | **3.25** | 1.34 | 0.04 |  | **2.89** | 1.3 | 0.04 |  | **2.13** | 1.4 | 0.03 |
|  | **15-30** | **3.07** | 0.94 | 0.03 |  | **5.53** | 0.9 | 0.05 |  | **4.08** | 1.0 | 0.04 |
| **Winter wheat, periodic summer**  |  |  |  |  |  |  |  |  |  |  |  |  |
| **forage, Minimal disturbance -**  |  **0-5** | **9.12** | 2.49 | 0.23 |  | *19.32* | 2.4 | 0.47 |  | *16.42* | 2.6 | 0.42 |
| **Unit 5 (WWMT)** | **5-15** | **9.64** | 1.33 | 0.13 |  | **5.58** | 1.4 | 0.08 |  | **3.16** | 1.3 | 0.04 |
|  | **15-30** | **2.32** | 0.97 | 0.02 |  | **8.19** | 1.0 | 0.08 |  | **1.74** | 0.9 | 0.02 |
| **Winter wheat, tilled -**  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Unit 8 (WWCT)** |  **0-5** | **8.65** | 1.80 | 0.16 |  | **10.14** | 2.0 | 0.20 |  | **3.54** | 1.8 | 0.06 |
|  | **5-15** | **3.08** | 1.09 | 0.03 |  | **1.88** | 1.1 | 0.02 |  | **2.48** | 1.0 | 0.03 |
|  | **15-30** | **3.47** | 1.05 | 0.04 |   | **6.06** | 1.0 | 0.06 |   | **8.74** | 1.0 | 0.09 |

Supplementary Table 5. The interactive effects of watershed by landscape position by depth on the spatial variability of soil phosphorus (mg P kg-1) and sulfate (mg SO4 kg-1) as measured by means (Aver.), standard deviations (St. Dev.) and coefficients of variation (CV).

|  |  |
| --- | --- |
| **Watershed Treatment Description** | **Phosphorus (P mg kg-1)** |
|  | **Depth** | **Tread** |  | **Riser** |  | **Toe** |
|  | **(cm)** | **CV** | **Aver.** | **St. Dev.** |  | **CV** | **Aver.** | **St. Dev.** |  | **CV** | **Aver.** | **St. Dev.** |
| **Southern tall grass prairie -**  |  |   |   |   |  |   |  |  |  |  |  |  |
| **Unit 1 (STGP)** |  **0-5** | *11.3* | 12.9 | 1.46 |  | **11.3** | 12.9 | 1.46 |  | **4.2** | 15.2 | 0.64 |
|  | **5-15** | **10.3** | 6.15 | 0.64 |  | *16.0* | 5.60 | 0.90 |  | **8.8** | 7.25 | 0.64 |
|  | **15-30** | *13.0* | 4.23 | 0.55 |  | 29.0 | 4.78 | 1.38 |  | *12.6* | 5.05 | 0.64 |
| **Winter wheat, periodic summer**  |  |  |  |  |  |  |  |  |  |  |  |
| **forage, Minimal disturbance -**  |  **0-5** | 33.0 | 27.7 | 9.15 |  | **3.66** | 17.4 | 0.64 |  | *20.9* | 22.1 | 4.62 |
| **Unit 5 (WWMT)** | **5-15** | 22.9 | 18.8 | 4.29 |  | *20.8* | 9.25 | 1.92 |  | **10.3** | 10.7 | 1.10 |
|  | **15-30** | **7.41** | 8.10 | 0.60 |  | 33.5 | 6.73 | 2.25 |  | *12.6* | 5.05 | 0.64 |
| **Winter wheat, tilled -**  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Unit 8 (WWCT)** |  **0-5** | 38.7 | 80.9 | 31.3 |  | 27.4 | 55.2 | 15.1 |  | *17.8* | 57.1 | 10.1 |
|  | **5-15** | *19.2* | 25.5 | 4.88 |  | **6.17** | 17.1 | 1.05 |  | 29.7 | 15.7 | 4.66 |
|  | **15-30** | *16.4* | 20.2 | 3.29 |   | 23.5 | 13.4 | 3.16 |   | 32.6 | 16.8 | 5.47 |
| **Watershed Treatment Description** | **Sulfate (SO4 mg kg-1)** |
|  | **Depth** | **Tread** |  | **Riser** |  | **Toe** |
|  | **(cm)** | **CV** | **Aver.** | **St. Dev.** |  | **CV** | **Aver.** | **St. Dev.** |  | **CV** | **Aver.** | **St. Dev.** |
| **Southern tall grass prairie -**  |  |   |   |   |  |   |  |  |  |  |  |  |
| **Unit 1 (STGP)** |  **0-5** | **3.03** | 9.70 | 0.29 |  | *11.7* | 8.35 | 0.97 |  | *12.3* | 7.73 | 0.95 |
|  | **5-15** | **10.9** | 9.10 | 0.99 |  | **9.96** | 6.88 | 0.68 |  | *12.4* | 6.18 | 0.76 |
|  | **15-30** | *19.0* | 8.53 | 1.62 |  | **8.20** | 5.93 | 0.49 |  | **10.8** | 5.30 | 0.57 |
| **Winter wheat, periodic summer**  |  |  |  |  |  |  |  |  |  |  |  |
| **forage, Minimal disturbance -**  |  **0-5** | **9.77** | 8.38 | 0.82 |  | *14.1* | 8.88 | 1.25 |  | **4.88** | 8.70 | 0.42 |
| **Unit 5 (WWMT)** | **5-15** | **10.1** | 9.30 | 0.94 |  | *12.4* | 8.00 | 0.99 |  | **10.1** | 9.05 | 0.91 |
|  | **15-30** | *11.5* | 11.2 | 1.29 |  | *14.1* | 8.73 | 1.23 |  | *17.3* | 7.50 | 1.30 |
| **Winter wheat, tilled -**  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Unit 8 (WWCT)** |  **0-5** | *15.9* | 12.1 | 1.92 |  | **7.31** | 11.0 | 0.81 |  | *13.4* | 9.48 | 1.27 |
|  | **5-15** | 24.7 | 10.6 | 2.62 |  | 21.6 | 8.58 | 1.86 |  | *12.5* | 10.0 | 1.25 |
|  | **15-30** | 24.2 | 7.88 | 1.91 |   | **9.21** | 6.95 | 0.64 |   | 24.9 | 6.90 | 1.72 |

Supplementary Table 6. The interactive effects of watershed by landscape position by depth on the spatial variability of soil potassium (mg K kg1) across treatment by slope by depth as measured by means (Aver.), standard deviations (St. Dev.) and coefficients of variation (CV).

|  |  |  |
| --- | --- | --- |
| **Watershed Treatment Description** |  | **Potassium (K, mg kg-1)** |
|  | **Depth** | **Tread** |  | **Riser** |  | **Toe** |
|  | **(cm)** | **CV** | **Aver.** | **St. Dev.** |  | **CV** | **Aver.** | **St. Dev.** |  | **CV** | **Aver.** | **St. Dev.** |
| **Southern tall grass prairie -**  |  |   |   |   |  |   |  |  |  |  |  |  |
| **Unit 1 (STGP)** |  **0-5** | *13.8* | 593 | 81.9 |  | **8.5** | 501 | 42.5 |  | *13.8* | 482 | 66.8 |
|  | **5-15** | 27.6 | 365 | 101 |  | *13.4* | 291 | 38.9 |  | *16.0* | 287 | 46.0 |
|  | **15-30** | *15.0* | 246 | 37.0 |  | *13.9* | 217 | 30.1 |  | **5.90** | 207 | 12.2 |
| **Winter wheat, periodic summer**  |  |  |  |  |  |  |  |  |  |  |  |  |
| **forage, Minimal disturbance -**  |  **0-5** | *13.8* | 572 | 78.9 |  | **7.14** | 416 | 29.7 |  | **5.12** | 415 | 21.2 |
| **Unit 5 (WWMT)** | **5-15** | 39.1 | 425 | 166 |  | *13.2* | 204 | 26.8 |  | **8.25** | 244 | 20.1 |
|  | **15-30** | 24.1 | 308 | 74.1 |  | **8.17** | 196 | 16.0 |  | **3.32** | 206 | 6.86 |
| **Winter wheat, tilled -**  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Unit 8 (WWCT)** |  **0-5** | *15.5* | 601 | 93.1 |  | *16.0* | 694 | 111 |  | 26.9 | 678 | 183 |
|  | **5-15** | *15.7* | 274 | 42.9 |  | **8.72** | 301 | 26.3 |  | *15.8* | 264 | 41.7 |
|  | **15-30** | **10.8** | 200 | 21.6 |   | **2.94** | 203 | 5.97 |   | 23.8 | 227 | 54.1 |

|  |  |  |
| --- | --- | --- |
| **Watershed Treatment Description** |  | **Potassium (K, mg kg-1)** |
|  | **Depth** | **Tread** |  | **Riser** |  | **Toe** |
|  | **(cm)** | **CV** | **Aver.** | **St. Dev.** |  | **CV** | **Aver.** | **St. Dev.** |  | **CV** | **Aver.** | **St. Dev.** |
| **Southern tall grass prairie -**  |  |   |   |   |  |   |  |  |  |  |  |  |
| **Unit 1 (STGP)** |  **0-5** | *13.8* | 593 | 81.9 |  | **8.5** | 501 | 42.5 |  | *13.8* | 482 | 66.8 |
|  | **5-15** | 27.6 | 365 | 101 |  | *13.4* | 291 | 38.9 |  | *16.0* | 287 | 46.0 |
|  | **15-30** | *15.0* | 246 | 37.0 |  | *13.9* | 217 | 30.1 |  | **5.90** | 207 | 12.2 |
| **Winter wheat, periodic summer**  |  |  |  |  |  |  |  |  |  |  |  |  |
| **forage, Minimal disturbance -**  |  **0-5** | *13.8* | 572 | 78.9 |  | **7.14** | 416 | 29.7 |  | **5.12** | 415 | 21.2 |
| **Unit 5 (WWMT)** | **5-15** | 39.1 | 425 | 166 |  | *13.2* | 204 | 26.8 |  | **8.25** | 244 | 20.1 |
|  | **15-30** | 24.1 | 308 | 74.1 |  | **8.17** | 196 | 16.0 |  | **3.32** | 206 | 6.86 |
| **Winter wheat, tilled -**  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Unit 8 (WWCT)** |  **0-5** | *15.5* | 601 | 93.1 |  | *16.0* | 694 | 111 |  | 26.9 | 678 | 183 |
|  | **5-15** | *15.7* | 274 | 42.9 |  | **8.72** | 301 | 26.3 |  | *15.8* | 264 | 41.7 |
|  | **15-30** | **10.8** | 200 | 21.6 |   | **2.94** | 203 | 5.97 |   | 23.8 | 227 | 54.1 |

Supplementary Table 7. The interactive effects of watershed by landscape position by depth on the spatial variability of soil calcium (mg Ca kg-1) and magnesium (mg Mg kg-1) as measured by means (Aver.), standard deviations (St. Dev.) and coefficients of variation (CV).

|  |  |
| --- | --- |
| **Watershed Treatment Description** | **Calcium (Ca mg kg-1)** |
|  | **Depth** | **Tread** |  | **Riser** |  | **Toe** |
|  | **(cm)** | **CV** | **Aver.** | **St. Dev.** |  | **CV** | **Aver.** | **St. Dev.** |  | **CV** | **Aver.** | **St. Dev.** |
| **Southern tall grass prairie -**  |  |   |   |   |  |   |  |  |  |  |  |  |
| **Unit 1 (STGP)** |  **0-5** | **3.94** | 3574 | 141 |  | **1.87** | 3513 | 65.7 |  | **9.27** | 3718.3 | 344.69 |
|  | **5-15** | **3.87** | 2966 | 115 |  | **4.62** | 3025 | 140 |  | **4.51** | 3229.5 | 145.66 |
|  | **15-30** | **2.27** | 3411 | 77.4 |  | **7.79** | 3323 | 259 |  | **0.90** | 3629.3 | 32.57 |
| **Winter wheat, periodic summer**  |  |  |  |  |  |  |  |  |  |  |  |  |
| **forage, Minimal disturbance -**  |  **0-5** | **5.05** | 2800 | 141 |  | **4.05** | 3026 | 122 |  | **5.12** | 3188.0 | 163.36 |
| **Unit 5 (WWMT)** | **5-15** | *20.2* | 2402 | 486 |  | **9.17** | 2480 | 227 |  | **4.77** | 2748.5 | 131.08 |
|  | **15-30** | **4.06** | 2813 | 114 |  | **8.56** | 2801 | 240 |  | **2.14** | 2981.0 | 63.89 |
| **Winter wheat, tilled -**  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Unit 8 (WWCT)** |  **0-5** | **3.41** | 2449 | 83.6 |  | **8.14** | 2647 | 215 |  | **4.24** | 2616.8 | 110.87 |
|  | **5-15** | **2.92** | 2470 | 72.2 |  | **7.72** | 2880 | 222 |  | **7.82** | 3079.3 | 240.78 |
|  | **15-30** | **2.60** | 2844 | 73.9 |   | **10.7** | 3119 | 333 |   | *11.50* | 2915.0 | 335.15 |
| **Watershed Treatment Description** | **Magnesium (Mg mg kg-1)** |
|  | **Depth** | **Tread** |  | **Riser** |  | **Toe** |
|  | **(cm)** | **CV** | **Aver.** | **St. Dev.** |  | **CV** | **Aver.** | **St. Dev.** |  | **CV** | **Aver.** | **St. Dev.** |
| **Southern tall grass prairie -**  |  |   |   |   |  |   |  |  |  |  |  |  |
| **Unit 1 (STGP)** |  **0-5** | **3.91** | 678 | 26.5 |  | **2.99** | 662 | 19.8 |  | **6.62** | 658 | 43.6 |
|  | **5-15** | **3.00** | 660 | 19.8 |  | **2.84** | 679 | 19.3 |  | **3.15** | 690 | 21.7 |
|  | **15-30** | **1.60** | 925 | 14.8 |  | **11.1** | 901 | 99.8 |  | **3.90** | 938 | 36.5 |
| **Winter wheat, periodic summer**  |  |  |  |  |  |  |  |  |  |  |  |  |
| **forage, Minimal disturbance -**  |  **0-5** | **10.7** | 507 | 54.3 |  | **7.19** | 593 | 42.6 |  | **7.60** | 623 | 47.3 |
| **Unit 5 (WWMT)** | **5-15** | *13.7* | 456 | 62.4 |  | **5.17** | 547 | 28.3 |  | **10.0** | 605 | 60.6 |
|  | **15-30** | **7.83** | 605 | 47.4 |  | **9.15** | 734 | 67.2 |  | **7.26** | 758 | 55.0 |
| **Winter wheat, tilled -**  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Unit 8 (WWCT)** |  **0-5** | **3.41** | 634 | 21.6 |  | **9.99** | 709 | 70.9 |  | **5.60** | 669 | 37.5 |
|  | **5-15** | **3.49** | 551 | 19.3 |  | **6.46** | 699 | 45.1 |  | **8.39** | 720 | 60.4 |
|  | **15-30** | **2.45** | 621 | 15.2 |   | **8.95** | 775 | 69.4 |   | *18.9* | 697 | 131 |

Supplementary Table 8. The interactive effects of watershed by landscape position by depth on the spatial variability of soil iron (mg Fe kg-1) and copper (mg Cu kg-1) across treatment by slope by depth as measured by means (Aver.), standard deviations (St. Dev.) and coefficients of variation (CV).

|  |  |
| --- | --- |
| **Watershed Treatment Description** | **Iron (Fe mg kg-1)** |
|  | **Depth** | **Tread** |  | **Riser** |  | **Toe** |
|  | **(cm)** | **CV** | **Aver.** | **St. Dev.** |  | **CV** | **Aver.** | **St. Dev.** |  | **CV** | **Aver.** | **St. Dev.** |
| **Southern tall grass prairie -**  |  |   |   |   |  |   |  |  |  |  |  |  |
| **Unit 1 (STGP)** |  **0-5** | **4.72** | 66.1 | 3.12 |  | **9.05** | 53.1 | 4.81 |  | *15.3* | 54.2 | 8.29 |
|  | **5-15** | **8.26** | 50.6 | 4.18 |  | 21.8 | 47.1 | 10.3 |  | *12.4* | 54.9 | 6.81 |
|  | **15-30** | **6.04** | 14.0 | 0.84 |  | 17.9 | 17.8 | 3.20 |  | *14.9* | 20.5 | 3.05 |
| **Winter wheat, periodic summer**  |  |  |  |  |  |  |  |  |  |  |  |  |
| **forage, Minimal disturbance -**  |  **0-5** | *18.9* | 42.4 | 8.00 |  | **6.99** | 95.2 | 6.65 |  | **6.93** | 78.0 | 5.40 |
| **Unit 5 (WWMT)** | **5-15** | *18.1* | 33.5 | 6.07 |  | **5.40** | 68.6 | 3.71 |  | **6.20** | 58.3 | 3.61 |
|  | **15-30** | *19.8* | 10.3 | 2.03 |  | 16.8 | 15.4 | 2.60 |  | 22.3 | 19.1 | 4.27 |
| **Winter wheat, tilled -**  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Unit 8 (WWCT)** |  **0-5** | *16.5* | 81.7 | 13.5 |  | **7.19** | 67.9 | 4.88 |  | *15.7* | 74.6 | 11.7 |
|  | **5-15** | *19.8* | 65.0 | 12.9 |  | *12.5* | 52.6 | 6.58 |  | 29.0 | 48.5 | 14.0 |
|  | **15-30** | *25.4* | 54.5 | 13.9 |   | 27.0 | 50.5 | 13.7 |   | 38.1 | 55.8 | 21.3 |
| **Watershed Treatment Description** | **Copper (Cu mg kg-1)** |
|  | **Depth** | **Tread** |  | **Riser** |  | **Toe** |
|  | **(cm)** | **CV** | **Aver.** | **St. Dev.** |  | **CV** | **Aver.** | **St. Dev.** |  | **CV** | **Aver.** | **St. Dev.** |
| **Southern tall grass prairie -**  |  |   |   |   |  |   |  |  |  |  |  |  |
| **Unit 1 (STGP)** |  **0-5** | *13.2* | 0.73 | 0.10 |  | 22.9 | 0.83 | 0.19 |  | *12.4* | 0.78 | 0.10 |
|  | **5-15** | **5.50** | 1.05 | 0.06 |  | *14.8* | 1.10 | 0.16 |  | *12.3* | 1.05 | 0.13 |
|  | **15-30** | **8.16** | 1.00 | 0.08 |  | 22.9 | 0.83 | 0.19 |  | *14.4* | 0.80 | 0.12 |
| **Winter wheat, periodic summer**  |  |  |  |  |  |  |  |  |  |  |  |  |
| **forage, Minimal disturbance -**  |  **0-5** | 30.9 | 0.70 | 0.22 |  | *17.2* | 0.75 | 0.13 |  | *15.3* | 0.83 | 0.13 |
| **Unit 5 (WWMT)** | **5-15** | 23.6 | 0.73 | 0.17 |  | **6.79** | 0.85 | 0.06 |  | **8.15** | 1.18 | 0.10 |
|  | **15-30** | *18.5* | 1.03 | 0.19 |  | *17.2* | 0.75 | 0.13 |  | 28.6 | 1.05 | 0.30 |
| **Winter wheat, tilled -**  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Unit 8 (WWCT)** |  **0-5** | *16.8* | 1.23 | 0.21 |  | 23.5 | 1.10 | 0.26 |  | **4.88** | 1.03 | 0.05 |
|  | **5-15** | *14.9* | 1.68 | 0.25 |  | *13.9* | 1.25 | 0.17 |  | 21.0 | 1.58 | 0.33 |
|  | **15-30** | 28.9 | 1.75 | 0.51 |   | **9.56** | 1.35 | 0.13 |   | 34.3 | 1.48 | 0.51 |

Supplementary Table 9. The interactive effects of watershed by landscape position by depth on the spatial variability of soil Zn (mg Zn kg-1) and Boron (mg B kg-1) across treatment by slope by depth as measured by means (Aver.), standard deviations (St. Dev.) and coefficients of variation (CV).

|  |  |
| --- | --- |
| **Watershed Treatment Description** | **Zinc (Zn mg kg-1)** |
|  | **Depth** | **Tread** |  | **Riser** |  | **Toe** |
|  | **(cm)** | **CV** | **Aver.** | **St. Dev.** |  | **CV** | **Aver.** | **St. Dev.** |  | **CV** | **Aver.** | **St. Dev.** |
| **Southern tall grass prairie -**  |  |   |   |   |  |   |  |  |  |  |  |  |
| **Unit 1 (STGP)** |  **0-5** | *11.4* | 2.43 | 0.28 |  | **10.9** | 2.63 | 0.29 |  | *12.4* | 2.75 | 0.34 |
|  | **5-15** | *16.5* | 0.35 | 0.06 |  | 28.6 | 0.35 | 0.10 |  | *16.5* | 0.35 | 0.06 |
|  | **15-30** | 40.0 | 0.13 | 0.05 |  | 38.5 | 0.15 | 0.06 |  | 0.00 | 0.10 | 0.00 |
| **Winter wheat, periodic summer**  |  |  |  |  |  |  |  |  |  |  |  |  |
| **forage, Minimal disturbance -**  |  **0-5** | 55.6 | 2.28 | 1.27 |  | **3.39** | 2.83 | 0.10 |  | 21.6 | 2.80 | 0.61 |
| **Unit 5 (WWMT)** | **5-15** | 125 | 0.80 | 1.00 |  | **0.00** | 0.30 | 0.00 |  | *16.5* | 0.35 | 0.06 |
|  | **15-30** | 85.7 | 0.18 | 0.15 |  | **0.00** | 0.10 | 0.00 |  | 40.0 | 0.13 | 0.05 |
| **Winter wheat, tilled -**  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Unit 8 (WWCT)** |  **0-5** | **4.44** | 1.13 | 0.05 |  | *11.2* | 1.15 | 0.13 |  | *12.3* | 1.03 | 0.13 |
|  | **5-15** | *16.5* | 0.35 | 0.06 |  | *18.2* | 0.28 | 0.05 |  | 27.2 | 0.30 | 0.08 |
|  | **15-30** | 36.9 | 0.35 | 0.13 |   | 22.2 | 0.23 | 0.05 |   | 27.2 | 0.30 | 0.08 |
| **Watershed Treatment Description** | **Boron (B mg kg-1)** |
|  | **Depth** | **Tread** |  | **Riser** |  | **Toe** |
|  | **(cm)** | **CV** | **Aver.** | **St. Dev.** |  | **CV** | **Aver.** | **St. Dev.** |  | **CV** | **Aver.** | **St. Dev.** |
| **Southern tall grass prairie -**  |  |   |   |   |  |   |  |  |  |  |  |  |
| **Unit 1 (STGP)** |  **0-5** | *17.2* | 0.19 | 0.03 |  | **7.13** | 0.18 | 0.01 |  | *17.0* | 0.21 | 0.03 |
|  | **5-15** | **5.20** | 0.15 | 0.01 |  | **8.02** | 0.15 | 0.01 |  | **1.98** | 0.16 | 0.00 |
|  | **15-30** | **6.10** | 0.19 | 0.01 |  | *13.8* | 0.17 | 0.02 |  | **3.84** | 0.17 | 0.01 |
| **Winter wheat, periodic summer**  |  |  |  |  |  |  |  |  |  |  |  |  |
| **forage, Minimal disturbance -**  |  **0-5** | **8.73** | 0.14 | 0.01 |  | **9.87** | 0.18 | 0.02 |  | **6.35** | 0.16 | 0.01 |
| **Unit 5 (WWMT)** | **5-15** | 45.9 | 0.10 | 0.05 |  | 23.6 | 0.12 | 0.03 |  | **7.90** | 0.12 | 0.01 |
|  | **15-30** | *13.4* | 0.14 | 0.02 |  | **9.91** | 0.17 | 0.02 |  | *14.0* | 0.15 | 0.02 |
| **Winter wheat, tilled -**  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Unit 8 (WWCT)** |  **0-5** | *15.3* | 0.11 | 0.02 |  | *13.8* | 0.11 | 0.01 |  | **4.55** | 0.10 | 0.00 |
|  | **5-15** | *16.7* | 0.11 | 0.02 |  | **9.04** | 0.11 | 0.01 |  | 35.6 | 0.13 | 0.04 |
|  | **15-30** | 23.3 | 0.16 | 0.04 |   | *13.0* | 0.16 | 0.02 |   | 22.8 | 0.13 | 0.03 |