WILDFIRE-INDUCED SOIL WATER REPELLENCY ON BADLAND HILLSLOPES IN NORTH DAKOTA

A Paper
Submitted to the Graduate Faculty
of the
North Dakota State University
of Agriculture and Applied Science

By

Todd Alan Braun

In Partial Fulfillment of the Requirements
for the Degree of
MASTER OF SCIENCE

Major Program:
Natural Resources Management

Major Department:
Soil Science

May 2004

Fargo, North Dakota

ABSTRACT

Braun, Todd Alan; M.S.; Program of Natural Resources Management; Department of Soil Science; College of Agriculture, Food Systems, and Natural Resources; North Dakota State University; May 2004. Wildfire-Induced Soil Water Repellency on Badland Hillslopes in North Dakota. Major Professor: Dr. Jimmie Richardson.

Personnel of the Dakota Prairie National Grasslands Unit of the U.S. Forest Service expressed concern that, following an August 2000 wildfire, severe erosion would occur on burned, devegetated hillslopes. This study was conducted to (1) examine water repellent soils formed from the "Blacktail Wildfire Burn of 2000" and the relationships among topography, soil texture, and vegetation types at the sites; (2) evaluate the patterns of soil erosion caused by water repellent soils within a burned catchment; and (3) assess the change in soil erodibility within the watershed.

The most common soils on hillslopes are the forested Arikara (fine-loamy, mixed, superactive, frigid Typic Haplustepts) and the grassland Cabbart (loamy, mixed, superactive, calcareous, frigid, shallow Aridic Ustorthents) soil series. The most common soil on footslope and toeslope positions is the Patent soil series (fine-loamy, mixed, superactive, calcareous, frigid Aridic Ustorthents).

Wildfire burned and unburned areas were selected for comparison, and water drop penetration time (WDPT) was measured on 30 profiles from each of the burned and unburned areas each year (120 total profiles). Profiles were sampled from the interfluve, midslope, and flood plain. North-facing slopes, with juniper canopy (*Juniperus scopulorum*), exhibited a significant degree of natural water repellency. Water repellency was much higher following the fire. Post-fire water repellency decreased in severity yearly for the two-year duration of the study. North-facing burned and unburned slopes are naturally more repellent than the equivalent south-facing burned and unburned slopes that

are vegetated with prairie grasses. Soil water repellency on burned north-facing slopes was greater than that of unburned north-facing slopes. Little difference was observed regarding water repellency between unburned and burned south-facing slopes. Burned north-facing slopes became water repellent, suggesting the high fuel and the *mor* humus of the juniper creates repellency that influences water movement in these watersheds.

Observations were made following a single heavy rainfall event one year after the fire. It was concluded that run-off was nearly 100% of the precipitation on north-facing burned slopes, based on the lack of wetting below 0.2 cm. The profoundly water repellent layers on north-facing slopes do not increase erodibility on the slopes. Some evidence exists, however, that the valleys do have rejuvenated erosion. Evidence of rejuvenated erosion is indicated by knickpoint migration and sediment deposition on the valley floor.