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Topsoil Depth Effects on Crop Yields as Affected by Weather

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Topsoil (A-horizon) depth is positively correlated with crop productivity; crop roots and available nutrients are concentrated in this layer; topsoil is critical for nutrient retention and water holding capacity. Its loss or reduction can be considered an irreversible impact of soil erosion. Climatic factors such as precipitation and temperature extremes that impose production stress further complicate the relationship between soil erosion and crop productivity. The primary research objective was to determine the effects of soil erosion on corn and soybean yields of loess and till-derived soils in the rain-fed farming region of Iowa. Data collection took place from 2007 to 2012 at seven farm sites located in different major soil regions. Collection consisted of 40 to 50 randomly selected georeferenced soil probe locations across varying erosion classes in well drained landscape positions. Soil probes were done to a minimum depth of 100 cm and soil organic carbon samples were obtained in the top 10 cm. Crop yields were determined utilizing georeferenced harvest maps from yield monitoring devices and cross referenced with georeferenced field data points. Data analysis targeted relationships between crop yields versus soil organic carbon contents (SOC) and crop yields versus topsoil depths (TSD). The variation of yield and growing season rainfall across multiple years were also evaluated to provide an indication of soil resiliency associated with topsoil depth and soil organic carbon levels across varying climatic conditions. Results varied between sites but generally indicated a greater yield potential at thicker TSD's and higher SOC concentrations; an annual variation in yield response as a function of precipitation amount during the growing season; largest yield responses to both TSD and SOC occurred in the driest study year (2012); and little to no significant yield responses to TSD occurred during the wettest study year (2010). These results were not representative for all seven sites. Of the sites sampled, five showed similar yield responses while two sites did not indicate a response, and results varied between corn and soybean crops. The results indicate the potential for crop yield sensitivity and lost production due to thinning topsoil depths and lost soil organic carbon is likely associated with soil erosion. This yield sensitivity appeared to increase during drier years as thinner topsoils typically have lower water retention capacity. Minimal yield response during the wettest year further suggests that topsoil plays a critical role in plant-soil water relations.