Assessing degradation of soils cultivated to irrigated corn in Nebraska

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Knowledge of cause and effect relationships on crop yield variability is helpful to recommend precision agriculture technologies. Understanding spatial variability of soil properties is important in identifying the effects of management on soil degradation and productivity and to suggest management options for enhanced sustainability. Research was conducted on two farm fields in the Platte River Valley of south central Nebraska to determine the utility of spatial variability of soil physical, chemical and biological properties to assess field soil degradation and crop productivity potential. The research sites have been cultivated for over twenty-five years, under intensive soil and crop management; initially moldboard plowing and most recently using a ridge tillage management system, center-pivot irrigation, and agrochemical inputs. The presence of uncultivated areas in close proximity to the experimental fields and on similar soil types and landscape positions were used as reference points. The reference area for the site with a silty clay loam soil (Gibbon) has been under alfalfa (*Medicago sativa* L.), and at the second site (Shelton) with a sandy soil the reference area has been under perennial reed canarygrass (*Pharlaris arundinacea* L.). Because of the great difference in soil management, the relative difference between soil properties measured in these two reference areas and those in adjacent cropped land could be used as an indicator of soil and environmental degradation. The soil properties selected for this propose were: pH as an indicator of acidification; electrical conductivity indicating soil osmotic conditions for biological activity and salinization; bulk density indicating compaction; and soil organic matter and particulate organic matter indicating the effects of tillage and water erosion on reduction of soil organic matter. Loss of organic matter due to soil tillage, acidification associated with application of ammoniacal fertilizer, and subsoil compaction were indicators of soil and environmental degradation. Also, differences in corn (*Zea mays* L.) grain yield of 4 to 5 Mg ha^{-1} observed under uniform management across the field landscape areas indicated soil degradation and apparent inefficiency of agricultural production as indicated by loss of plant available N and associated soil acidification. Soil properties measured in the field indicate that the systems of soil and crop management used by farmers resulted in reduced soil quality and increased soil degradation in parts of the field where erosion was most intense. In some lower lying areas of the fields soil aggradation occurred due to erosional deposition of soil and associated organic matter. Additional inputs of fossil fuel-derived energy in irrigation and fertilizers will be necessary to sustain high levels of corn production, which will likely lead to further soil and environmental degradation.

Keywords: spatial variability, soil degradation, soil quality, irrigated corn