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Soil compaction has detrimental effects on soil quality and root growth. Soil compaction due to cultural operations is an acknowledged problem by growers in the northern Great Plains, USA. A field study was conducted near Sidney, MT, USA in 2007 to evaluate spatial and temporal variations of penetration resistance (PR) across sugarbeet rows under both conventional and strip tillage systems. Strip tillage (ST) was performed using a single operation with special equipment that provided alternating 30-cm wide strips of tilled and untilled soil while conventional tillage (CT) consisted of six to seven separate operations using different tillage implements following the harvest of one crop in preparation for the next crop. Soil penetration resistance (PR) measurements as an indicator of soil compaction were determined across the sugarbeet rows within ST and CT systems on a clay loam soil. A digital cone penetrometer was used to measure soil PR on a semi-grid sampling scheme (5 cm horizontal [U+F0B4] 2.5 cm vertical). The penetrometer was pressed into the soil every 5 cm along a 61-cm transect using a steel template bisecting the sugarbeet rows. At each transect point, measurements were recorded at 2.5-cm depth increments to a maximum depth of 30 cm. Soil PR measurements were recorded prior to planting, after the first cultivation, and before and after harvest. Soil water contents were gravimetrically determined at the time of PR measurements. Soil PR was significantly greater in CT than in ST across the rows at the 0 to 30 cm depth for all sampling dates. Generally, soil PR increased with depth at every position across crop rows for four sampling dates under both tillage systems. Significant temporal variations in soil PR within each tillage system were observed throughout the growing season. Spatial variation data showed that less compaction was observed in crop rows compared to between rows under both tillage systems. Soil PR values increased as the growing season progressed and were the highest prior to crop harvest, approaching values greater than 3.5 MPa below the soil surface. These temporal variations were likely associated with variations in soil moisture content. Interpolative 2-D spatial maps of soil PR were also produced to visualize soil compaction distribution induced over time by each tillage system.