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Freeze-Thaw Cycles Effects on Soil Compaction in a Clay Loam

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Inappropriate soil management practices and heavier farm machinery and equipment have led to an increase in soil compaction in the last two decades prompting increased global concern regarding the impact of soil compaction on crop production and soil quality in modern mechanized agriculture. A 3-yr comprehensive study was established to evaluate the dynamic of freeze-thaw cycles on soil compaction in a clay loam soil. Plots of frozen soils were compared with plots where soils were prevented from freezing with electrically heated blankets commonly used on concrete. Results showed that frequent freeze-thaw cycles over the winter alleviated a majority of soil compaction at the 0 – 20 cm depth. Soil penetration resistance in compacted soils was reduced by 73 and 68% over the winter at the 0 - 10 and 10 – 20 cm depths, respectively, due to dynamic effects of freeze-thaw cycles on soil structure and particles configuration. In unfrozen compacted soils, the penetration resistance was also reduced by 50 and 60% over winter at the 0 - 10 and 10 – 20 cm depths, respectively, due to the biology of soil, microbial activity, and disruptive effects of shrink-swell cycles. These results have demonstrated of how repeated freeze-thaw cycles can alleviate soil compaction, alter soil physical quality and create optimal soil conditions required for profitable growth of agricultural crops. The results from this study will save growers considerable time, money and energy currently required to alleviate soil compaction using other methods such as sub-soiling and deep tillage. We believe that Mother Nature provides ways to reverse soil compaction and improve soil structure and aggregation through the dynamic of freeze-thaw cycles that soils in Montana and other parts of the country go through each year. We concluded that the Mother Nature is the most effective and cheapest way to alleviate soil compaction.