Division 4. The Role of Soils in Sustaining Society and the Environment

Commission 4.3 - Soils and Land Use Change

Description of Commission 4.3
Soils play a large role as source and sinks of greenhouse gases. In a context of global sustainability, this Commission will investigate how the source/sink function of the soils can be managed and controlled to mitigate the impact of climate change. Land use change is of a major interest to all, what is the effect of urbanization, loss of productive land to other uses, forest conversion, and other changes are of major interest and these changes will fall under this Commission.

During the 2015 International Year of Soils, the IUSS Division 4 will illustrate its main topics through articles written by Division 4 officers or their colleagues. These will each be highlighted every week from October to December 2015.

For this fifth week, we are displaying an article from Jabro Jay, the Commission 4.3 vice-chair.

Soil Compaction

Jay D. Jabro, Ph.D.
NPARL-ARS-USDA- Sidney, MT, USA

Heavier machinery and inappropriate soil management have led to an increase in soil compaction (Fig. 1) prompting increased global concern regarding the impact of soil compaction on crop production and soil quality in mechanized agriculture. Soil compaction affects crop yields through alteration of soil physical, chemical and biological properties. Worldwide, problems from compacted soil affect an estimated 68 million hectares from farm machinery traffic alone. Research showed that approximately 80% of soil compaction from wheel traffic occurs on the first pass of a tire.

Soil compaction may occur during tillage, planting, spraying, and harvesting (Fig. 1). We generally think of compaction being caused by wheel traffic, but it can also be caused by tillage tools which cause a “hard pan” just below the tilled depth.

Soil moisture content has a great impact on soil compaction. Dry soils would not compact nearly as much as a moist soil under the same applied load. Heavy axle loads of large equipment tend to drive compaction deeper than light axle loads.

Soil compaction is a factor in reducing crop yield. Roots cannot easily penetrate compacted soil and therefore the plant can’t absorb water and nutrients from the soil. Compacted soils do not readily absorb water so they contribute to increased runoff on slopes and ponding in low areas. Runoff may carry fertilizers and pesticides into streams and rivers.

Soil compaction can reduce crop yield up to 50% in some areas depending upon the depth of compaction and its extent.

Deep rooted cover crops (e.g., rye grass, oilseed radish, safflower, turnip) that can penetrate hard soils may be used to create root channels that later decay and loosen the soil. Deep tillage is commonly used to alleviate soil compaction. Increasing soil organic matter and encouraging earthworm activities can also soften compacted soils.

Research at the Northern Plains Agricultural Research Lab in Sidney, MT, USA showed that frequent freezing and thawing cycles decreased a majority of soil compaction at the 0 - 30 cm depth after the first winter in compacted clay loam soils (Fig. 2).

In addition to the methods mentioned above, limiting wheel traffic to a single path will subject a lesser portion of the field to compaction as will avoid field operations on wet soil.

The development of proper farming practices (e.g., no-till, reduced tillage, crop rotations) that minimize soil compaction is essential for maintaining good soil structure and eliminating the need for multiple field operations.

In conclusion, wheel traffic is number one cause to soil compaction in the field and stay out of the field when it is too wet (Figs. 1 and 2).

Fig. 1. Soil Compaction caused by heavy machinery under wet field conditions.

Fig. 2. Wheel tracks from a farm truck during the compaction process in a clay loam soil.