Different strategies to alleviate soil compaction risk during tillage operations

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**Abstract.** Compaction causes soil degradation, but different strategies can help to mitigate this phenomenon, such as increasing soil strength during traffic events and decreasing soil stress due to equipment features. The first one can be achieved by raising soil organic carbon and limiting the traffic when the soil water content is too high. Decision support systems help this choice and can improve the machine settings to reduce soil stress. Controlled traffic farming can enhance soil compaction mitigation by confining all the equipment transit on the traffic lane. Crop seedbeds remain undisturbed, improving crop performance and increasing yield. Controlled traffic needs equipment standardisation for all the operations, from tillage to harvest, that can overcomplicate equipment travel on public roads and resort to contractors.

This work aims to investigate three different strategies to alleviate soil compaction risk during soil tillage. The first is “Random traffic with wheeled tractors” (RW), the Second is “Random traffic with tracked tractors” (RT), and the third is “Controlled traffic” (CT). The three scenarios were compared by using the following traffic indexes: Rut Length, Traffic Intensity, Mechanization Degree, and Field Load Index. Soil stresses on specific scenarios were calculated with the Terranimo® model. Collection of soil bulk density, penetrometer resistance, working time analysis, field traffic analysis and fuel consumption with telemetry was carried out to complete the analysis on a real scale thanks to a 19 ha field test on a farm in northeast Italy.

The soil stress is higher in the Controlled traffic than in the other two random traffic scenarios, due to the narrow width of the wheels used to decrease the trafficked area. The field index Ruth Length shows a higher value on CT caused by a lower working width. On Mechanization Degree the RT scenario has a 47% increase in comparison to CT and 21% more than RW due to the high power tractor used. Lower bulk density values were found in CT and penetrometer resistance showed statistically significant differences among scenarios and correlation with stresses modelled with Terranimo®.