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Evaluation of COMPSOIL model in predicting soil compaction using pedotransfer functions

Pauline Défossez (1), Kawtar Saffih-Hdadi (2), André Chanzy (3), and Guy Richard (4)

(1) UR1263 EPHYSE, INRA, Bordeaux, France (Pauline.Defossez@bordeaux.inra.fr), (2) UR1158 AgroImpact, INRA, Laon, France, (3) UMR1114 EMMAH, INRA, Avignon, France, (4) UR0272 Science du Sol, INRA, Orléans, France

Soil protection in respect to soil compaction has become an important concern in Europe. Identifying the vulnerability of soils to compaction damage becomes an increasingly important issue both in the planning and execution of farming operations at a field scale and in planning environmental protection measures at a largest scale. Soil compaction models can be used to estimate the soil sensitivity to compaction as function of climate, soil and cultural system (crop, forest, and vineyard). These models describe (i) the propagation of the loading forces within the soil resulting from forces applied at the soil surface from farm vehicles (ii) the soil stress-strain behaviour, i.e. the soil mechanical properties. They require parameters about the vehicle equipment (load, wheel characteristics) and the soil mechanical properties. But these data can be limited in the context of applications for decision support (map of risk ...). This paper aims at evaluating the compaction model COMPSOIL for predicting soil compaction when decreasing the information available on sites. We performed wheeling experiments on different soils (a clay soil, a loamy soil and a calcareous soil) and we measured their mechanical properties at different soil water content and at different initial bulk density. The COMPSOIL prediction accuracy was quantified with (i) a comparison between simulations performed with direct measurement on soils or using pedotransfer function for the mechanical properties (Saffih-Hdadi et al., 2009) (ii) a sensitivity analysis to the stratification of soil properties (iii) a comparison to in situ compaction experiments. The model predicted an increase in bulk density at wheeling in agreement with observations for both clay and calcareous soils (error less than 20%) whereas it underestimated the bulk density in the loamy soil (error higher than 60 %), this difference between simulations and observation increased when model parameters were estimated with pedotransfer functions.

Saffih-Hdadi K., Défossez P., Richard G., Cui Y.J., Tang, A-M., Chaplain V. 2009. A method to predict the soil susceptibility to compaction of surface layers as function of water content and bulk density, Soil and Tillage Research 105. 96-103.