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SOIL-TOOL INTERACTIONS : FIELD STUDIES USING SOIL PROFILE DESCRIPTIONS

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Sois-tool interactions studies deal with various disciplines. From the agronomist's point of view presented here, the aims are : (i) to define soil physical conditions which don't affect plant growth, in relation with climate, (ii) how to obtain these conditions using tillage machines.

These aims lead to choose specific methods to characterize, at field, soil physical conditions in tilled horizons. Soil tilth is defined with 2 criteria : (i) the porosity of clods : « △ » is compact, containing only textural pores ; « ⌐ » contains structural pores, and « ∅ » derives from « △ » but contains cracks ; the relationships between these typic status are presented in Fig. 1 ; (ii) the way clods are brought together : 4 types can be defined (« M » when massive, « SD » when clods are closely packed together, « SF » when they are adherent but can be described, « F » when they are individualized (diameter of clods is noted in F and SF). The combination of the values of these 2 criteria defines a « morphologic unit ». Several units are described in a given anthropic horizon ; a soil tilth map can then be made (this map is a usefull guide for physical measurements in heterogeneous horizons and for soil-roots interactions studies). It can be synthetized : (i) evaluation of the relative frequencies of the internal statues in the horizon, (ii) the horizon is called « O » when F and SF are dominant, « C » when M and SD, and « B » when M and F (with decimetrical clods separated by large voids) units constitue the major part of the horizon. An example in this paper shows how this approach leads to an understanding of soil structure formation, as a result of climatic agents and agricultural practices interactions.

The 2nd part of this paper shows the use of profile descriptions in obtaining soil tillage references for specified pedoclimatic conditions : the way of establishment of a corresponding table between tillage operations and soil tilth is shown, using a qualitative regression method (fig. 2) : in a loamy soil with continuous corn, the effect of compactions prior ploughing is particularly noticed. Qualitative predictive models of soil structure changes for given implements can also be made, using soil consistancy and tilth as initial variables.

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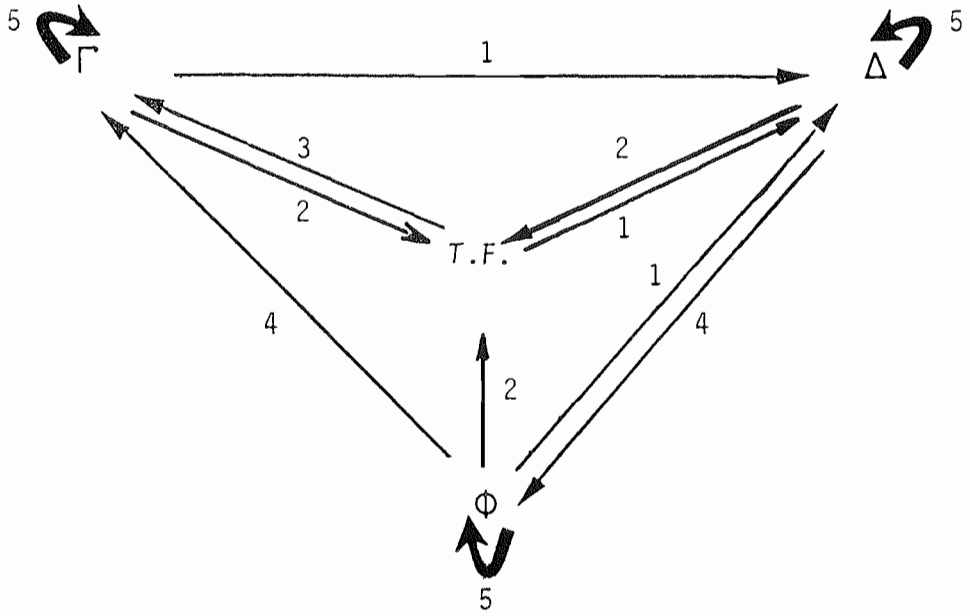

Figure 1 : Relationships between typic status of clods

1. Compaction (mainly anthropic)
2. Tool actions (fragmentation)
3. Aggregation (climate-texture)
4. Swelling and shrinkage
5. Minor changes

T.F. : Very fine aggregates (as a result of tools actions)

Post-ploughing Operations	PRIOR PLOUGHING									
	NO COMPACTION					COMPACTION				
	a	b	c	d	e	a	b	c	d	e
S	B △/Γ					B △/Γ				
MH			C △/Γ				B △			
H		C △							C △	

Figure 2 : Corresponding Table between groups of tillage operations and soil tilth after sowing of Corn (Continuous Corn in Loamy Soil - Béarn, France) - Results of Qualitative Regression Method « Requin » (40 fields).

a, b, c, d, e : Energy applicated to soil after ploughing (function of number tractor passes and weight of implements), increasing from « a » to « e ».

S, MH, H : Humidity of the ploughed-layer (increasing from « S » -dry- to « H » -above Field Capacity).

B △/Γ and C △/Γ : Tilth Types where « △ » is predominating ; B △ and C △ : « △ » only exists. Soil Tilth Type « O » has never been observed in these fields (it was noted in meadow-Corn rotations).