ERODIBILITY AND CHEMICAL ANALYSES

The erodibility of the soil is governed by various soil properties including texture, soil structure, aggregate stability, clay mineralogy and organic matter.

Texture

Texture for the four main soil types as determined by laboratory methods are similar using either the USDA or the CSIRO classifications. The genera trend is from loam/silt loam surface soils grading into silty clay loam/clay loam horizons (A_3/B_1). Sub soils are generally silty clay or clay (undifferentiated).

The high proportion of silt is often an indicator of erodibility, however other factors as mentioned above also influence erodibility.

Cation exchange capacity (CEC)

This refers to the measure of the negativity charged sites on the surfaces of clay-humus particles[2]. Values for each soil type are given (table 13). The table indicates the higher values for the 'wet' soil types compared with the 'dry' and 'gley' soil types. There is also a decreasing trend down profile in all soils.

CEC values over 10 (milli-equivalent %) are reasonably high and for high clay-content soils are indicative of clay mineral types. For example, CEC of 10-40 indicates the dominance of illite and possible some kaolinite particularly at lower values. Montmorillonite, the most expansive clay mineral has an approximate ECE range of 50-80. The proportion of these minerals also indicates the shrink swell potential of the soil.

Table 13: Cation Exchange Capacity for each soil type (m.e. %)

Soil type:		W	(W)T	(D)T	D	O	G
Horizon	A	47.1	38.9▲	59.0▲	26.2	26.7*	16.5*
	A/B	43.3		38.6▲	29.0		
	B	40.6	30.4	27.4	23.5	24.2*	15.8*

Table 14: organic matter (Organic Carbon (W&B x 2.24) %.

Soil type:		W	(W)T	(D)T	D	O	G
Horizon	A	13.81	6.98▲	18.58	5.27▲	5.14*	1.328
	A/B	5.67		6.88	3.43▲		
	B	3.87	3.82▲	3.24	2.57	4.22*	2.24*

* 1 sample ▲ 2 samples

Organic matter also influences CED, with values usually over 100 (m.e. %) and this accounts for the higher CEC values for A horizons.

Although CEC's are high, the base saturation is low (total bases = Ca^{++} + Mg^{++} + K^{+} + Na^{+}) which indicates a high proportion of hydrogen and aluminium ions available in the soil, which render the soils are strongly acidic. This is also indicated by the low pH values. The low base saturation is an indication of the advanced leaching of these soils.

However there is an increase in base saturation for a number of sites near drainage lines ('accumulation zones'), magnesium being the dominant base with calcium also significant.

Organic matter

[2] Tropical soils and soil survey; A. Young, 1980. Cambridge University Press.

Organic matter is important in stabilising the mineral component of the soil and has numerous effects as already mentioned. It contributes to water holding capacity and permeability of the soil by bonding with the mineral component and therefore increasing the openness lowering the bulk density.

Organic matter content was calculated from laboratory analysis for organic carbon. The distribution of organic matter varies for each soil type (See table 14) and A horizons have the highest organic matter contents, particularly for the 'wet' and organic soil types. High levels of organic matter can also be found for the 'dry' transitional soil type although generally lower than for 'wet' soils. There is a noticeable decrease in organic content for all horizons of the 'dry' soil type. Only the B horizon of the gley soil sampled has a lower value, due to the higher mineral content of its transported clay particles.

Erodibility indices

Two indices for erodibility are given, the Emerson test which measures soil aggregate stability and the K (erodibility) factor used in the Universal Soil Loss Equation (USLE).

The Emerson tests were carried out by a laboratory staff and indicate the degree of moisture and work required to induce dispersion of the sample. There are 8 classes from rapid dispersion to nil. For all samples taken, the Emerson class was 5, which indicates dispersion on saturated working using a 1:5 suspension of soil in water. However divisions within the class have been made by the SCA laboratory staff; from 5A to 5E. The former is the most dispersive, the latter is relatively stable with saturated working.

Results indicate that 'dry' soils and the gully soils are more dispersive than the 'wet' soils, nearly all being in class 5A. However all soils are within class 5 and therefore relatively stable (See appendix 4).

The Erodibility factor; K (USLE) is derived form an equation by a monograph, which takes into account the silt and fine sand proportion of the soil, organic matter, permeability and structure 9see table 15).

The table indicates that the 'wet' soils have a lower potential erodibility for the A horizon, but have slightly higher values at depth compared with the 'dry' soils.

The 'dry' soil upper a horizon and the B horizon of the gley soil have a high erodibility factors. These erodibility values are 'moderate' but are the result of the derived data. For example large values of organic matter (which is a stabilising factor in the equation) were discounted due tot he limit of 4% organic matter in the equation 9see table 15). The data could be used in future estimation of total soil loss, using suitable rainfall and storm intensity data for the area to estimate erosivity. Constant values for the equations more relevant to conditions in south-eastern Australia could be estimated from such data. The equation used is derived from United States data.

Table 15: Erodibility factor K (USKE).

Soil type:		W	(W)T	(D)T	D	O	G
Horizon	A	0.44	0.537▲	0.412*	0.621▲	0.379*	0.418*
	A/B	0.405		0.416	0.276		
	B	0.34	0.320	0.323	0.313	0.369*	0.548*

[1] Derived from the equation $100K^3 = 2.1M^{1.14}(10^{-4})(12-a)+3.25(b-2)+2.5(c-3)$

Where M = a combined silt and sand factor
a = organic matter %; 45 maximum allowable
b = soil structure
c = profile permeability factor 9band C – 4 for calculation)

[2] 2.24 was the multiplication factor converting organic carbon (W&B) to organic matter

[3] K was multiplied by 1.292 to change K from an imperial base to a metric base (tonnes/hectare).

Table 16: electrical Conductivity (µS/cm)

Soil type:		W	(W)T	(D)T	D	O	G
Horizon	A	77.6	38.0▲	77.0	39.0▲	55.0*	21.0*
	A/B	46.0		56.8	38.7		
	B	34.0	36.5	51.3	33.0	35.0*	26.08

* 1 sample ▲2 samples

pH

All the soils are acidic, most having pH values being below 5.0. This was also indicated by the high proportion of hydrogen ions making up the cation exchange capacity.

Electrical conductivity

Electrical conductivity of the soil is a measure of the soluble salt content of the soil. Values greater than 16 mS/cm (milli Siemens/centimetre) are usually limiting for most agricultural crops depending on the type of salt. However values over 100 ms/cm are found in salt-affected agricultural areas.

Overall levels are very low, however the higher values for the 'wet' and 'dry' transitional soils can be explained by organic acids derived from the high proportion of organic matter. Sub soil levels are much lower and relatively constant for all soil types, the exception being the gley soil with much lower values and also a low organic content. (see table 16).

Chloride

There were low levels of chloride ions for all soil types ranging from less than 0.001% to 0.007%. this also indicates low sodium levels (and therefore sodium salts) and is normally compared with electrical conductivity to assess salt levels. The distribution of this parameter does not seem to correlate with the soil types distribution and levels are insignificant.

Linear shrinkage

This parameter was determined for two profiles; one a 'wet' soil, the other a 'dry' transitional soil. Linear shrinkage increased with depth but was greater for the 'wet' soil, the B horizon having a linear shrinkage of 16% compared with 10% for the 'dry' transitional soil.

Chemical analysis

The availability of free iron oxides was also determined. The ferrous oxide content of selective sample sites was analysed by the laboratory and indicated higher values for 'wet' soils than those for 'dry' soils, with a gradation in between. Iron is an essential micro-nutrient and its mobility in soil is closely related to soil aeration, soil acidity and greatly influences soil colouring.

Examples

Soil Type	Fe_2O_3%
'Wet'	4.8
'Wet' Transitional	3.0
'Dry' Transitional	2.6
'Dry'	1.9