## Harmonized World Soil Database

**pH**, measured in a soil-water solution, is a measure for the acidity and alkalinity of the soil.
Five major pH classes are considered here that have specific agronomic significance:

| | |
|---|---|
| pH < 4.5 | Extremely acid soils include Acid Sulfate Soils (Mangrove soils, cat clays). Do not drain because by oxidation sulfuric acid will be produced and pH will drop lower still. |
| pH 4.5 – 5.5 | Very acid soils suffering often from Al toxicity. Some crops are tolerant for these conditions (Tea, Pineapple). |
| pH 5.5 –7.2 | Acid to neutral soils: these are the best pH conditions for nutrient availability and suitable for most crops. |
| pH 7.2 – 8.5 | These pH values are indicative of carbonate rich soils. Depending on the form and concentration of calcium carbonate they may result in well structured soils which may however have depth limitations when the calcium carbonate hardens in an impermeable layer and chemically forms less available carbonates affecting nutrient availability (Phosphorus, Iron). |
| pH > 8.5 | Indicates alkaline soils often highly sodic (Na reaching toxic levels), badly structured (columnar structure) and easily dispersed surface clays. |

**CEC Clay**, cation exchange capacity of the clay fraction in top- and subsoil.

The type of clay mineral dominantly present in the soil is often characterizes a specific set of pedogenetic factors in which the soil has developed. Tropical, leaching climates produce the clay mineral kaolinite, while confined conditions rich in Ca and Mg in climates with a pronounced dry season encourage the formation of the clay mineral smectite (montmorillonite).

Clay minerals have typical exchange capacities, with kaolinites generally having the lowest at less than 16 cmol $kg^{-1}$, while smectites have one of the highest with a CEC per 100g clay being 80 cmol $kg^{-1}$, or more. The classes generally used are.

| | |
|---|---|
| 1 | <20 cmol $kg_{-1}$ clay (kaolinite dominant) |
| 2 | 20-50 cmol $kg_{-1}$ clay (mixed with kaolinite present) |
| 3 | >50-100 cmol $kg_{-1}$ clay (mixed, illite) |
| 4 | >100 cmol $kg_{-1}$ clay (montmorillonite)* |

* Soils developed on volcanic materials rich in amorphous sesquioxides may have very higher values (over 150 cmol $kg^{-1}$)

**CEC Soil**, cation exchange capacity in top- and subsoil.

The total nutrient fixing capacity of a soil is well expressed by its Cation Exchange Capacity. Soils with low CEC have little resilience and can not build up stores of nutrients. Many sandy soils have CEC less than 4 cmol $kg^{-1}$. The clay content, the clay type and the organic matter content all determine the total nutrient storage capacity. Values in excess of 10 cmol $kg^{-1}$ are considered satisfactory for most crops. This is reflected by the following classes:

| Code | Cation Exchange Capacity |
|---|---|
| 1 | < 4 cmol $kg_{-1}$ |
| 2 | 4-10 cmol kg-1 |
| 3 | >10-20 cmol $kg_{-1}$ |
| 4 | >20-40 cmol kg-1 |
| 5 | >40 cmol $kg_{-1}$ |

**BS**, base saturation in top- and subsoil.

The base saturation measures the sum of exchangeable cations (nutrients) Na, Ca, Mg and K as a percentage of the overall exchange capacity of the soil (including the same cations plus H and Al). The value often shows a near linear correlation with pH. Critical values as follows:

| Base Saturation | Soil conditions |
|---|---|
| < 20 % | desaturated soils, similar interpretation as extremely acid pH |
| 20 – 50 % | corresponds with acid conditions. |
| 50 – 80 % | neutral to slightly alkaline which are ideal conditions for most crops |
| > 80 % | indicates saturated conditions often calcareous, sometimes sodic or saline |

**TEB**, total exchangeable bases in the top- and subsoil.
Total exchangeable bases stand for the sum of exchangeable cations in a soil: sodium (Na), calcium (Ca), magnesium (Mg) and Potassium (K).