Answer on Question #80858 – Chemistry – General Chemistry

4. A soil analysis shows a CEC of 25.9 meq/100g of soil and 2900 ppm of Ca^{2+}, 200 ppm of Mg^{2+}, 200 ppm of K^{+} and 64 ppm Na^{+}; also a pH 6.5. Bulk density 1.1 g/cm³, depth of 20 cm. Which element must be reinforced and which may need to be restricted to maintain a good balance of bases?

a) Mention which cations should be increased and which elements should be reduced in order to get a good balance of cations on the CEC

b) Which Calcium source between Gypsum ($CaSO_4 \cdot 2H_2O$) or Lime ($CaCO_3$) should be used to increase the percentage of Ca^{2+}?

c) Calculate the amount of Calcium source from Question (b) that will be required to get 75% of Ca^{2+} on the CEC? Final Answer in Kg/ha

d) Calculate the necessary amount of the K_2O that will be required to achieve 2% K^{+}? Final Answer in Kg/ha

Solution:

4.

a) Optimum base saturation percentages recommended are:

Na	K	Mg	Ca
<10%	2-7%	15-20%	65-75%

Calcium 2900/200 = 14.5
Magnesium 200/120 = 1.67
Potassium 200/390 = 0.51
Sodium 64/230 = 0.28
Hydrogen 0

w(Ca) = 14.5 / 25.9 × 100% = 55%
w(Mg) = 1.67 / 25.9 × 100% = 6%
w(K) = 0.51 / 25.9 × 100% = 2%
w(Na) = 0.28 / 25.9 × 100% = 1 %

Limestone needs to be applied at a rate to neutralize all of the acidity on the soil exchange sites. It takes, 1000 lbs of limestone for each meq/100g of soil acidity.

$$\text{Limestone (tons/acre)} = 0.5 \times (\text{CEC} \times \text{H\%})$$

Soils containing more than 15% exchangeable sodium are prone to poor drainage and salt buildup. Application of a soluble source of calcium, such as gypsum, is recommended to replace the sodium off of the exchange sites and be leached out of the root zone. Gypsum recommendations are 3,440 lbs. per meq/100g of sodium wanting to be replaced per foot of soil.

$$\text{Gypsum (tons/acre foot)} = 1.7 \times \text{CEC} \times (\text{Na\%} - 5\%)$$

1 % = 1000 $mg \cdot kg^{-1}$ = 10 $g \cdot kg^{-1}$ = 0.001 $kg \cdot kg^{-1}$
1 ha = 10000 m^2 = 10^8 cm^2
1 ha = 10^8 cm^2 × 20 cm = 20 × 10^8 cm^3
1 ha = 20 × 10^8 cm^3 × 1.1 $g \cdot cm^{-3}$ / 1000 = 2.2 × 10^6 kg
0.001 × 2.2 × 10^6 = 2.2 × 10^6 kg/ha