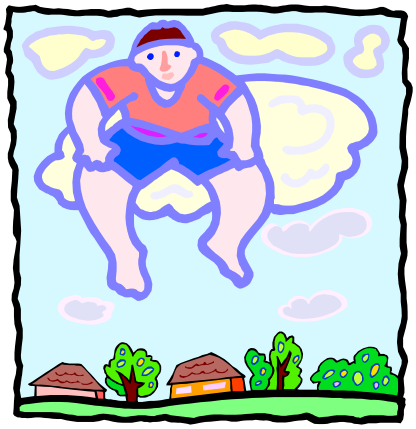
SOIL FUNCTION DATASHEET #5

If there is too much Hydrogen, will my Soil Float Away?



Hydrogen is one of the Major Essential Nutrients for both plants and animals, but of course plants don't take it up from the soil. As a result, many people wonder why we spend so much time talking about Hydrogen in Soil. In fact a soil chemist who should have known better once told us there could not be any Hydrogen in soil – or it would all float away!

In this Fact Sheet, we look at Exchangeable Hydrogen in the soil and why it is so important.

Hydrogen is an important part of the soil system. It occurs in the soil water where we measure it as pH, but it is also a component of the mineral particles and organic matter.

Many people make the mistake of judging everything on a soil test report in terms of Plant Nutrition. Of course Hydrogen is an essential plant nutrient, but they obtain it from water – not the soil. So why bother testing for it?

The reason we test exchangeable Hydrogen in soil is to make sure that we can get the Cation Balance Proportions right. This example may help illustrate the situation. See what happens to the percentages when we just leave Hydrogen out:

	Ca	Mg	Na	K	H	Total
me/100g	*14.5*	*5.5*	*0.3*	*0.9*	*8.0*	*29.2*
	49.7%	18.8%	1.0%	3.1%	27.4%	100%
me/100g	*14.5*	*5.5*	*0.3*	*0.9*	-	*21.2*
	68.4%	25.9%	1.4%	4.3%	-	100%

Clearly, we cannot get the balance right without knowing the Hydrogen percentage.

Where is all this Hydrogen?

One of the things making this planet ideal for life is the presence of water – which is really tricky stuff. It is one of the few things that can dissolve in itself! That is, even in pure water some of the molecules separate into ions the same way salt does. The more H^+ in the water, the more acid its pH will be, but there are other forms of Hydrogen in the soil.

$NaCl \leftrightarrow Na^+ + Cl^-$ (in water)

Similarly:

$H_2O \leftrightarrow H^+ + OH^-$

Hydrogen is also found in soil colloids (clay and humus), but each of these operates differently. The problem is that if you analyse soil for exchangeable Hydrogen and then just add up the five cations (Ca, Mg, Na, K & H) to give the Cation Exchange Capacity, you can end up with some really strange results. This is because Humus is a far more complex kind of stuff than clay.

Let's look at an example with samples of two very different soils taken from the SWEP database – a Loamy Fine Sand (lyfS) and a Heavy Clay (HC):

	pH	OM%	Exch. H	CEC
lyfS	5.2	16.2	13.8	25.6
HC	6.6	4.4	8.3	25.4

Clearly, the reason these two soils can have about the same CEC is that the sand is so high in Organic Matter (OM%). This may seem fine, but consider the task of balancing the soil. These two should require about the same amount of Lime, but any farmer can tell that this would be a rather silly suggestion.

The problem was solved when research carried out by Ted Mikhail showed that some of the exchangeable Hydrogen in Organic Matter was required as an intrinsic part of its make up – this part of the exchangeable Hydrogen does not take part in the soil balance! So to make the one set of balance proportions work for soils from anywhere in the World, we need to adjust the amount of exchangeable Hydrogen to suit the over-all situation in the soil. For the soils in our example, the results then are as follows:

	pH	OM%	Adj. H	Adj. CEC
lyfS	5.2	16.2	5.7	17.5
HC	6.6	4.4	6.1	23.2

Other laboratories deal with this problem in different ways. One is to estimate the Hydrogen using pH as a guide, but this is unreliable since there is no direct relationship between the two forms of H^+.

Another is to ignore Hydrogen altogether, on the assumption that is only a small part of the equation. Of course, this is simply incorrect and produces a distorted result.

Because soils are so variable and the amount of organic matter is so important to soil function, the amount of Hydrogen must be both measured and correctly adjusted.

At present, only SWEP has the research, experience and technical capability to both.

For more information on the material covered in this Fact Sheet, contact SWEP on (03) 9701 6007 or talk with your local SWEP Agent.