Geology and Soil Types of the HAA Allotments

Given the recent general improvement in vegetable production on many of our plots – as shown by many of the prize-winning exhibits at the Village Show (!) – we thought a short guide to the different soils on our land might be useful for beginners, and anyone else who is struggling: and why some plots seem to grow good veggies effortlessly and some are *apparently* less productive.

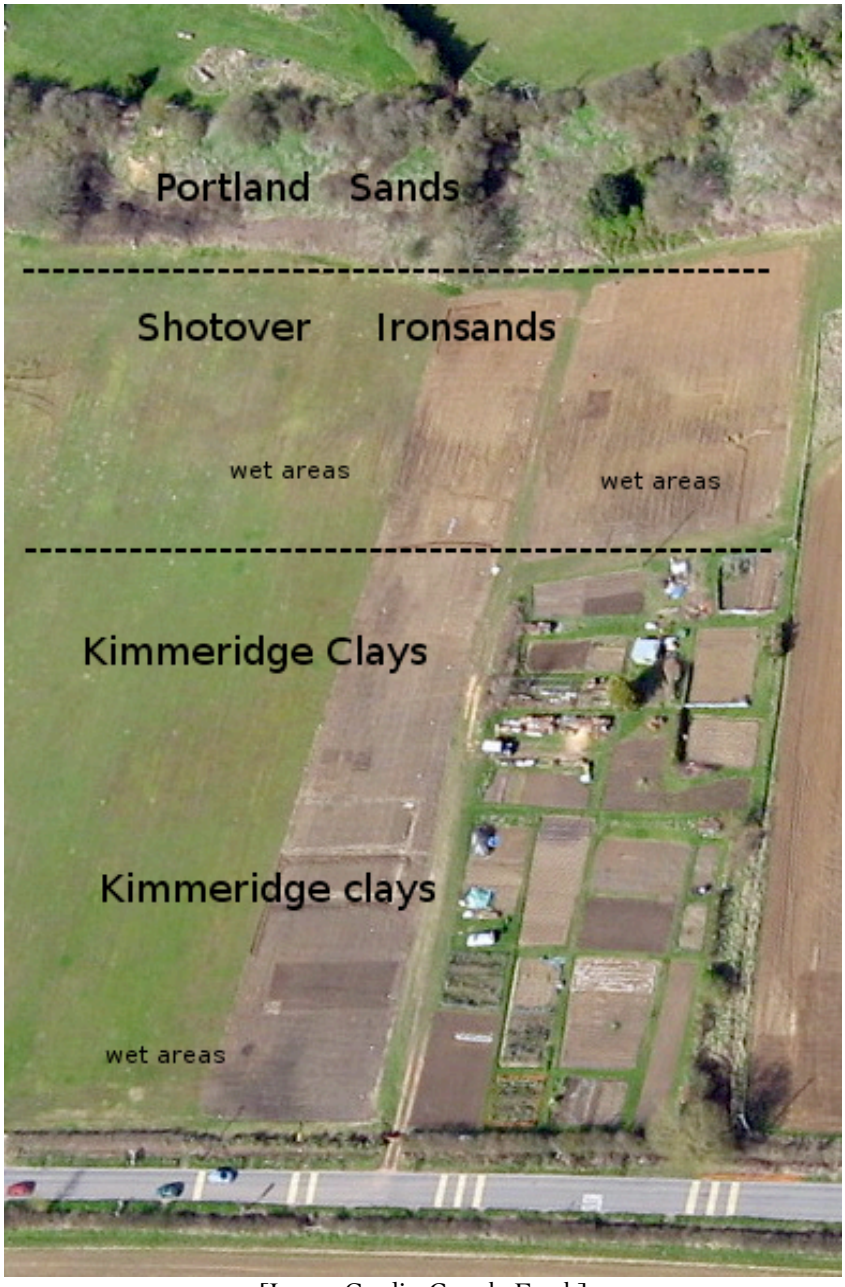
So here we've included an explanation as to why the underlying geology greatly affects your soil and what you grow and, more importantly, how to change the chemistry of that soil to improve your crops.

It's really not rocket science – just simple common sense - once the basics of soil science is understood.

Please contact Chris or Fiona for more advice: we are here to help you!

Chris Pym; on behalf of Fiona and the HAA Management Committee

Underlying Geology



[Image Credit: Google Earth]

Running from the top to bottom (from the steep bank at the top down to the road) our plots consists originally of three main strata.

At the very top were the **Shotover Ironsands** – slightly acidic (low pH) thin soil. Needs frequent application of manure and fertiliser to produce any vegetable crops.

Immediately below that were the **Portland Sands** – pH neutral and very fertile.

Beneath this mixed stratum and lower down, a deep layer of **Kimmeridge clay** runs right down to the gate.

The Kimmeridge clay is slightly more straightforward with regard to soil quality. Although the pH is generally low overall, the clay itself, if alternately limed and dunged, is very fertile. Kimmeridgian clay is calcareous (chalky) clay containing Kimmeridgian limestone. (This is the principal soil type of the Loire Valley, Champagne and Burgundy regions. So our neighbour's vineyard is well-sited!)

Note: Over the millennia the two top strata have become thoroughly mixed up by erosion of the heavier Iron-sands down onto the lower Portland Sands. Thus most of the top plots have soils consisting of good Portland Sands with great chunks of Ironstone therein, as you will have noticed!

So the diagram above represents the current working reality.
However, to add confusion, many folded clay ridges and gullies are hidden beneath this overlay of eroded sands. Therefore the drainage on the plots across this area is varied. In places there are very wet spots where the rainwater run-off comes to the surface of the clay as springs. Far worse in winter, but often a problem in summer too. In these wet areas lateral drainage channels *at the top of the affected plots* are absolutely essential to prevent marshy bogs developing: ones that will drown any crops. If you only drain at the *bottom* of the plot the rainwater will already have produced a wonderful bog.
Others are sandy, well-drained and relatively dry in comparison.

For a more detailed view of our geology see:-

<http://www.shotover-wildlife.org.uk/leaflets_files/lf-geol.pdf>

Soil pH

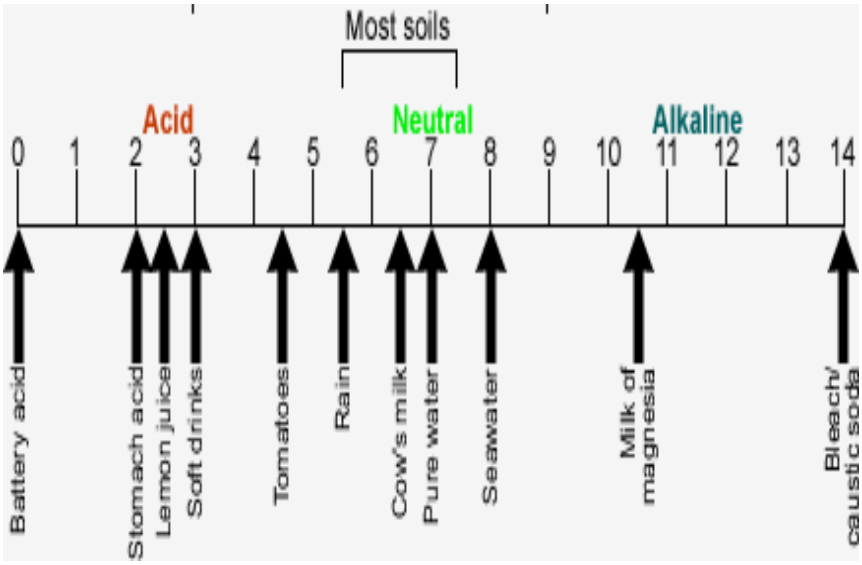
One factor that is *absolutely crucial* to understand in growing good vegetables (ask any farmer) is to try to understand the "fertility" of our soil. Our ancestors referred to soil as being either "sweet" or "sour", which just about sums it up. Although we now call it either acid or alkaline, the pH scale is now used to get a more scientific measure – which is a measure of the **p**ercentage concentration of **H**ydrogen ions in the soil. (*panic not; all will be revealed..*).

In acidic soil conditions hydrogen ions form strong molecular bonds with whatever plant foods (**nutrients** - see below) are present. At low pH values (sour) the nutrients may well be present, but are unavailable as the plant roots are unable to break those strong ionic bonds and are unable to absorb the nutrients they need.

Fortunately for us, these molecular bonds can be broken by the use of garden lime. Lime

contains alkaline or 'base' ions, such as calcium, magnesium and potassium. Adding them to the soil raises the pH. The higher the concentration of these base ions, the more alkaline (sweet) the soil becomes, and the more nutrients will be available to those plants which need it. But some plants, noticeably potatoes, prefer slightly sour soil so you need to know the preference of the plants before doing anything. Pretty simple stuff really, once you've got the hang of it!

Soil pH is measured chemically on an overall scale of 1 (extremely acidic) to 14 (extremely alkaline), with 7 as neutral: neither acidic or alkaline :-
The scale below illustrates a range of common products and their pH for comparison. Note that the pH scale is logarithmic, so each single digit above or below that is twice as alkaline or acidic, thus even a small increase or decrease in pH values can have a substantial effect on your plants' ability to get the food it needs from your soil.



For the purposes of vegetable gardening, we are only concerned with soil pH values from about 5 to 8. Outside that narrow range no vegetables will grow, but many weeds and wild flowers will! These are called soil indicators, i.e., indicating to the enlightened what sort of soil they are growing in.

Take a look at <http://www.organicgardening.com/learn-and-grow/listen-to-your-weeds>, especially the note on Mare's Tails which bedevils us on these allotments. (For the recyclers among us, Mares Tails were sold as pot-scourers in Mediaeval times due to silica particles on their fronds, and they still work rather well!)

More scientifically, cheap soil pH testing kits are available in most garden centres and are a good investment. See for example :
<http://www.amazon.co.uk/Two-Wests-Elliott-257-Testing/dp/B0017866I4>

For example, **potatoes** grow best with a pH of around 5.5 to 6, so best practice is to dig in manure *the previous Autumn* to let it rot down while the soil is still warm, thus increasing the humus and its nutrients. See below re humus:-

<http://faq.gardenweb.com/faq/lists/organic/2002121127011493.html>

However, dung lowers the pH because of the acidic animal urine present in it. If you leave manuring till the last minute before planting, not only will the slugs have a field day with your crop due to the high moisture content, but any woody straw material in the manure will actually take nitrogen from your soil to fuel the microbes that decompose woody stuff.

Most **brassicas** (cabbages, sprouts, swedes, *etc.*) need a minimum of pH 7, but cauliflowers needs a pH of around 8 to get the sort of glorious heads you see on seed packets!

The usual process for a **brassica** patch is to add dung *at least* two months before planting and dig or rotavate it in thoroughly to enrich the soil with a whole range of **nutrients** (see below). Then a month before planting add lime at a rate of about one pound per square yard, *but don't dig or rotavate it in* - let the rain or soil moisture absorb it slowly.

Caveat: *If you add the lime while the dung is still visible, the two neutralise each other & the benefits are completely lost.*

Your brassica patch is probably *the* most important area on our often sour lower allotment soils where you need to know the pH well before planting: unless you actually want Bonsai cabbages and sprouts… Some of us – myself included - have grown absolutely *perfect* cabbages: nine inches tall…
To recap then*:*
Adding manure to the soil it makes it more acidic but will improve the humus.

Adding lime to the soil makes it more alkaline and allows crops to access whatever nutrients are present.

NB: Soils tend to become more acidic over time due to rainfall, which is slightly acidic. A further problem is heavy rainfall dissolving & leaching out nutrients - something we have had around here to excess over the past few years, as you may have noticed.

Many gardeners take the view that our plots are akin to our bank accounts: over the long haul you can only take out what you've put in. Crops take up nutrients, are then harvested and, unless you take action, the nutrients aren't returned to the soil: fertility decreases and the pH declines. Thus you can end up with a lifeless, barren plot; become disappointed, and then give up – as quite a few once keen gardeners have done over the years, sadly.

Do also bear in mind that some of the new HAA plots are on old farm-land that has been on

"set aside" for many years and has remained fallow. Hence the pH & nutrient levels may already be low and in need of some TLC.

There are hundreds of websites giving more details in this area and well worth browsing. Typically:- <http://www.gardenersnet.com/atoz/phlevel1.htm>

Nutrients

The main plant foods: Nitrogen, Phosphorus and Potassium and their effects.

Although knowing the pH value of your soil before planting is vital, there are also three basic nutrients, or plant foods, that must be available for your plants if you are to get a worthwhile crop. Remember, *even if they are present, at low pH levels they will be locked in and unavailable to your plant's roots.*
These three crucial plant nutrients are known in gardening and farming shorthand as N.K.P.

Their functions are:-
Nitrogen (N): promotes leaf and stem development.
Potassium (K): plays a major part in root growth as well as in stem development.
Phosphorus (P): also plays a role in the growth of roots and fruiting.

If you use a “balanced” inorganic fertilizer such as "Growmore", see for example :-
<http://www.webbsdirect.co.uk/westlands-growmore-garden-fertilizer-prodgrowmore/>
you'll encounter the NPK formula when reading the contents printed on the bag. It won't always say "NPK" and may simply be implied, but you will at least see a series of three numbers, which correspond respectively to the nitrogen, phosphorus and potassium content of that fertilizer.

Why is it important to know what NPK means?

It's important because not all plants have the same nutrient requirements. You can sometimes do more harm than good when applying chemical fertilizers haphazardly. For example, applying a non-balanced fertilizer high in nitrogen (indicated by the fact that the first number on the package is high, which is what farmers need for cereal crops) this will cause plants to put all their energy into producing stems and foliage, at the expense of the root-crop you do want. More on this at :-
<http://www.learn2grow.com/gardeningguides/fertilizer/basics/understandingfertilizernumbers.aspx>

More sophisticated soil-test kits for nutrient **and** pH levels are also available from garden centres or on-line. See for example:-

<http://www.harrodhorticultural.com/soil-testing-kit-pid7676.html>

If you don't know much about the nutritional needs of your plants (or are too busy, or can't be bothered!) but still feel the need to feed your soil, your best bet is to:

- Use compost instead of a chemical fertilizer
- Stick to a simple three-year crop rotation (see below)
- Use a chemical fertilizer labelled as being specifically for that particular type of crop

Trace Elements

Other essentials for healthy plants, albeit it at very low concentrations (measured in parts per million, hence "trace"), are:-

Copper, Zinc, Iron, Manganese, Boron, Selenium, Cobalt, Molybdenum, Chromium, Vanadium & Yttrium.

As far as I know these are present in our local soils - with the possible exception of Selenium.
However, most manures and composts will contain small amounts of all of these so the majority of gardeners don't bother too much about these trace elements, except when a failing crop's leaves show signs of yellowing or other disturbances, like a lack of nitrogen or magnesium. Often caused by growing the same plant in the same place too often.

In which case consult:-

<http://gardening.about.com/od/gardenproblems/a/NutrientDeficie.htm>

Crop Rotation

John Harrison's monthly newsletter, <john@allotment-garden.org> which Fiona often circulates, is a treasure trove of information.

Here is his excellent overview of this topic:-

If you grow the same crop in the same place year after year you will get a build up of pests and diseases specific to that crop. Different crops take different levels of nutrients from the soil and inevitably these become unbalanced, exhausting one nutrient but leaving a lot of another. This is often referred to as a 'sick soil'. Even the addition of fertilizers is unlikely to help since it is likely the trace elements and micro-nutrients are depleted in the same way.

Some gardeners persist in growing their runner beans or onions in the same place each year but it has been proven this is not a good idea - not every old fashioned method is good! Rotating crops will reduce losses to pest and disease. Combine this with bettter use of nutrients and you will find increased yields from the same area of land.

What is Crop Rotation?

The simplest rule of crop rotation is not to grow the same thing in the same place two years running.

In fact, the larger the gap between a crop occupying the same piece of ground the better. Some pests may be present at high levels initially but a gap of three or four years will see their numbers fall to acceptable levels without a host to sustain them.

There are many different systems for rotating crops, some fairly crude and some quite complex, designed to ensure that following crops utilise nutrients left by previous crops. The simplest on a small plot is a three year crop rotation.

Please remember:

Our Management Committee is here to help you make your gardening fun!
Don't hesitate to contact us over any of your problems.