Investigation into soil texture in my area

Aim

The aim of my investigation is to calculate how much sand, silt and clay is present in a sample of soil from my garden and to compare it with a sample taken from a nearby field. I will then compare the results against information on the BGS mySoil app.

Underlying environmental science

Soil is made of mineral matter, organic matter, water, air and soil organisms. These show that soil forms through interaction between the geosphere, biosphere, atmosphere and hydrosphere. One of the soil components that is very important is the mineral matter. This comes from solid rock breaking down through erosion and physical weathering into smaller and smaller pieces. These pieces are named depending on size.

Particle type	Diameter
Gravel	More than 2.0 mm
Sand	0.06 – 2.0 mm
Silt	0.002 – 0.06 mm
Clay	Less than 0.002 mm

The types of mineral matter found in soil affect its texture, and affects the amount of water and air the soil can hold and how they move through the soil through permeability and porosity. This will also affect how the land can be used. If there is too much clay the soil can get waterlogged. It can also dry out and crack easily. Too much sand would mean that water and nutrients would drain through very quickly and the soil will blow away easily, meaning the land won't be very good for agriculture. The best mix for agriculture is a soil which has a mix of around 40%-40%-20% sand-silt-clay. This mix means that the different sized mineral matter particles fit closely together enough to hold onto moisture and nutrients but still allow drainage and movement of water and gases.

The area where I live has a very sandy soil which blows away easily in strong winds. The local bedrock is sedimentary Old Red Sandstone with surface deposits of sands and gravels mostly transported from the Cairngorm Mountains by rivers or by coastal winds.

Method

I dug holes in different areas of grass in my garden and removed samples of soil and then combined them into one big sample, which was mixed thoroughly. I did the same with soil from a ploughed field near my house.

Soil samples were placed in jars and filled with water, then shaken well and left to settle. After 24 hours I measured the total depth of the sediments in each jar and also the depth of each sediment layer.

Experimental data

Sample number	Total depth of sediments (mm)	Sand (mm)	Sand %	Silt (mm)	Silt %	Clay (mm)	Clay %
Garden 1	42	35	83	5	12	2	5
Garden 2	49	38	78	9	18	2	4
Garden 3	40	29	73	10	25	1	3
Mean %			**78**		**18**		**4**
Field 1	57	45	79	9	16	3	5
Field 2	43	39	91	4	9	0	0
Field 3	49	44	90	5	10	0	0
Mean %			**87**		**12**		**2**

I calculated the standard deviation for each sample using the formula

$$s = \sqrt{\frac{\Sigma(x - \bar{x})^2}{n - 1}}$$

- x = observations
- $\bar{x}$ = the mean
- n = the number of observations

For sand, the calculation is:

Sample number	Sand % (x)	$\bar{x}$	$(x - \bar{x})$	$(x - \bar{x})^2$
Garden 1	83	78	5	25
Garden 2	78	78	0	0
Garden 3	73	78	-5	25
n = 3				∑ = 50

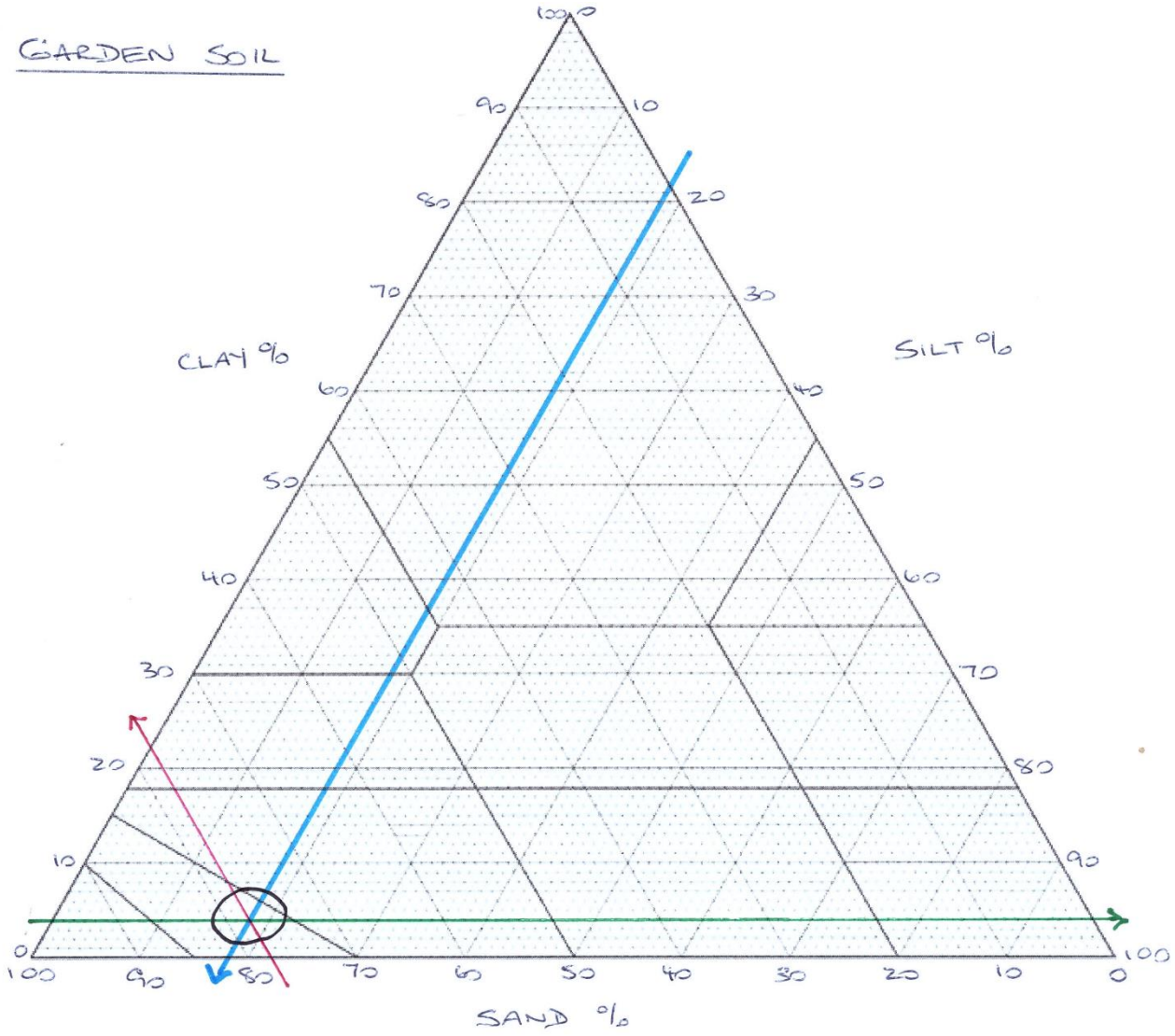
$s = \sqrt{\frac{50}{(3-1)}}$ → $\sqrt{25}$ = 5

Sample number	Sand %	Silt %	Clay %		Sample number	Sand %	Silt %	Clay %
Garden 1	83	12	5		Field 1	79	16	5
Garden 2	78	18	4		Field 2	91	9	0
Garden 3	73	25	3		Field 3	90	10	0
Mean %	**78**	**18**	**4**		**Mean %**	**87**	**12**	**2**
SD	**5**	**6.5**	**1**		**SD**	**6.7**	**3.8**	**2.9**

The mean % for each type of sediment in each sample has been rounded to make it easier to plot them on a triangular graph. The point where the 3 lines cross can be checked against a soil texture classification triangle to find out what kind of soil texture is present in my garden and in the field.

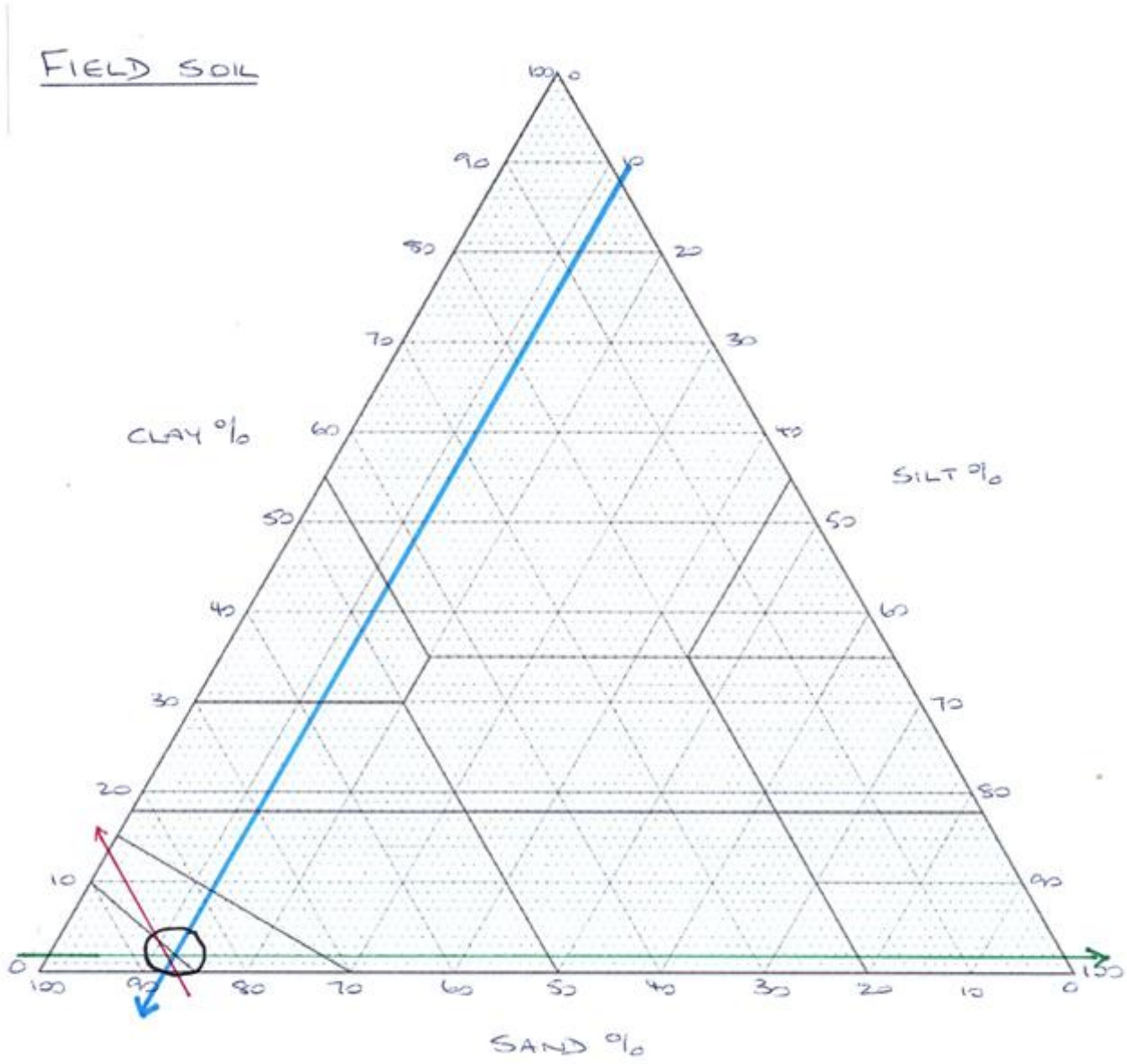
Triangular graph for my garden soil: 78% sand, 18% silt, 4% clay

Red = sand blue = silt green = clay

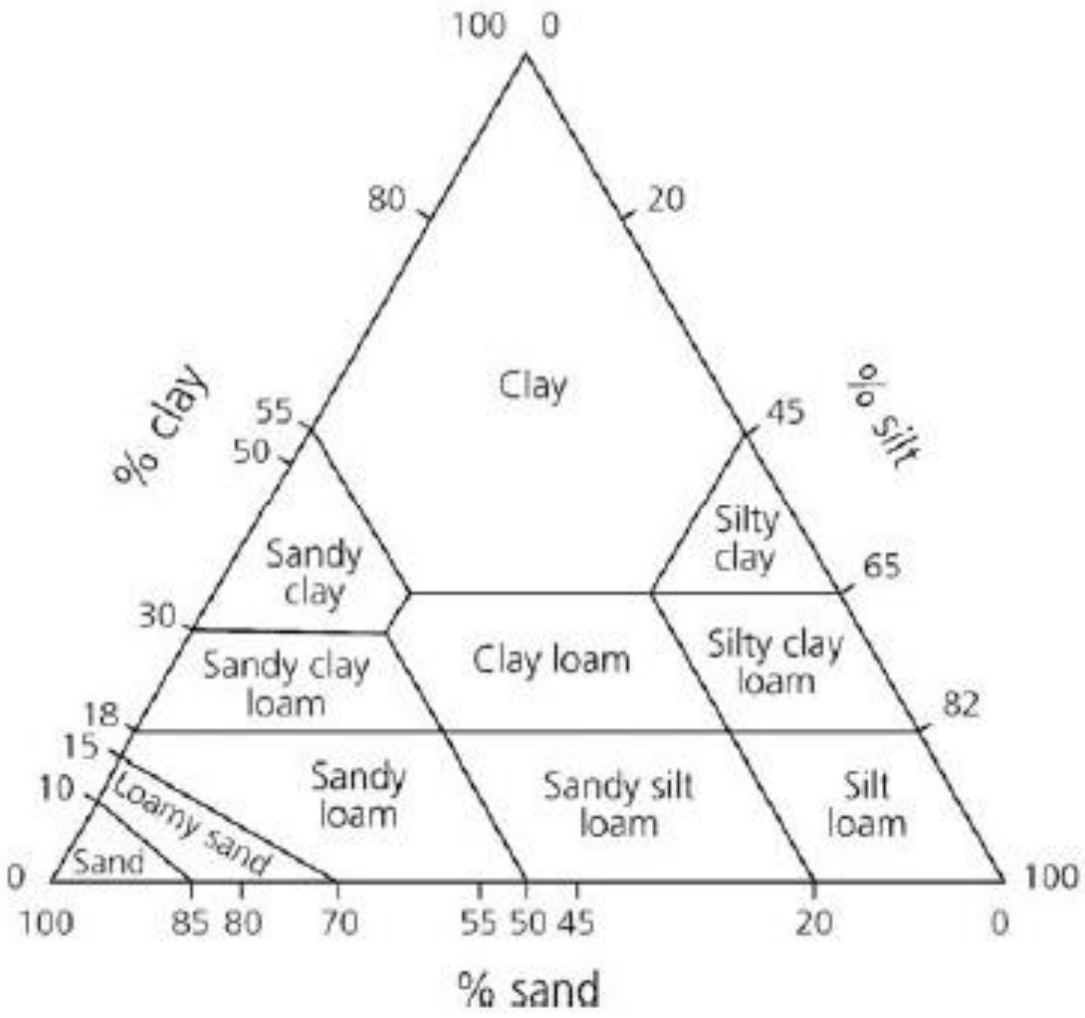


Triangular graph for field soil: 87% sand, 12% silt, 2% clay

Red = sand blue = silt green = clay



Soil texture classification triangle for the UK (1):



BGS data (2)

The information given by the BGS mySoil phone app for my area is:

Analysis

The results from my experiment show that my garden soil is a loamy sand and the field soil lies on the boundary between sand and loamy sand. The BGS mySoil app says the soil in the area is sand to loam. A loam is a soil containing less than 52% sand, 28-50% silt, and 7-27% clay (3). Neither of my soil samples matches with these proportions.

Standard deviation for the garden soil is lower overall than for the field soil, except for silt. This means that the mix of sand and clay present is my field samples is more varied than for the garden samples.

Conclusion

My experimental results show that my garden soil is a loamy sand and the field soil is a sand/loamy sand. The BGS app said that the soil in my area is a sand to loam, so my findings agree with the app to some degree but are closer to sand than to loam.

Evaluation

I collected several samples from across the garden and mixed them well and did the same for the field soil. This should mean I have a good coverage across both sites, but I could have analysed each soil sample individually rather than mixing them, which could have shown up differences across each site.

It was very difficult to measure the clay layer in the jars as the layer was very thin and most clay particles were still suspended in the water even after 24 hours. I only managed to get one clay measurement for the field soil, meaning that the mean and standard deviation results for clay in that soil don't make much sense. More time was needed for the experiment to allow the clay to settle out.

The British Geological Survey mobile app was very useful for details about soil and geology in my area. The information on soils has come from several major research organisations, including the Met Office, European Commission and the Centre for Ecology and Hydrology, so the information they provide should be reliable. However the soil texture information is very broad and there could be significant local differences that could be important for a farmer.

References

(1) Natural England technical information note TIN037 Soil texture (1st edition, 2008)
(2) British Geological Survey mySoil http://www.bgs.ac.uk/mySoil/ (Feb 2018)
(3) The Spruce https://www.thespruce.com/what-is-loam-1401908 (Feb 2018)