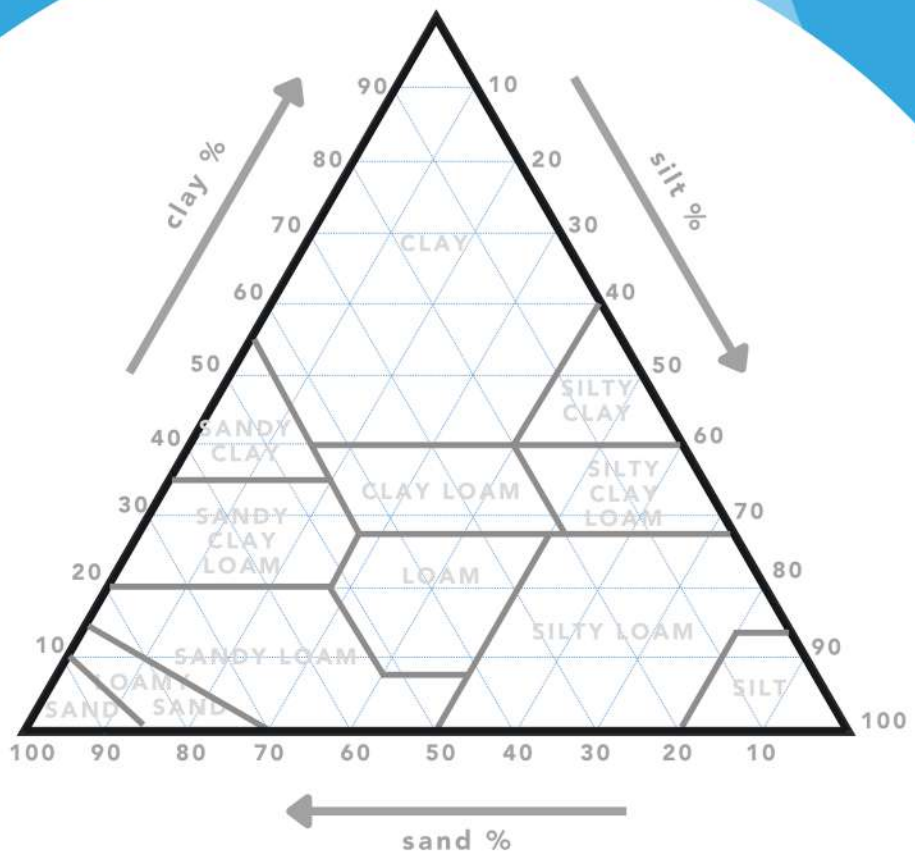
SENSOTERRA

Wireless soil moisture sensors

SOIL CALIBRATION GUIDE



Terms

Volumetric Water Content (VWC): The ratio of the volume of water to the unit volume of soil.

Matric Potential: Soil suction or water tension. The forces which bind water molecules to solid particles in the soil pores.

Pascal (Pa): Unit of pressure which expresses soil water tension. Often seen as kilo-pascals (kPa), hectare pascals (hPa) or bars.

pF: The log of the pressure (hPa), expressed as a curve in terms of volumetric water content of soil.

Conversions	pF	-hPa
Full saturation	0	10^0
Field capacity	2	10^2
Irrigation point	3.3	$10^{3.3}$
Wilting point	4.2	$10^{4.2}$
Bone dry	7	10^7

Introduction

Different soil types have different 'soil moisture behavior'. Every soil type has an 'ideal' window (percentage range) of soil moisture - which is called 'plant available water'. At the low end, plants will experience stress and will ultimately wilt. At the high end of soil moisture (anything above field capacity), nutrients will wash out and less air will be available for the roots. These thresholds vary greatly, based on variations in size of the pores in the different soils. This is why calibrating your soil moisture sensors to the correct soil type is so important.

The Sensoterra sensors work in all soil types. However, the right calibration is crucial for improving the accuracy and precision of the soil moisture measurements. Sensoterra has its own laboratory, where soils are analyzed to add new calibration curves to continuously improve soil moisture accuracy.

We've put together this reader to support your decisions on selecting the correct soil type by sensor.

Soil & Water

Soil moisture content shows the amount of moisture in a soil a a certain time, but isn't sufficient to determine an irrigation regime. The moisture holding capacity is determined by the soil type, texture, organic material, structure, amongst other soil characteristics. The amount of water in the soil from precipitation and irrigation partly moves freely from gravitation pull, a certain proportion is retained as capillary and plant absorbed water. The interaction of soil and water requires energy, termed as soil-water potentials and described in units of pressure hPa.

Soil-water potential is highly determined by soil texture. Clay particles have the largest surface area, and create micropores within the soil, and hold on to water molecules more so than silty and sand particles which form meso- and macro-pores respectively. Matric potential is important for irrigation scheduling as it is representative of the soil water available to plants.

Soil Type

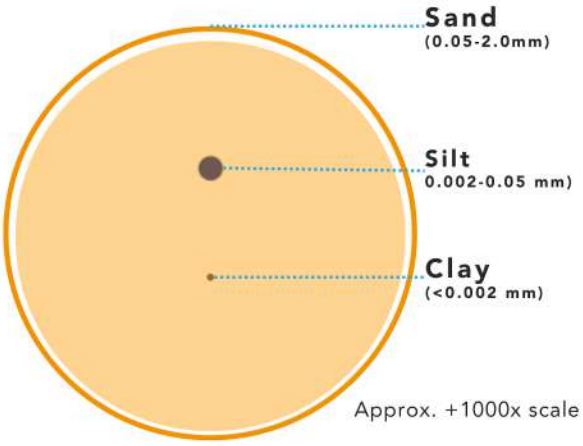
The first step in the formation of soil is the weathering of rock. Most soils derive from material that is transported by wind, water or ice.

Soils may be grouped broadly into either organic or mineral soils. Organic soils are those that contain more than 30% organic matter, like peat. Mineral soils consist of four main components: mineral material, organic matter, air and water. In a typical soil, minerals and organic matter consist of roughly 50% of the soil's volume. The remaining 50% is occupied by variable proportions of air and water.

Water Holding Capacity

Structure refers to the combination of sand, silt, clay, and organic matter into soil aggregates. Aggregates, bulk density, porosity, and compaction, determine water holding capacity of the soil.

Coarse soils with large particles and large pores will drain water quickly (sand), where as fine soils with small particle and small pores will retain water (clay). This is due to the particle diameter related surface tension.



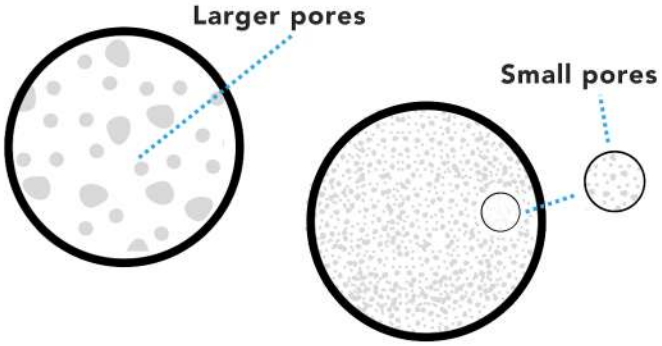
Soil Texture

There are three broad sizes of inorganic particle within a soils fine earth fraction:

- Sand (0.05 to 2.0 mm),
- Silt (0.002 to 0.05 mm) and,
- Clay (less than 0.002 mm)

Pore Space

Sandy soils	**Clay soils**
Lower porosity	Greater porosity
High permeability	Low permeability



Soil Texture & Functionality

Property	Clay	Silt	Sand
Water holding capacity	High	Moderate	Low
Drainage rate	Slow (unless cracked)	Moderate	Fast
Water erosion vulnerability	Low	High	Moderate
Water erosion susceptibility	Moderate	High	Low
Cohesion, stickiness, shrink-swell	High	Moderate	Low
Inherent fertility	High	Moderate	Low
Ease of pollutant leaching	Low (unless cracked)	Moderate	High
Ease of compaction	High	Moderate	Low

The differences in soil texture has significant impacts on different land and water functions to different extents.

Soil Texture Triangle

The Soil Texture Triangle illustrates the various proportions of the three particle sizes and separates them into 12 different classes. The most common soil texture is loam, which is defined as a texture where no single particle size is dominate.

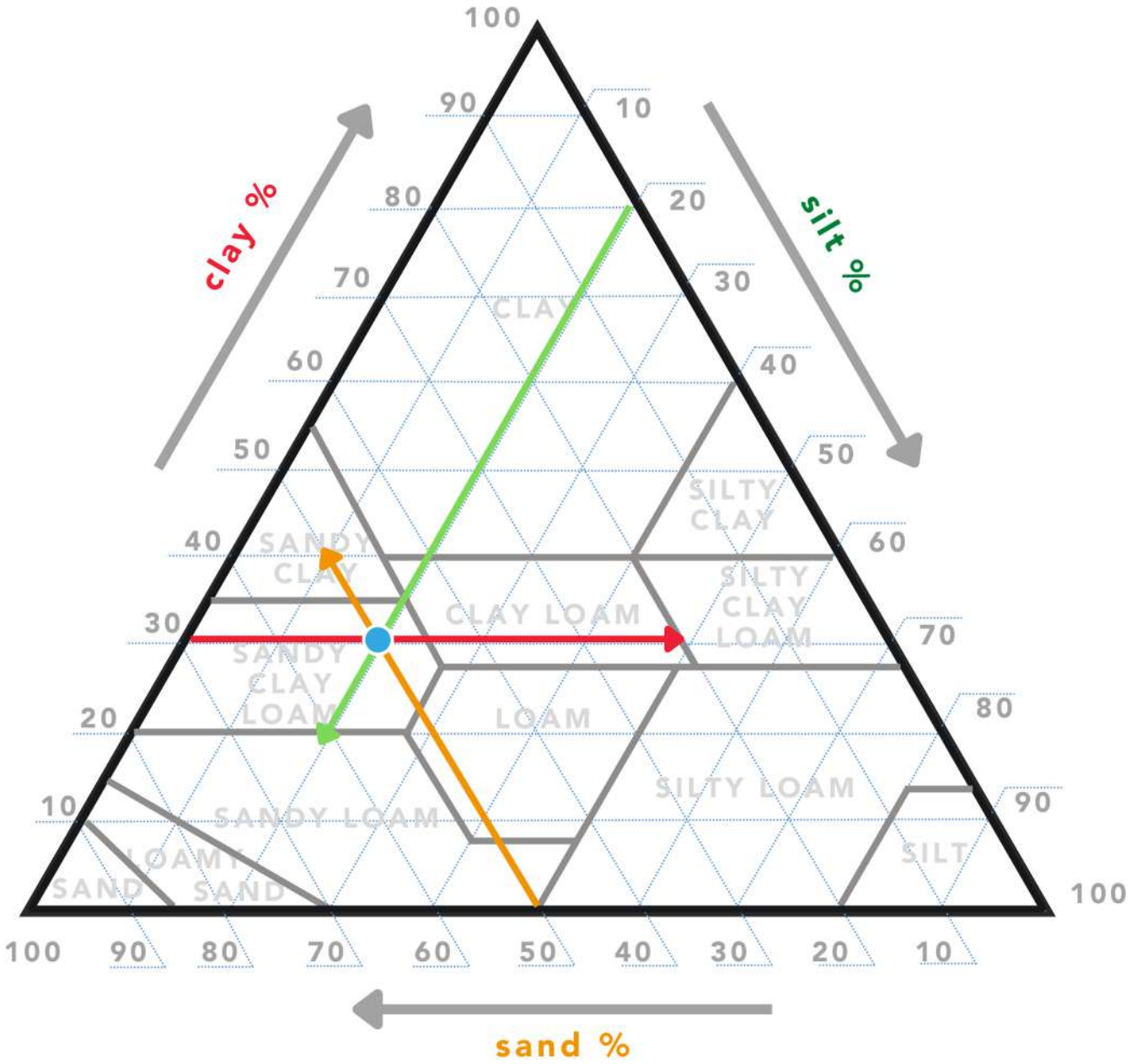
Texture is the most important variable determining water holding capacity. Sensoterra uses the texture classes based on USDA soil texture classification system.

For example, a soil with 30% clay, and 50% sand, will fall within the sandy clay loam classification. The point of intersection is the soil mineral composition (blue dot).

Reading the soil triangle

To read the soil texture triangle, you must have two of the three soil particles represented, in order to derive the position and soil class.

- The clay percentages are listed on the left side of the triangle. Lines corresponding to clay percentages extend from the percentages reading left to right (red line).
- The silt percentage is on the right side, with lines extending downwardly, diagonally from right to left (green line).
- The sand percentage is on the right side, with lines extending upwardly, diagonally from right to left (orange line).



Soil Moisture Content

Water is vital to plants and makes up 80-95% of fresh weight of non-woody plant parts. Water maintains plant rigidity through turgor pressure, forming a 'skeleton' of the plant. Without sufficient water, plants will visibly wilt, indicating a loss in turgor pressure. Plants 'waste' a lot of water: only 1% of water uptake is converted into biomass. Which is why maintaining plant available water is critical for optimum plant growth.

Volumetric water content is measured as a percentage of the soil solution. The amount of moisture available to plants differs per soil type. The illustration and chart below show the differences in soil type and their soil moisture content, considering porosity and pore size.

Plant Available Water

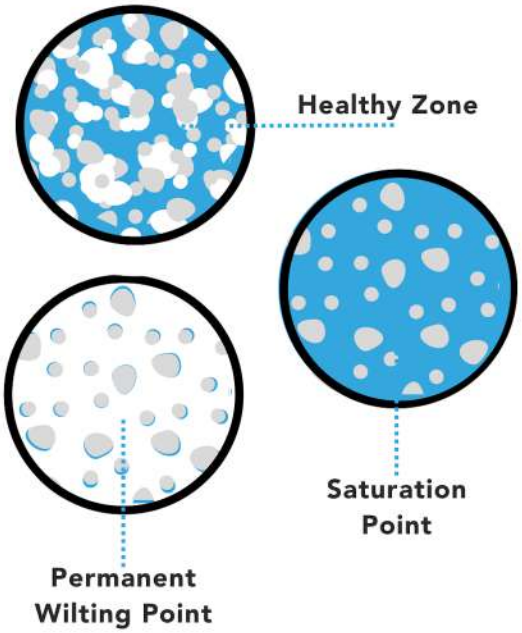
Plant available water is water held within the soil solution which plants can easily take-up without under going stress. Over field capacity, plants will experience hypoxia (too much water, lacking oxygen). The opposite is true for permanent wilting point where too little water is available for plant uptake. This is threshold differs by soil type, and shown in the chart and illustrations below.

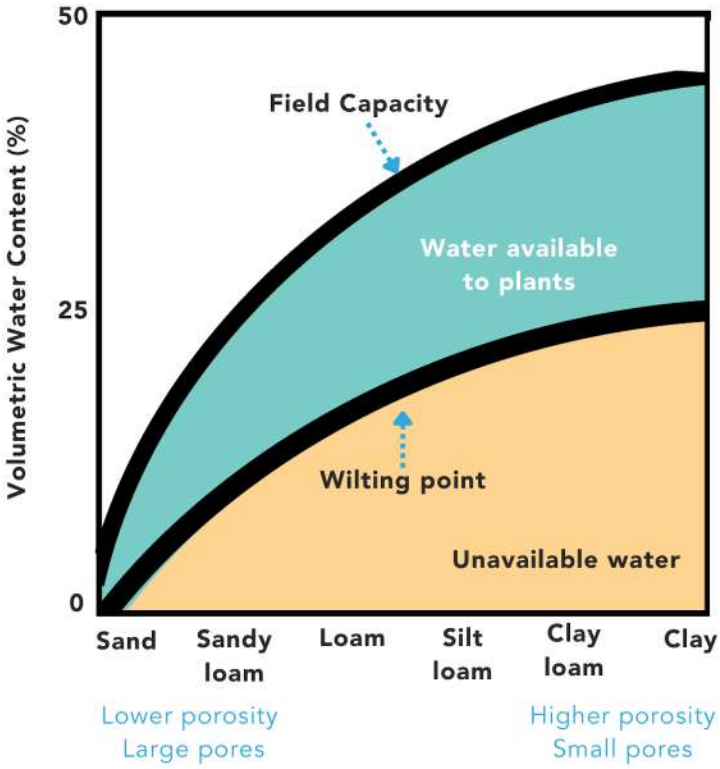
Soil Matric Potential

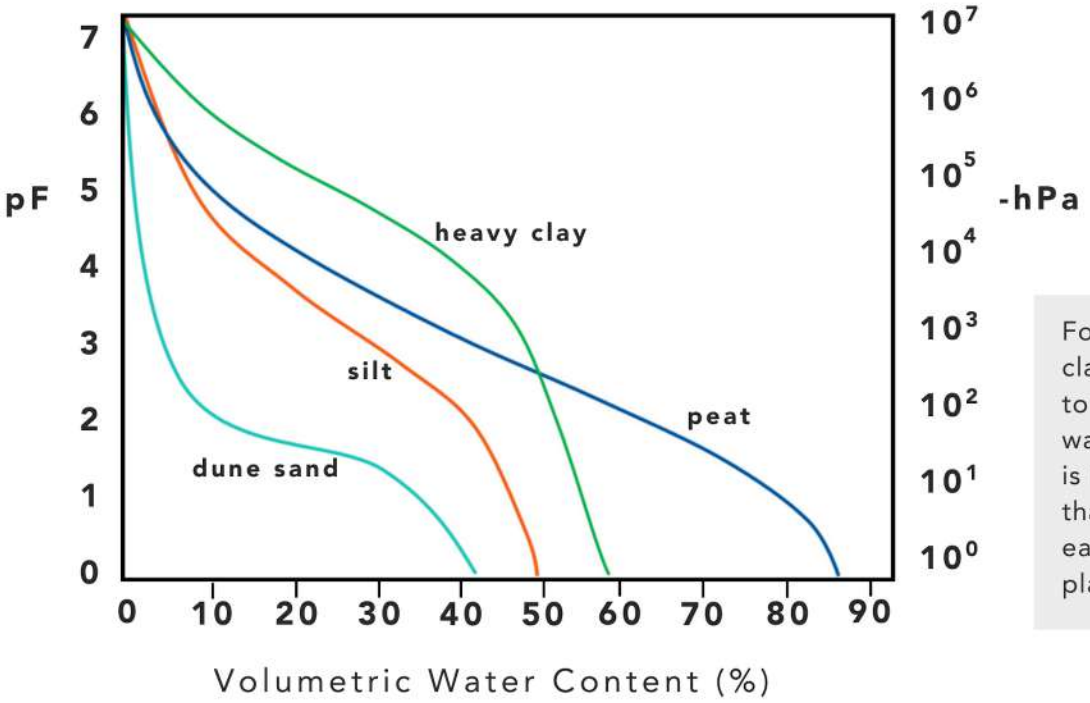
Soil matric potential, also called soil suction or soil water tension, represents the forces that bind water molecules to solid particles and to each other in soil pores, thus restricting the movement of water through the soil.

Plants must apply a force greater than matric potential to be able to extract water from the soil. As the water is removed from the soil, the remaining water is held more strongly, making it harder for the plant to extract water from the soil through its roots. The matric potential increases as the water is removed from the root zone of the plant. The matric potential is expressed hectopascal (hPa) which can be expressed in volumetric water content (VWC) with the correct calibration. Since matric potential is a negative pressure (suction), the values have a negative sign.

Matric potential is often expressed as the log of the pressure in hPa, and is termed as pF (ex. 100 hPa is equal to a pF2). The relationship between pF and the volumetric water content (VMC) is called the water retention curve or pF curve. The water retention by soils is critical for plants and acts as the main source of moisture availability.







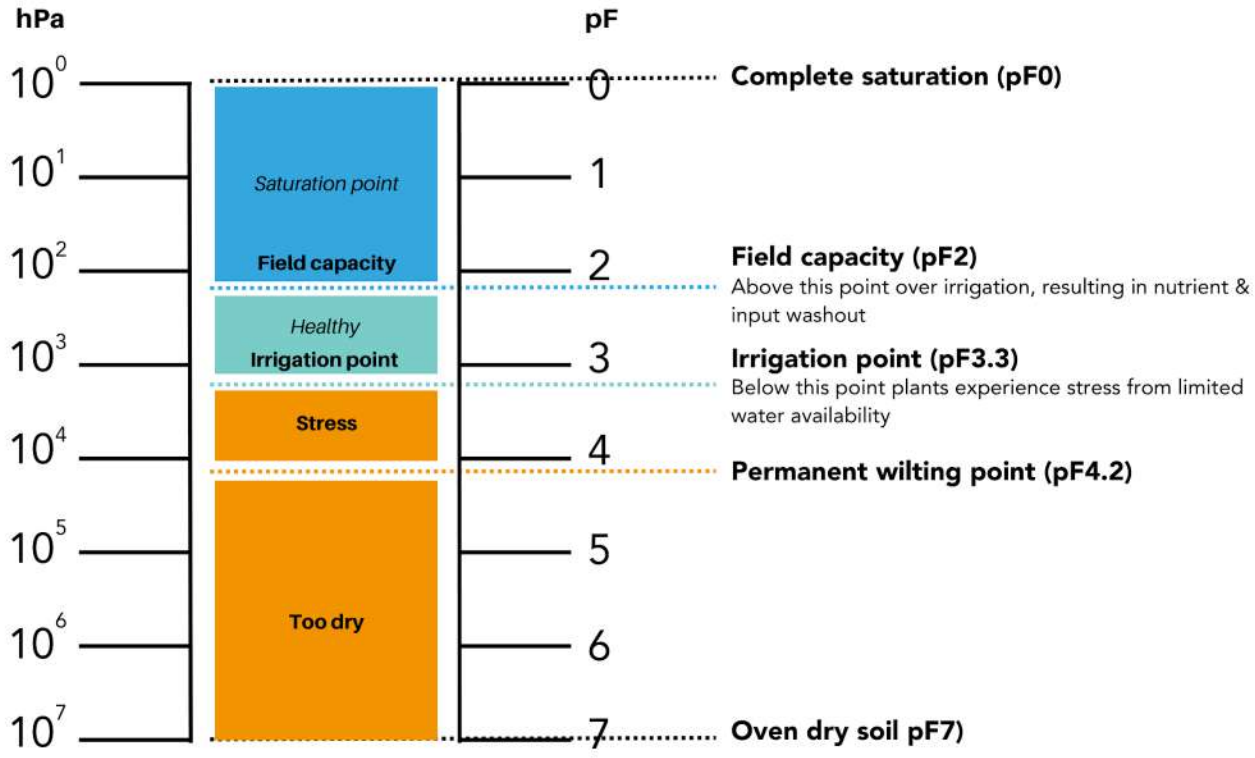
For example, heavy clay (green), is able to contain a lot of water, however water is bound so strongly that it will not be easily available to plants.

pF or Water Retention Curve

The pF or water retention curve, is a plot expressed in number or log hPa (pF) which the standard thresholds for saturation, plant available water, stress, field capacity, and permanent wilting can be derived.

Reading the pF Plot

The pF curve plots water characteristics by soil type in terms of pF (Y-axis) and water content (X-axis). The pF (Y-axis) is expressed as full saturation (0) to bone-dry (7). The X-axis is the volumetric water content, and the curve is this log of this based on the specific soil type. As the curve bends to the left and up, soil moisture (X-axis) decreases while pF (Y-axis) increases.

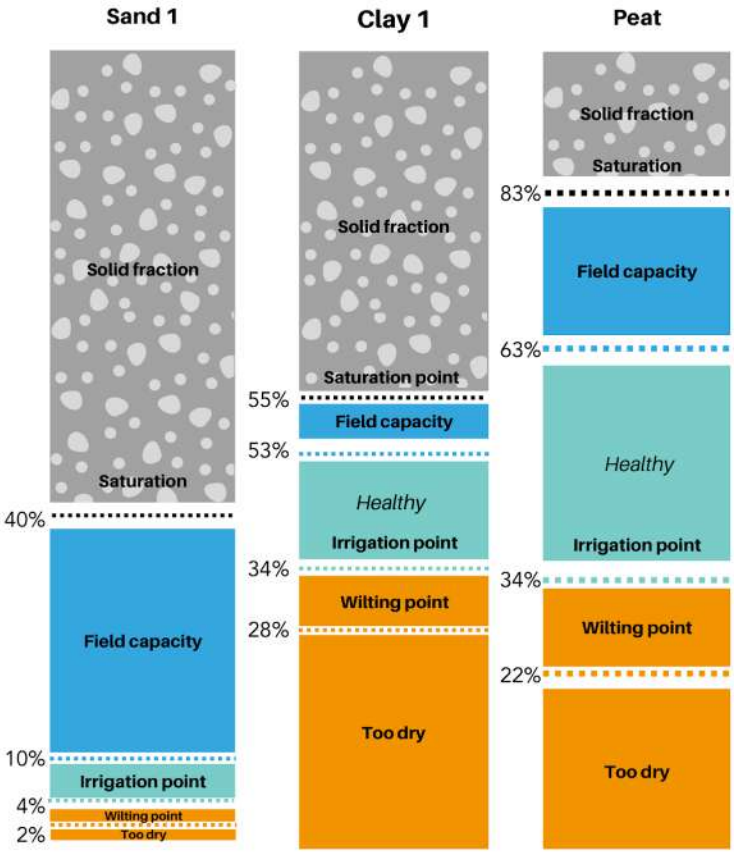


Thresholds based on pF

The pF values help determine the thresholds for water management. Sensoterra has set irrigation thresholds based on the pF values of different soil types.

- Full saturation 'Too Wet' is anything between pF2 and pF0 (blue)
- Plant available water 'Healthy' is between pF3.3 (irrigation point) and pF2 (field capacity) (teal)
- Stress to plants begins when soil moisture is between pF3.3 and pF4.2 (permanent wilting point) (orange)
- Permanent wilting, 'Too Dry' will be experienced by a plant at pF4.2 (orange)
- Oven dry is pF7 (orange)

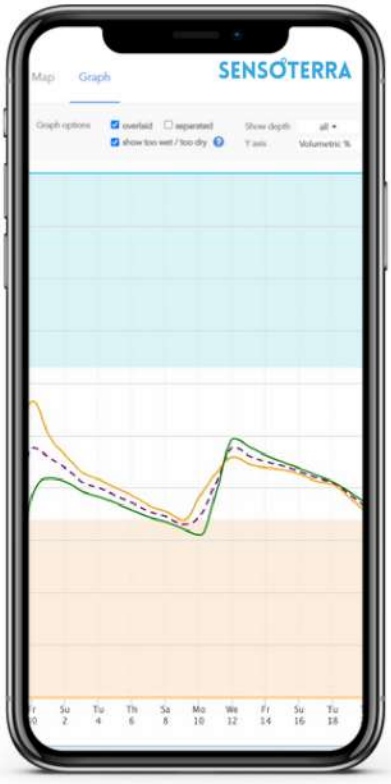
These values are available as Volumetric Water Content, and pF within the Sensoterra Monitor App. The thresholds are set automatically based on selected soil type, but can be adjusted based on user preference.



Visible differences in soil moisture values and thresholds for different soil types. Given in volumetric water content (VWC) percentage.

Averages

By averaging soil moisture data based on sensors in the same location and soil type, you can have an indicative overview of the performance of multiple installation sites.



Identifying Irrigation Patterns

By keeping irrigation within soil moisture levels between pF3.3 and pF2, you'll know when to start irrigation and when to stop, preventing water waste and nutrient runoff.

Standard Calibrations

Sensoterra soil calibration considers the soil texture, organic matter and pF or water retention curve thresholds. These differ by soil type. With clever Sensoterra algorithms, soil calibration thresholds are set automatically, and can be adjusted.

Currently, there are 30+ standard soil calibrations available, where pF calibration curves are determined in the Sensoterra Lab. Should you have a soil texture which is not offered in the standard calibration library (listed on the soil triangle below), you can request a specific calibration for your soil by sending a mail to lab@sensoterra.com.

Sensoterra sensors measure at a 3cm radius from the electrodes (approx. tennis ball volume). Because soil types can vary across a field, it is important to determine the correct soil texture at the placement site of the sensors in order to have the most accurate soil moisture data. To read more on placement of Sensoterra sensors, please refer to our FAQ or installation guide.

Soil Texture Identification

The following is an outline to provide a clear indication of setting the correct calibration for your sensors based on soil type.

1. Known soil type

If soil type is known, select the closet corresponding calibration offered. You may set your own irrigation thresholds if they differ from the calibrated standard.

2. Lab Analysis

If you do not know the soil type, a lab analysis can identify the specific soil textures, and volumetric moisture content, and (pF) thresholds. We work with, and recommend Eurofins lab analysis, however many labs will provide these readings which are accurate for the purposes.

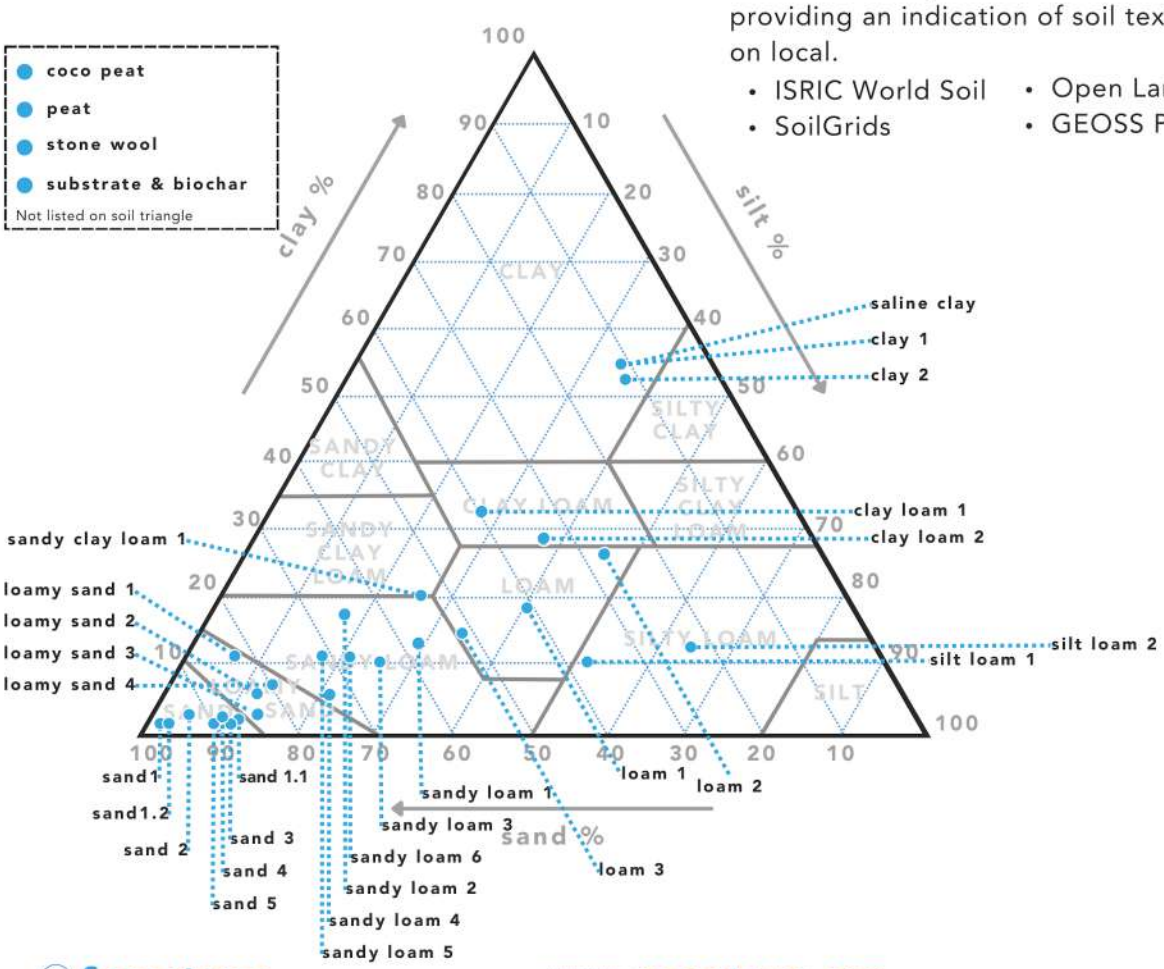
3. Jar & Field Tests

There are multiple self-tests which can help to identify the soil texture class, to varying reliability. We have provided a guide for these tests.

4. Map Estimators

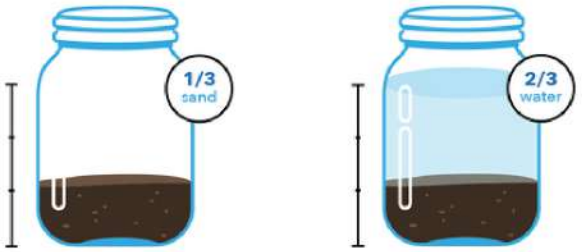
There are multiple online resources for providing an indication of soil texture based on local.

- ISRIC World Soil
- SoilGrids
- Open Land Map
- GEOSS Portal



Jar Test - Soil Texture Estimator

Should lab analysis not be readily available, an interim solution is the 'jar test' procedure. This procedure will take 48 hours to allow soil particle fractions to settle.

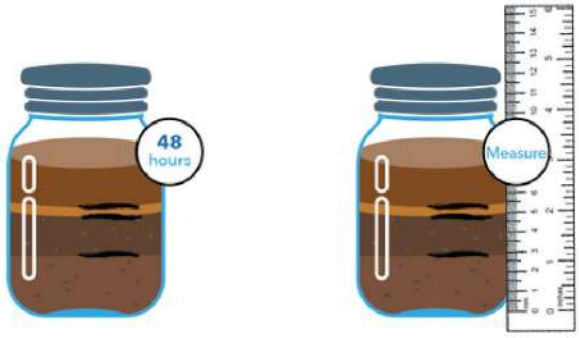


Materials

- Straight-edged, clear jar
- Permanent marker
- Ruler
- Watch or stopwatch
- 1 tablespoon of powdered dishwashing detergent
- Mesh sieve or old colander

Procedure

1. Using a mesh sieve or old colander, sift the soil to remove any debris, rocks, and large organic matter
2. Fill the jar ⅓ full of the soil to be tested
3. Fill the remainder of the jar with clean water, and leave some space at the top.
4. Add 1 tablespoon of powdered dishwashing detergent
5. Cap the jar and shake vigorously until the soil solution turns into a uniform slurry
6. Set on a level surface and time for one-minute
7. Place a mark on the outside of the jar, indicating the coarse sand layer which has settled on the bottom
8. Leave the jar for 2 hours
9. Mark the top of the next settled layer with permanent market to indicate the silt layer.
10. Leave the jar on a level surface for 48 hours
11. Mark the top of the settled layer with the marker to indicate the clay layer.
12. Using a ruler, measure and record the height of each layer and the total height of all three layers. Use the soil texture analysis below to record and derive the results.
13. Calculate the soil texture composition percentages, and track the values on the soil texture triangle

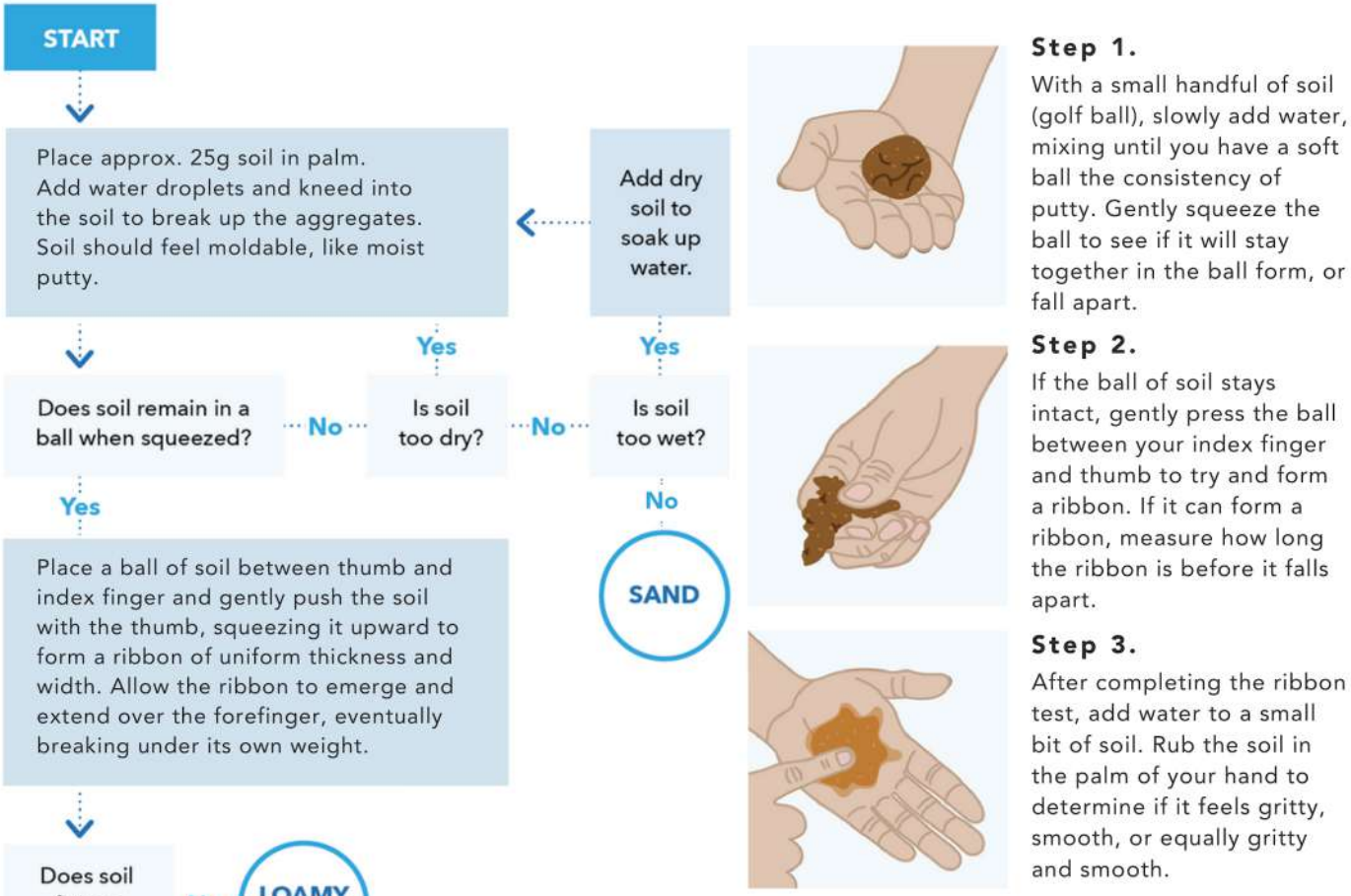


Worksheet

Height of sand layer	_____ cm / in
Height of silt layer	_____ cm / in
Height of clay layer	_____ cm / in
Total height of the layers	_____ cm / in

To find the correct percentage, divide each soil layer height by the total height, and multiply by 100. This will give an estimation of the soil particle ratio which can be identified in the soil texture triangle.

Field Texture Test



Step 1.

With a small handful of soil (golf ball), slowly add water, mixing until you have a soft ball the consistency of putty. Gently squeeze the ball to see if it will stay together in the ball form, or fall apart.

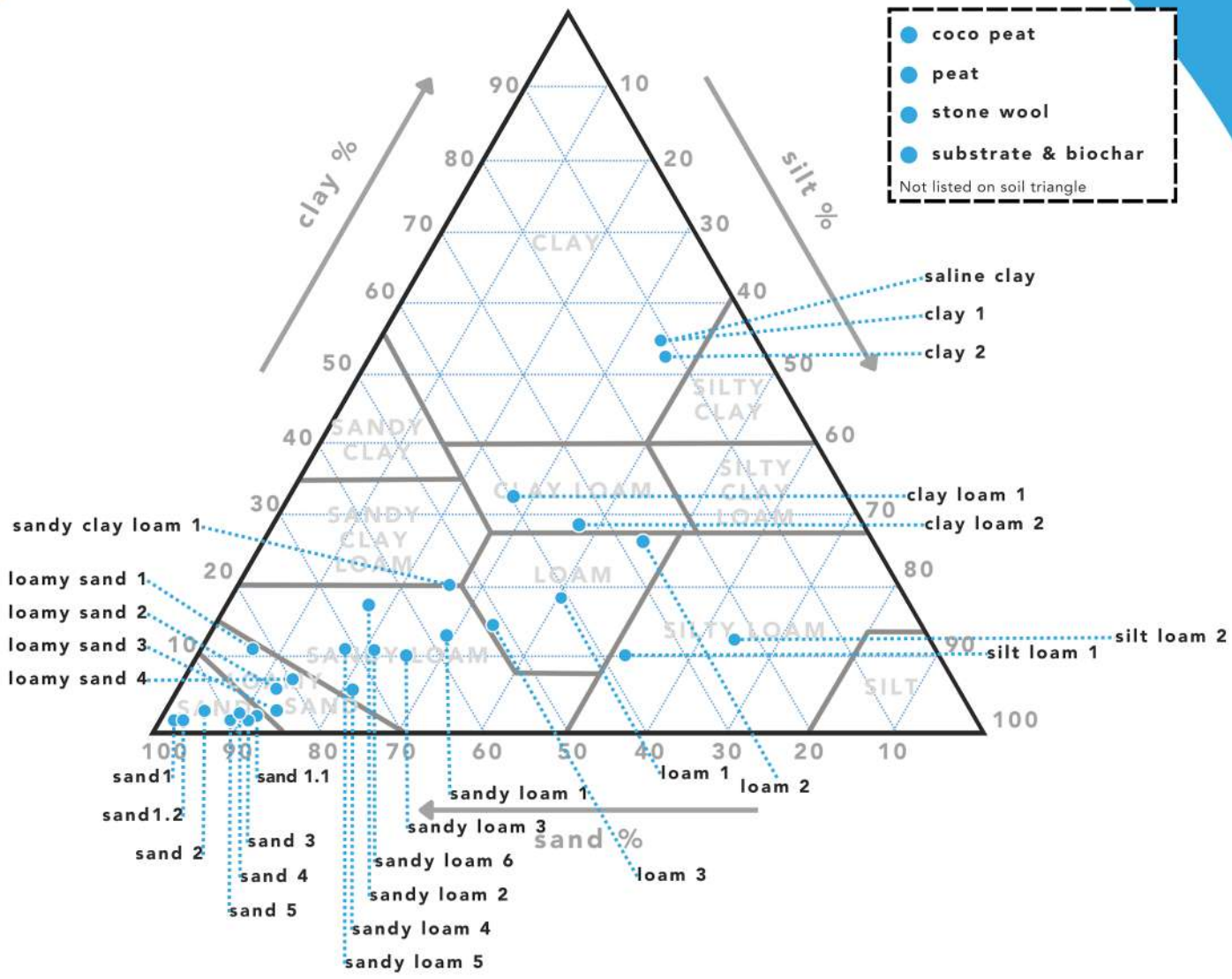
Step 2.

If the ball of soil stays intact, gently press the ball between your index finger and thumb to try and form a ribbon. If it can form a ribbon, measure how long the ribbon is before it falls apart.

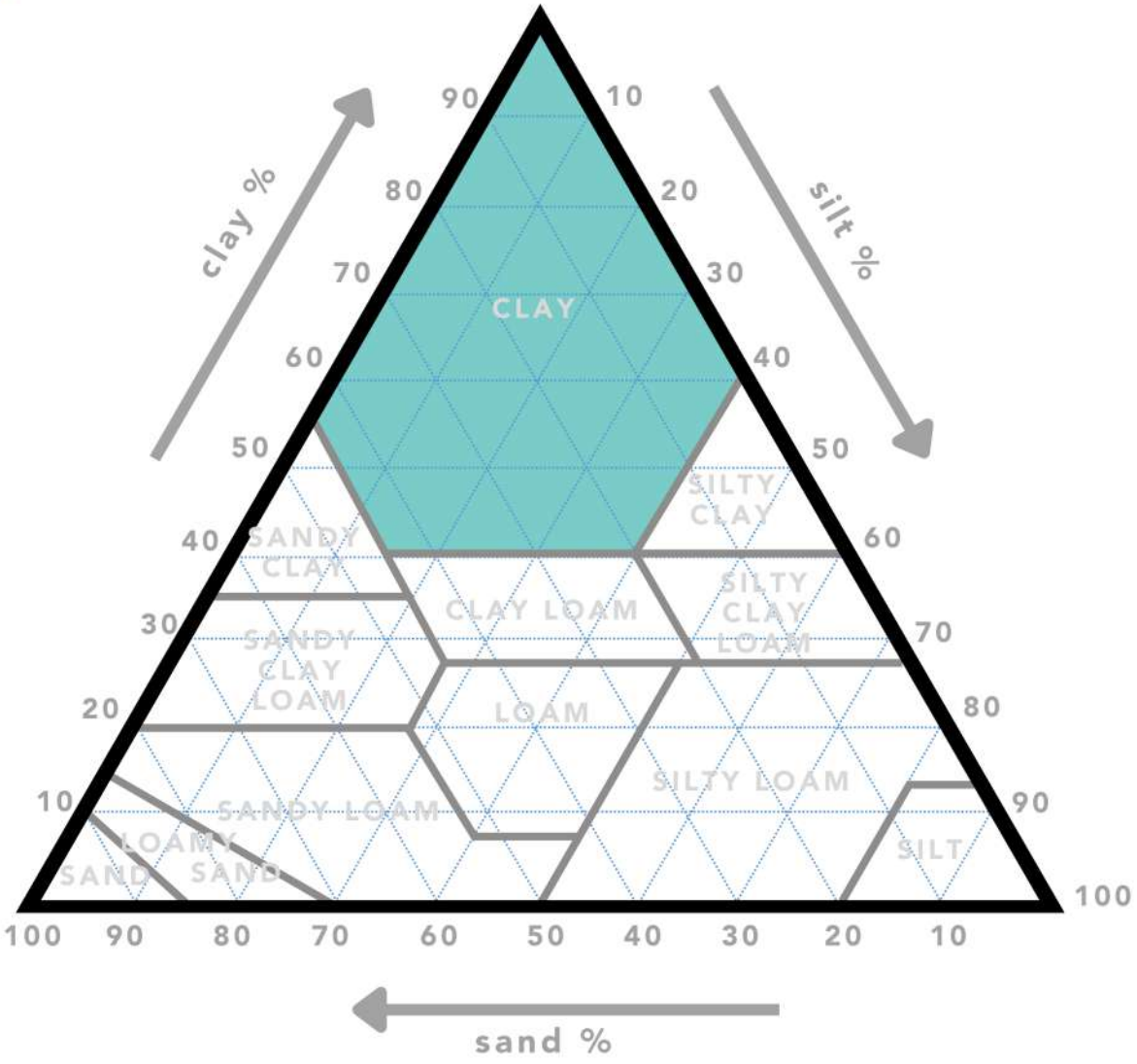
Step 3.

After completing the ribbon test, add water to a small bit of soil. Rub the soil in the palm of your hand to determine if it feels gritty, smooth, or equally gritty and smooth.

SOIL CALIBRATIONS



CLAY


clay %
silt %
sand %
CLAY
SILTY CLAY
SANDY CLAY
CLAY LOAM
SILTY CLAY LOAM
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LOAM
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SANDY LOAM
LOAMY SAND
SAND
SILT
90
80
70
60
50
40
30
20
10
100

CLAY 1
(0% Organic Matter)

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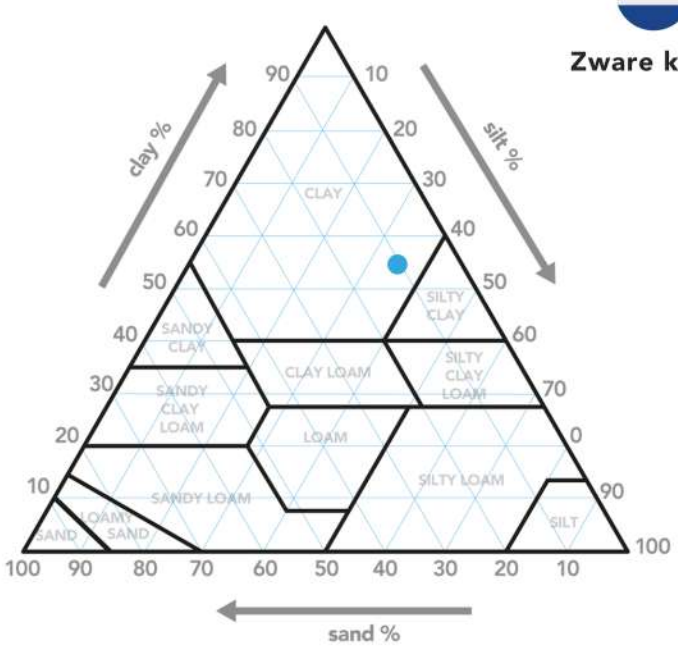
Zware klei 1 | Ton 1 | Arcillosa 1 | Argile 1

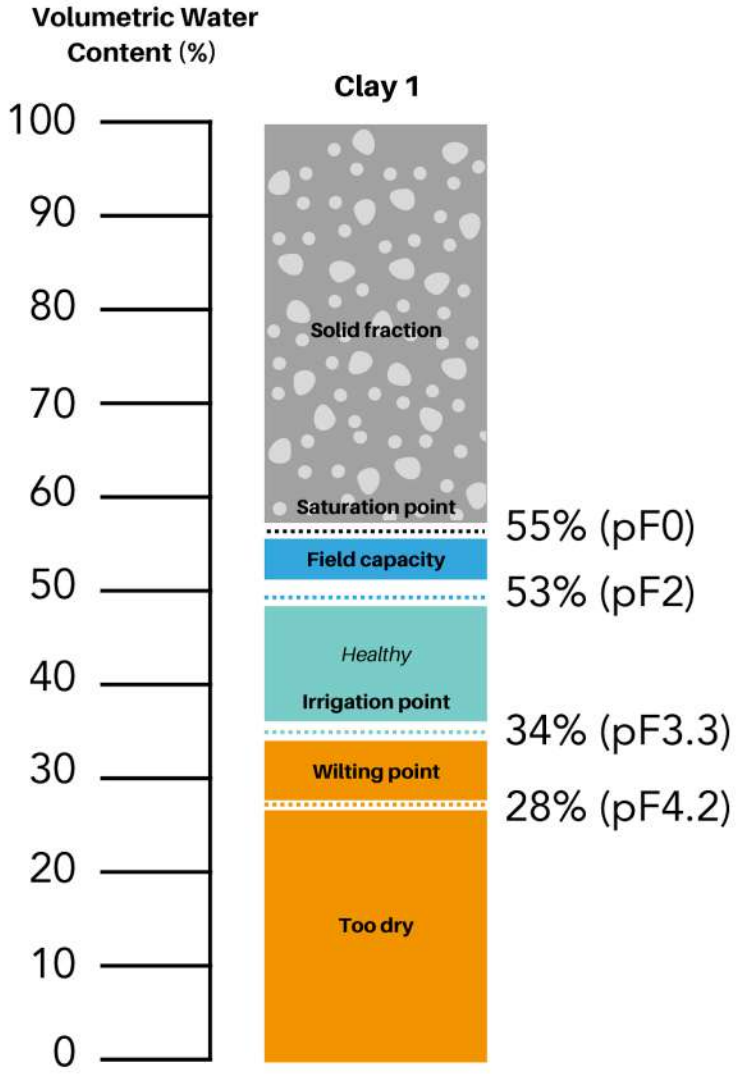


Composition

Clay - 55%
Silt - 35%
Sand - 10%
Organic Matter - 0%

Characteristics

Clay soils have relatively small particles and can thus hold more water than most other soil types. However, only about half of this water is available to the plants. These soils swell during wet conditions and shrink and crack in dry conditions. The structure of clay soils is prone to degradation especially in very wet conditions. They have rapid limited infiltration and poor drainage.



Recommendations for thresholds

Setpoint high: 53%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses
Setpoint low: 34%
Irrigation point (pF3.3), prevents water stress on the plant.

All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.

CLAY 2

(12.4% Organic Matter)

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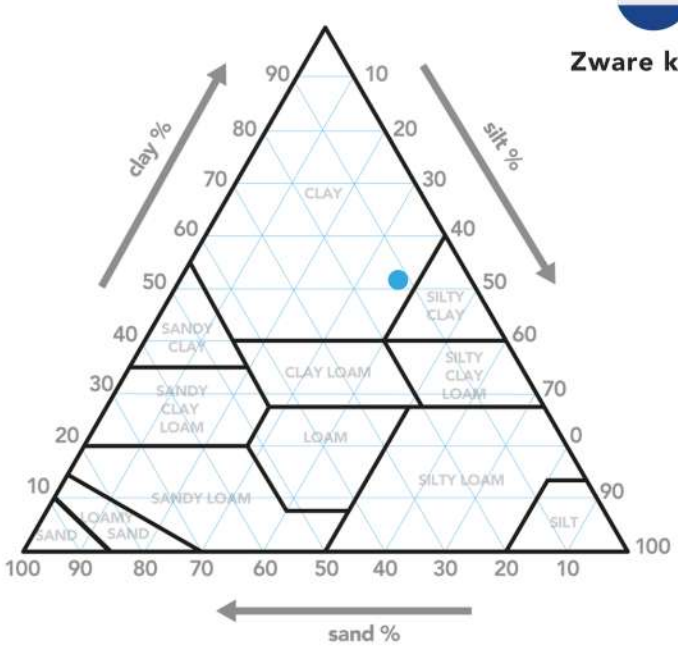
Zware klei 2 | Ton 2 | Arcillosa 2 | Argile 2

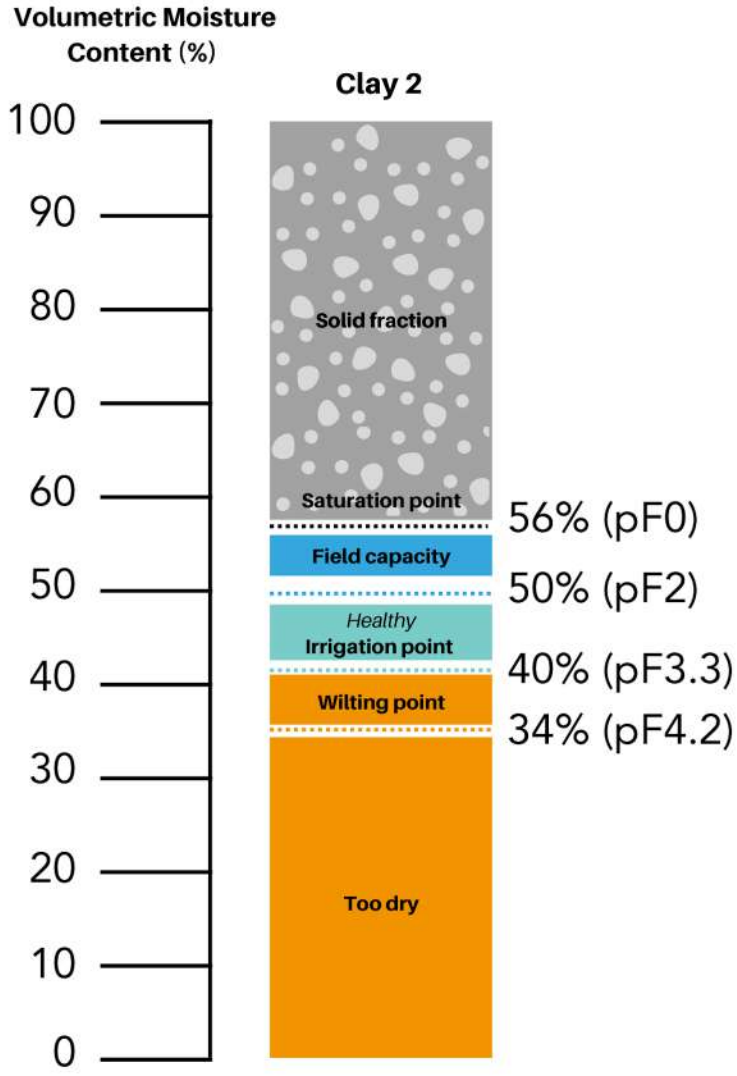


Composition

Clay - 53% Sand - 11%
Silt - 36% Organic Matter - 12.4%

Characteristics

Clay soils have relatively small particles and can thus hold more water than most other soil types. However, only about half of this water is available to the plants. These soils swell during wet conditions and shrink and crack in dry conditions. The structure of clay soils is prone to degradation especially in very wet conditions. They have rapid limited infiltration and poor drainage.



Recommendations for thresholds

Setpoint high: 50%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses
Setpoint low: 40%
Irrigation point (pF3.3), prevents water stress on the plant.

All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.

SALINE CLAY

(0% Organic Matter)

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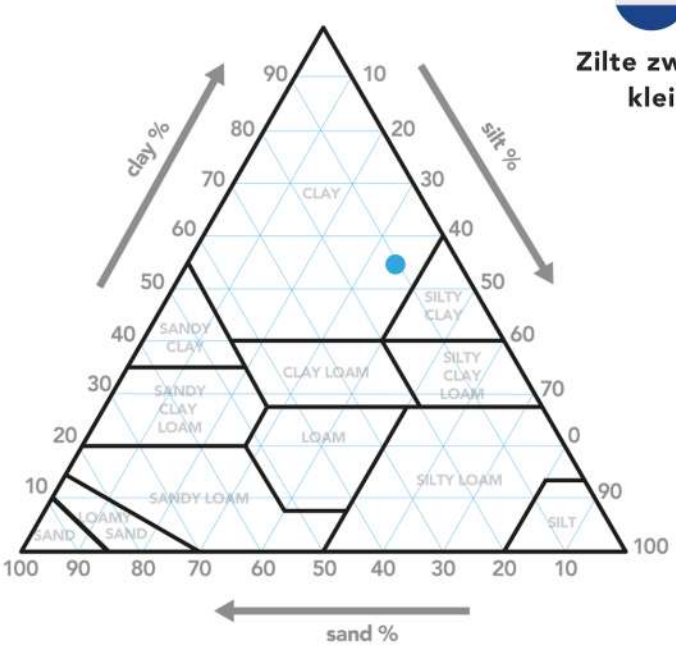
Zilte zware klei | Salziger Ton | Arcillosa salina | Argile saline



Composition

Clay - 55%
Silt - 35%
Sand - 10%
Organic Matter - 0%
Salinity (EC: mS/cm) - 5

Characteristics

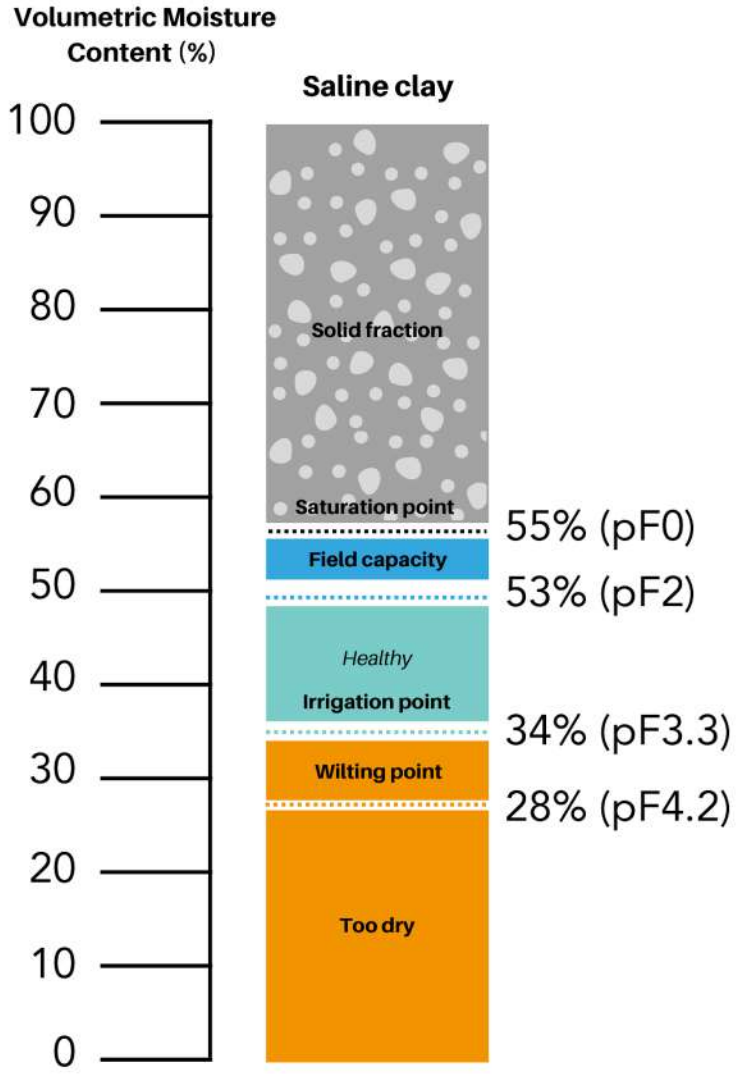
Clay soils have relatively small particles and can thus hold more water than most other soil types. However, only about half of this water is available to the plants. These soils swell during wet conditions and shrink and crack in dry conditions. The structure of clay soils is prone to degradation especially in very wet conditions. They have rapid limited infiltration and poor drainage.

Salinity levels of ~5 mS/cm corresponding to highly saline irrigation or intense use of fertilizers.

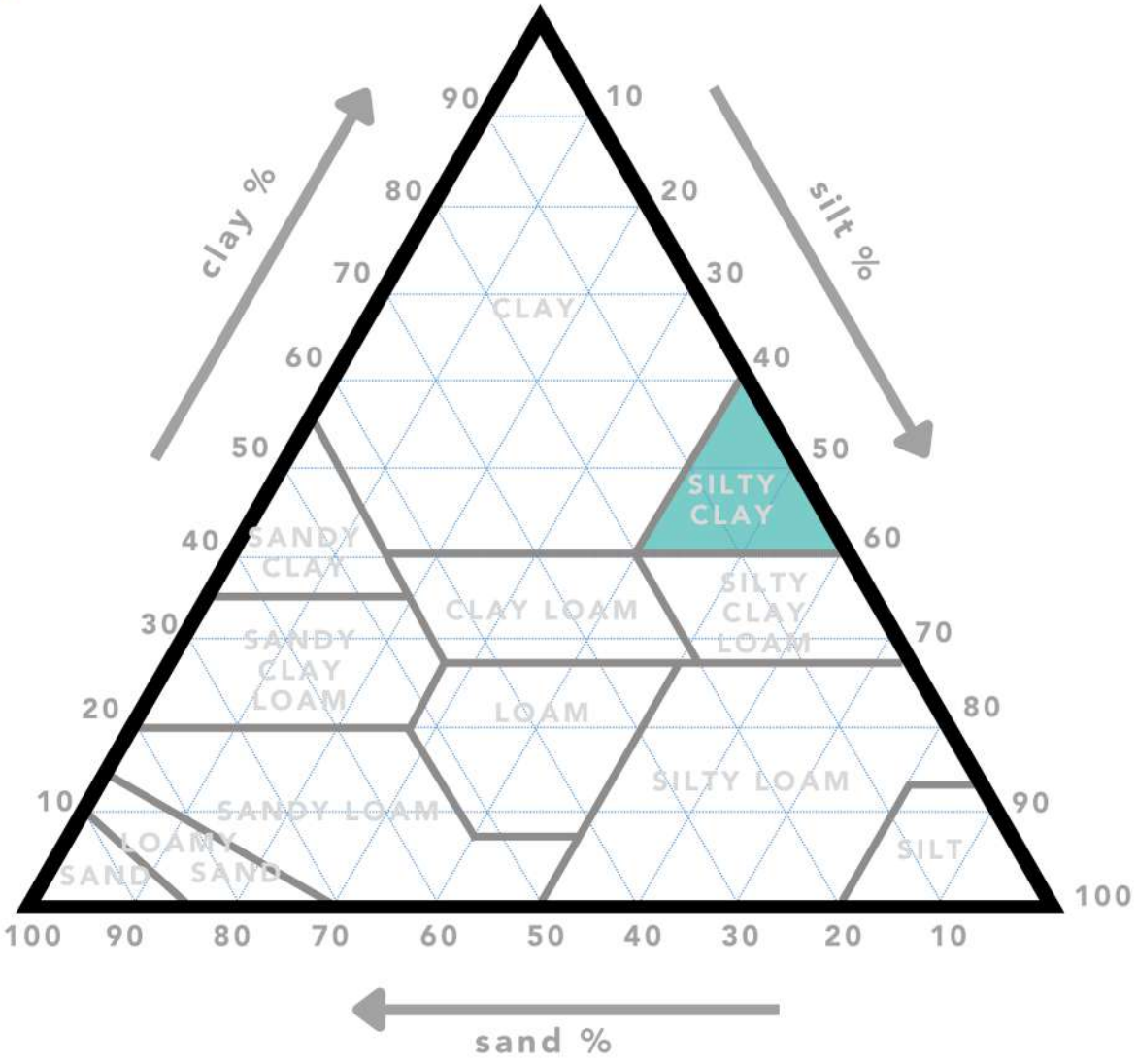
Recommendations for thresholds

Setpoint high: 53%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses
Setpoint low: 34%
Irrigation point (pF3.3), prevents water stress on the plant.

All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.



SILTY CLAY


clay %
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CLAY
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CLAY LOAM
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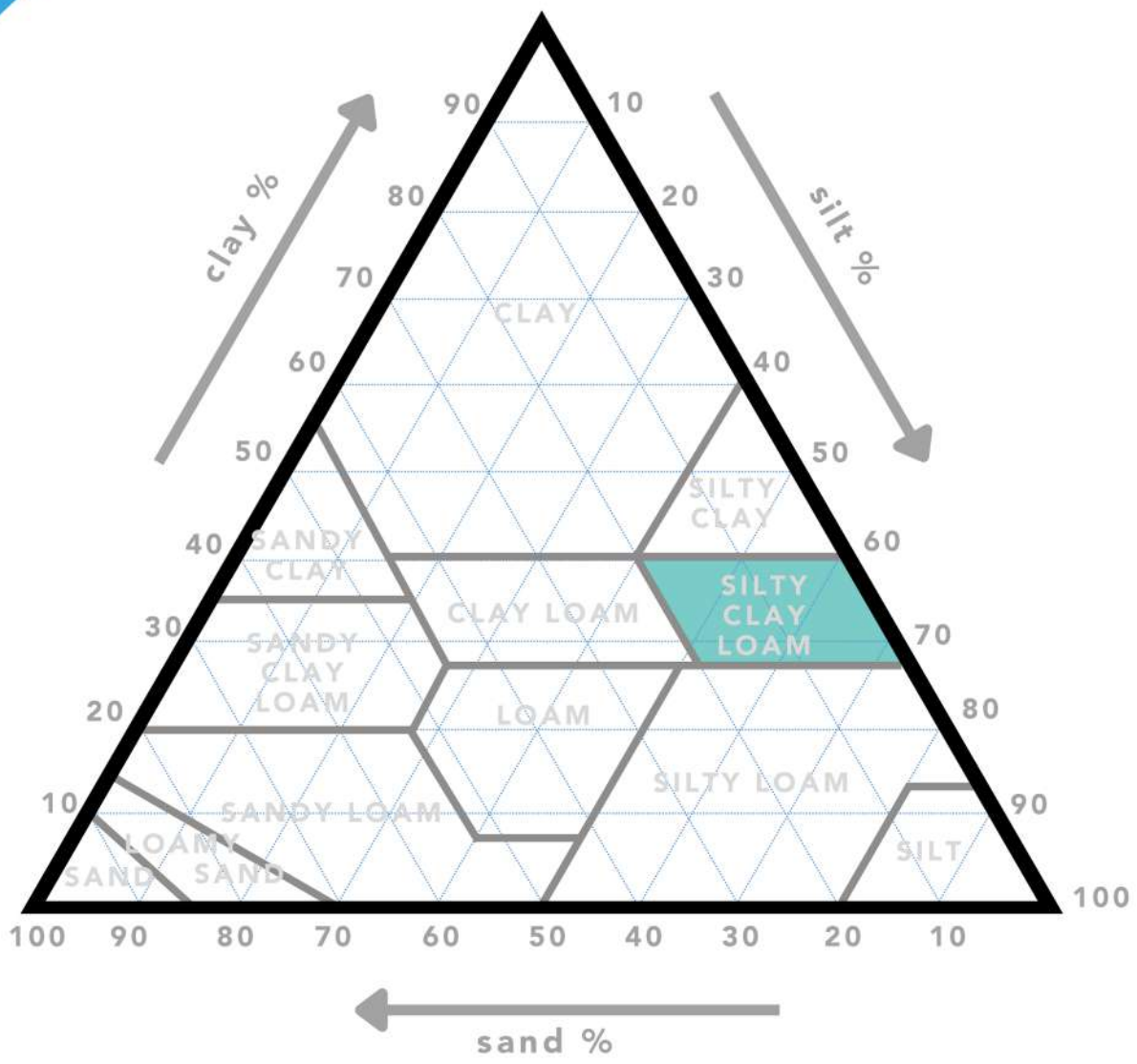
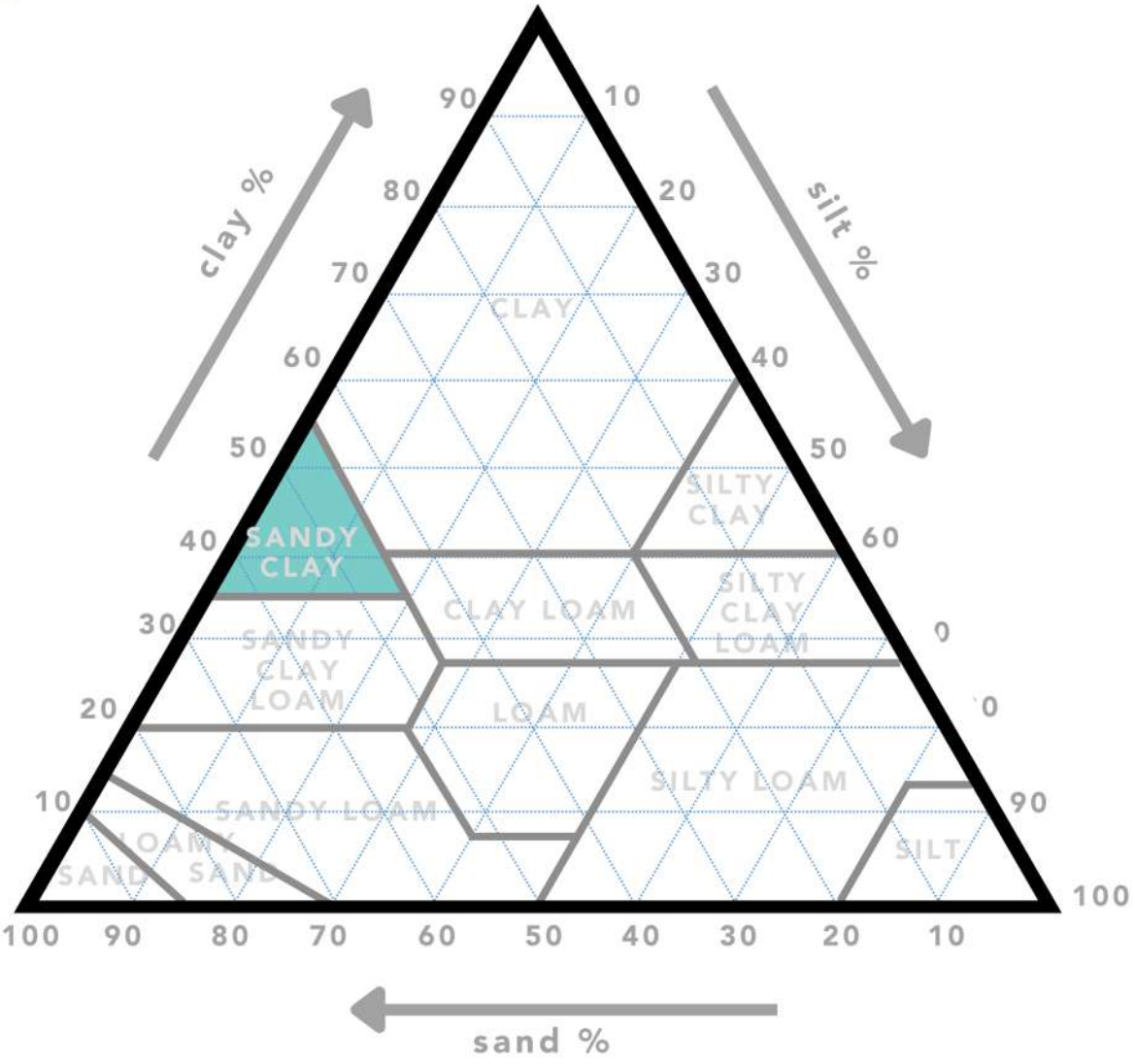
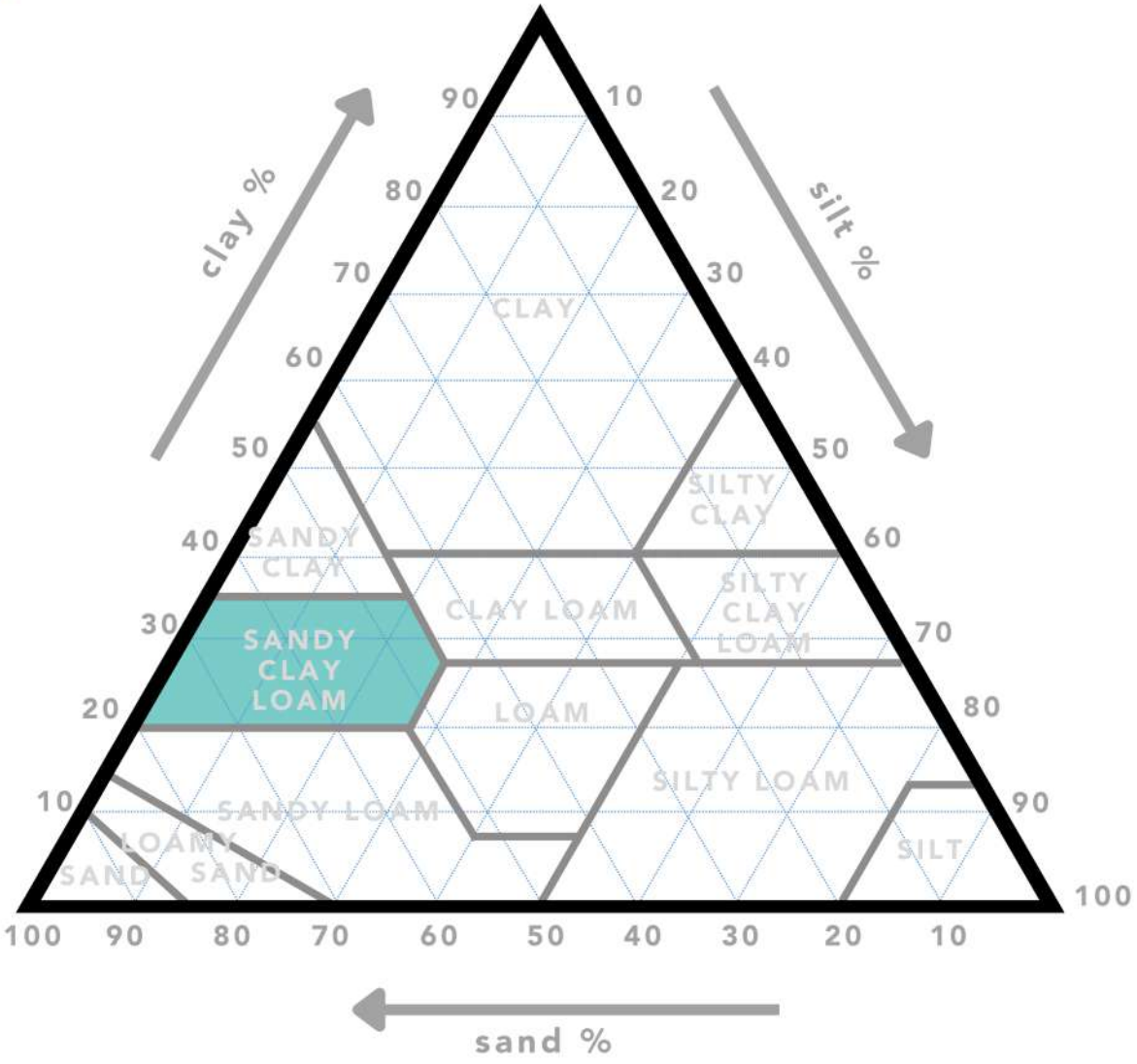
SILTY CLAY LOAM



SANDY CLAY


clay %
silt %
sand %
SANDY CLAY
CLAY
SILTY CLAY
CLAY LOAM
SILTY CLAY LOAM
SANDY CLAY LOAM
LOAM
SILTY LOAM
SANDY LOAM
SILT
LOAMY SAND
SAND

SANDY CLAY LOAM



SANDY CLAY LOAM 1
(12.2% Organic Matter)

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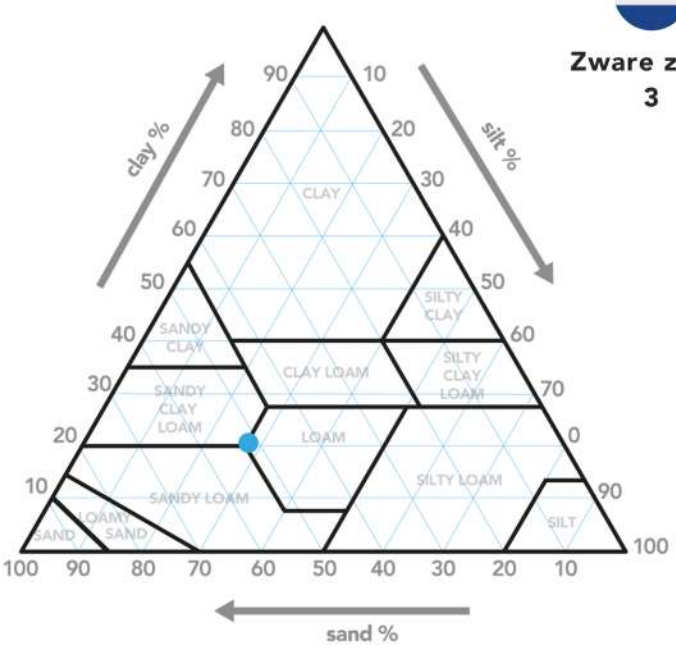
Zware zavel 3 | Sandiger Tonlehm 1 | Franco arcillo arenosa 1 | Limon argilo-sableux 1

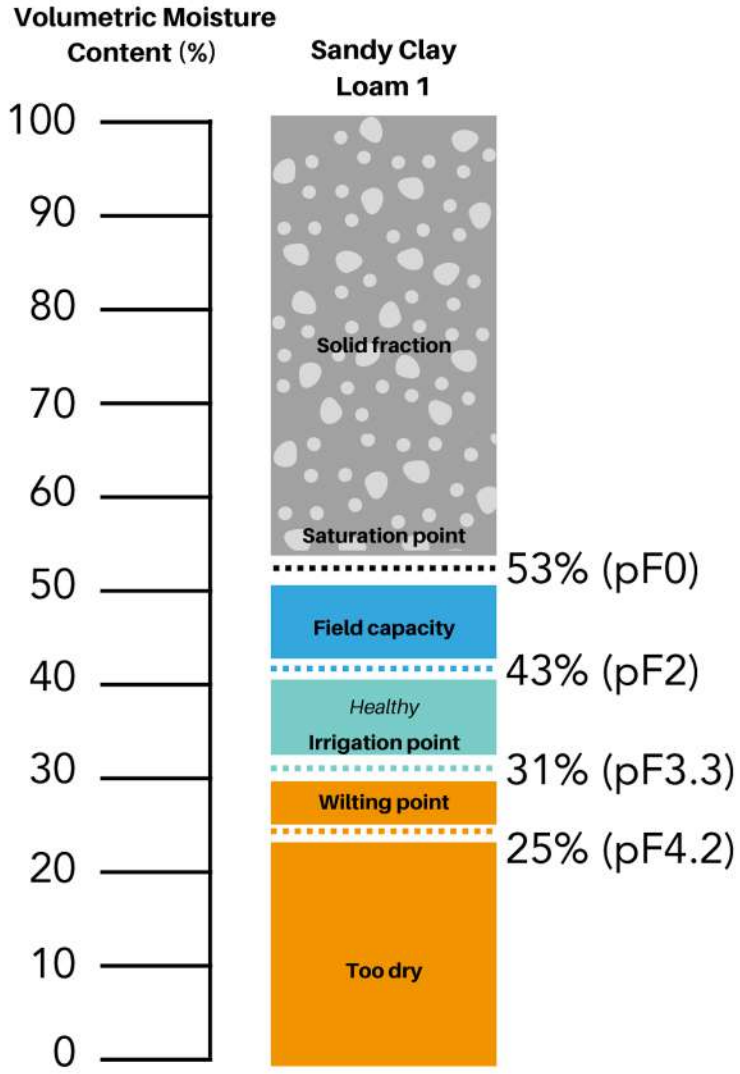


Composition

Clay - 20%
Silt - 26%
Sand - 53%
Organic Matter - 12.2%

Characteristics

Loam is a soil with a significant amount of clay, silt and sand. This results in a soil with good structure, as well as good water and nutrient holding capability. Sandy clay loams have a lower percentage of silt than loam soils, resulting in a slightly inferior structure but better water holding capabilities compared to loam.

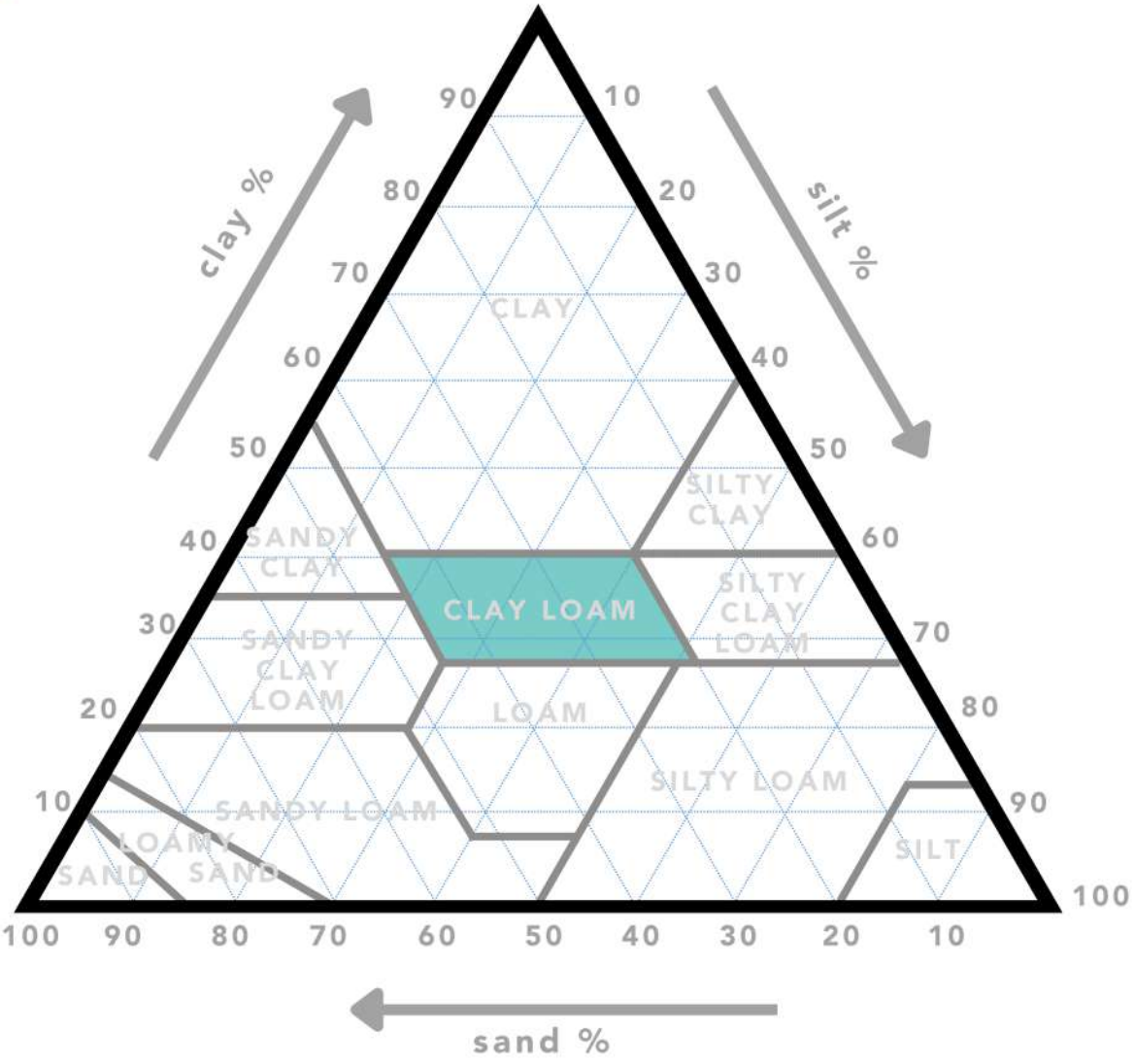


Recommendations for thresholds

Setpoint high: 43%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses
Setpoint low: 31%
Irrigation point (pF3.3), prevents water stress on the plant.

All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.

CLAY LOAM

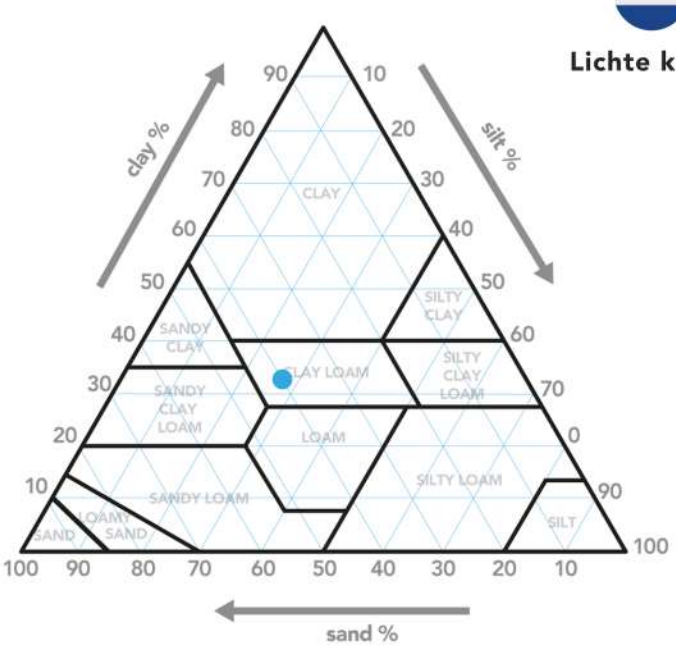

clay %
silt %
sand %
90
80
70
60
50
40
30
20
10
100
CLAY
SILTY CLAY
SANDY CLAY
CLAY LOAM
SILTY CLAY LOAM
SANDY CLAY LOAM
LOAM
SILTY LOAM
SANDY LOAM
LOAMY SAND
SILT

CLAY LOAM 1

(0.2% Organic Matter)

SENSOTERRA

Lichte klei 1 | Tonlehm 1 | Franco Arcillosa 1 | Limon argileux 1



Composition

Clay - 32%
Silt - 28%
Sand - 40%
Organic Matter - 0.2%

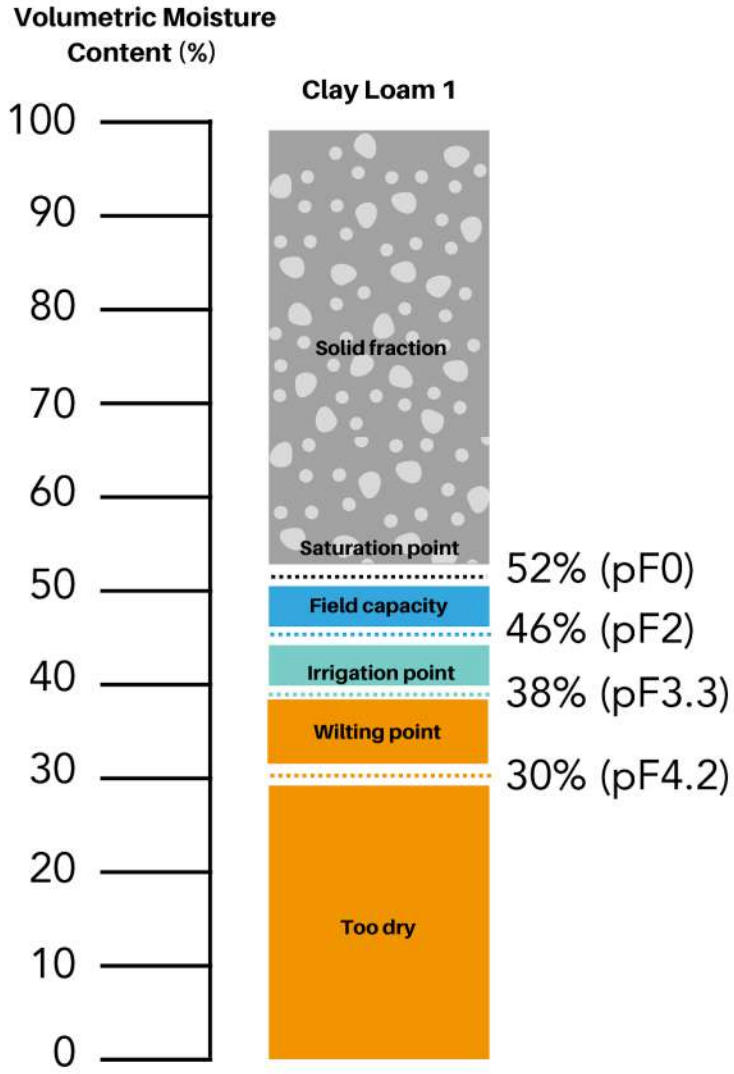
Characteristics

Loam is a soil with a significant amount of clay, silt and sand. This results in a soil with good structure, as well as good water and nutrient holding capability. Clay loams have a higher percentage of clay than loam soils, resulting in a slightly inferior structure but better water holding capabilities compared to loam.

Recommendations for thresholds

Setpoint high: 46%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses
Setpoint low: 38%
Irrigation point (pF3.3), prevents water stress on the plant.

All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.

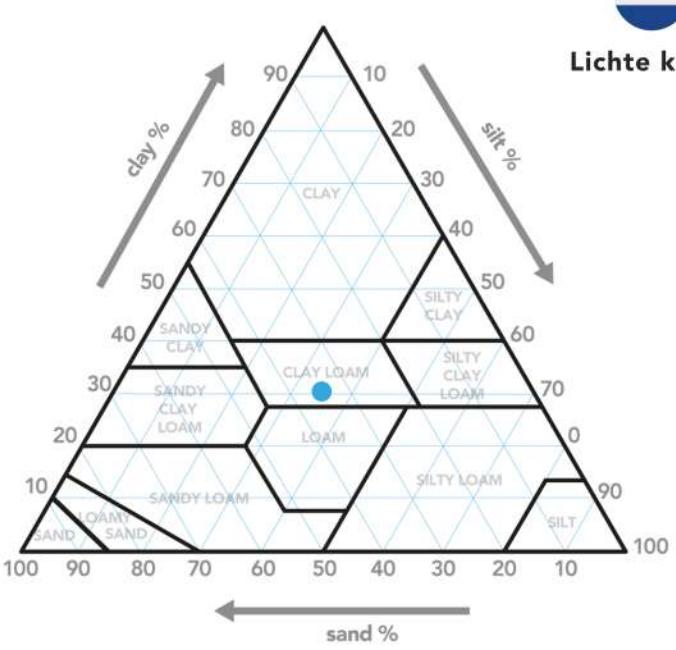


CLAY LOAM 2

(4.1% Organic Matter)

SENSOTERRA

Lichte klei 2 | Tonlehm 2 | Franco Arcillosa 2 | Limon argileux 2

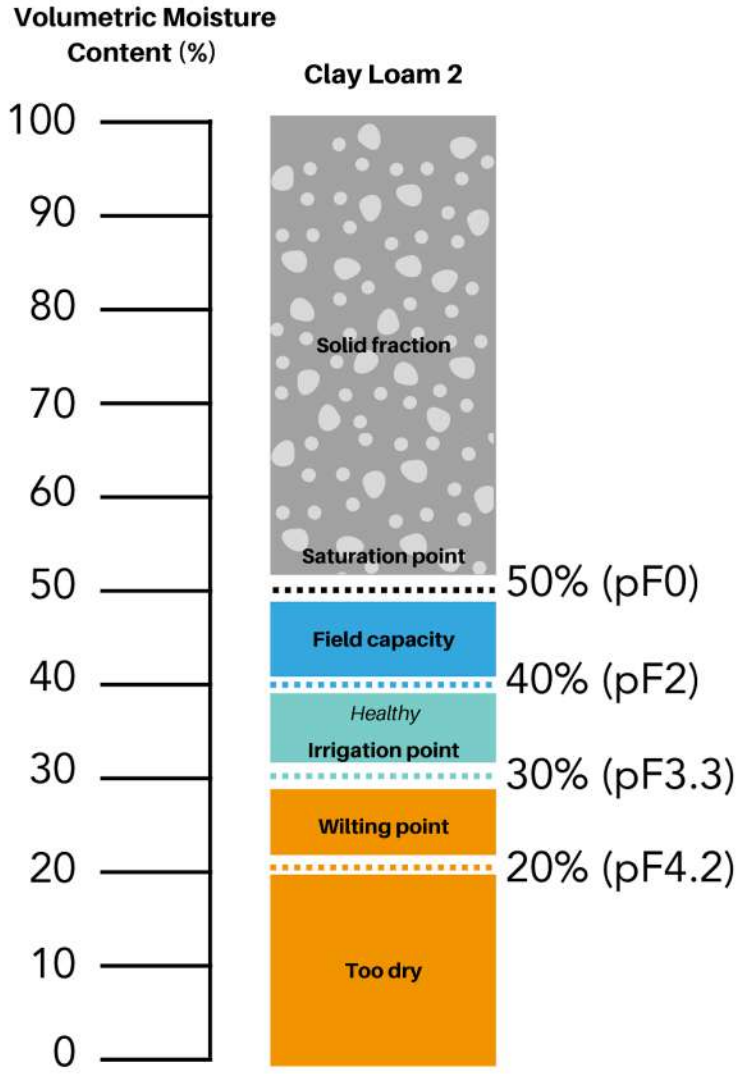


Composition

Clay - 29%
Silt - 38%
Sand - 33%
Organic Matter - 4.1%

Characteristics

Loam is a soil with a significant amount of clay, silt and sand. This results in a soil with good structure, as well as good water and nutrient holding capability. Clay loams have a higher percentage of clay than loam soils, resulting in a slightly inferior structure but better water holding capabilities compared to loam.

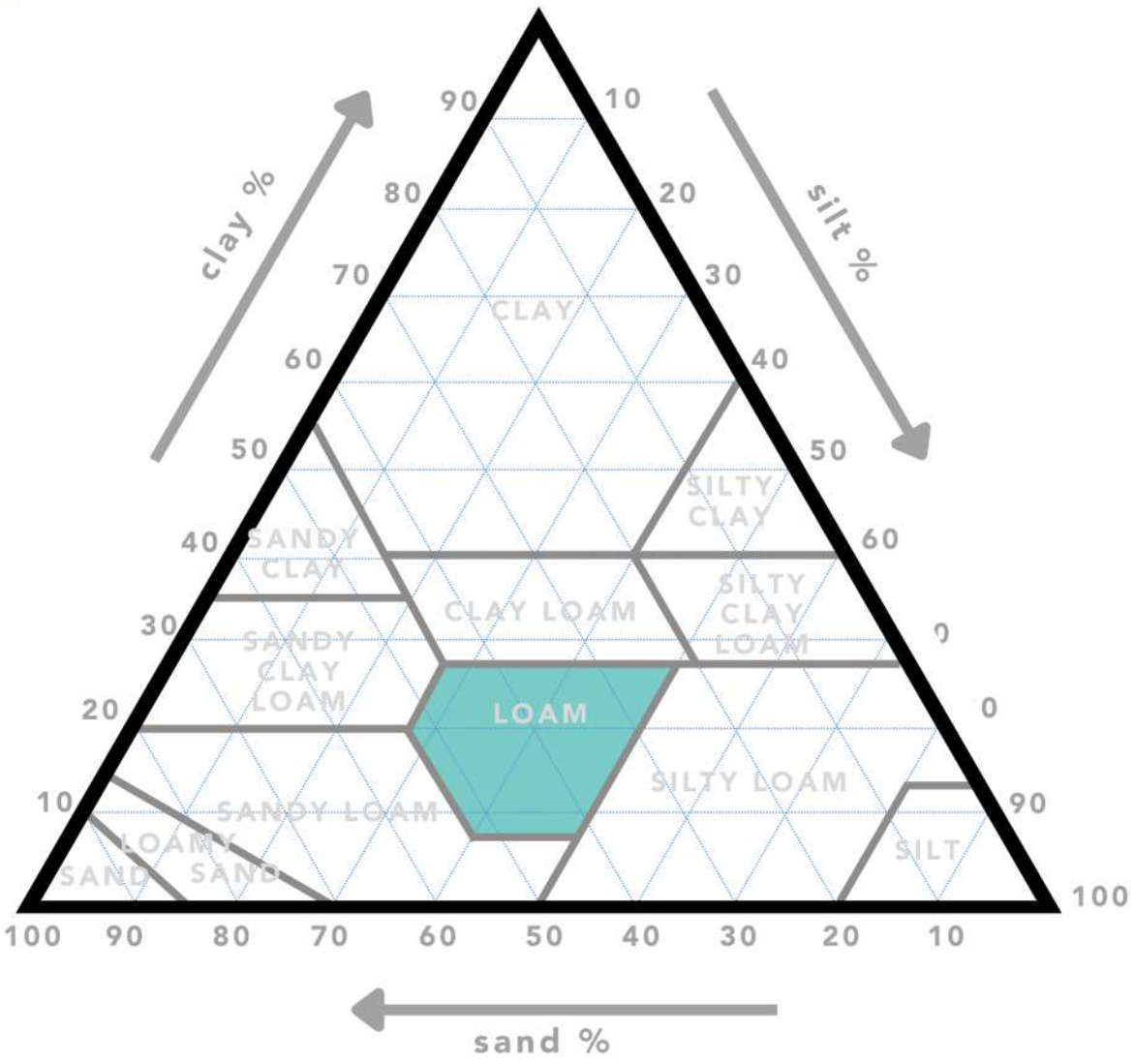


Recommendations for thresholds

Setpoint high: 46%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses
Setpoint low: 38%
Irrigation point (pF3.3), prevents water stress on the plant.

All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.

LOAM

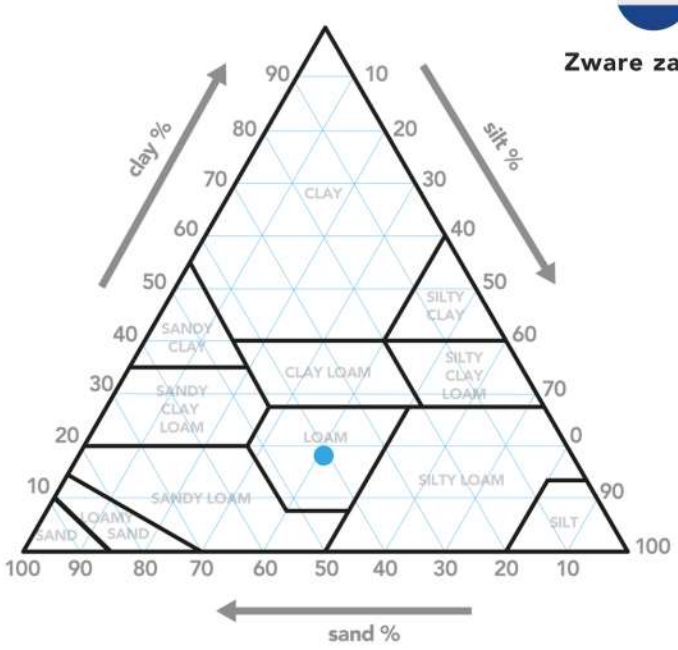

clay %
silt %
sand %
CLAY
SILTY CLAY
SANDY CLAY
CLAY LOAM
SILTY CLAY LOAM
SANDY CLAY LOAM
LOAM
SILTY LOAM
SANDY LOAM
LOAMY SAND
SILT
90
80
70
60
50
40
30
20
10
100

LOAM 1

(12.1% Organic Matter)

SENSOTERRA

Zware zavel 1 | Lhem 1 | Franca 1 | Limon 1

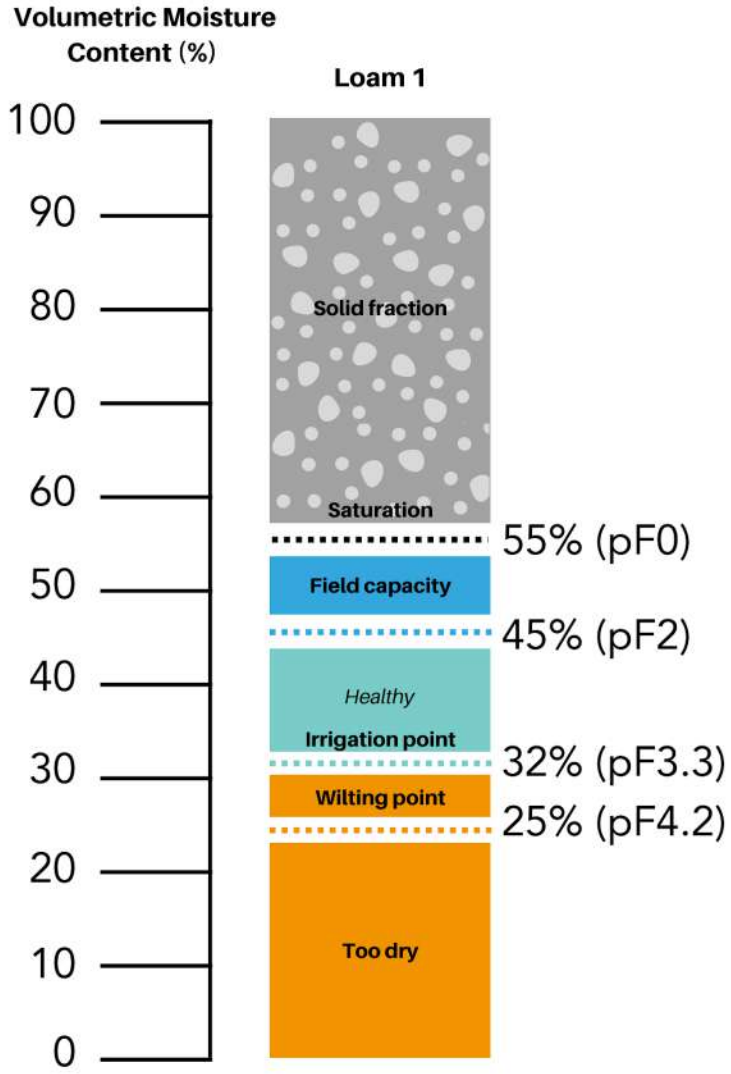


Composition

Clay - 19%
Silt - 41%
Sand - 40%
Organic Matter - 12.1%

Characteristics

Loam is a soil with a significant amount of clay, silt and sand. This results in a soil with good structure, as well as good water and nutrient holding capability.



Recommendations for thresholds

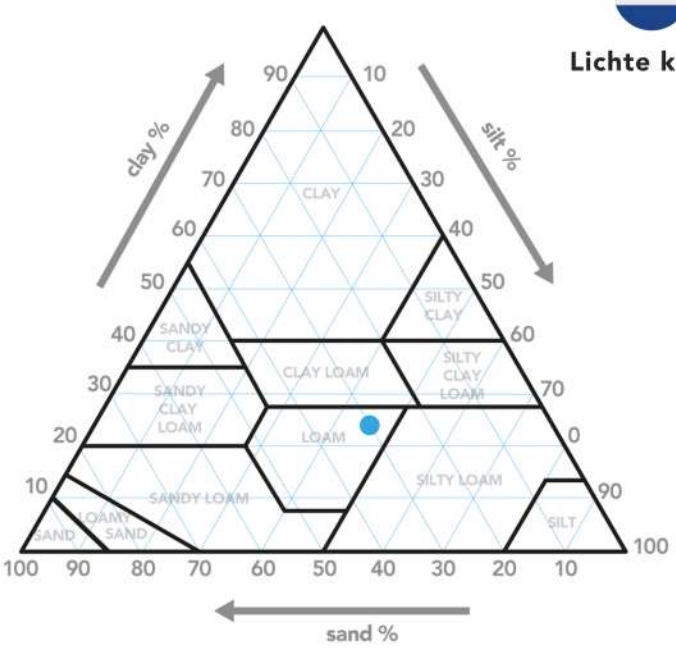
Setpoint high: 45%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses
Setpoint low: 32%
Irrigation point (pF3.3), prevents water stress on the plant.

All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.

LOAM 2
(3% Organic Matter)

SENSOTERRA

Lichte klei 2 | Lhem 2 | Franca 2 | Limon 2

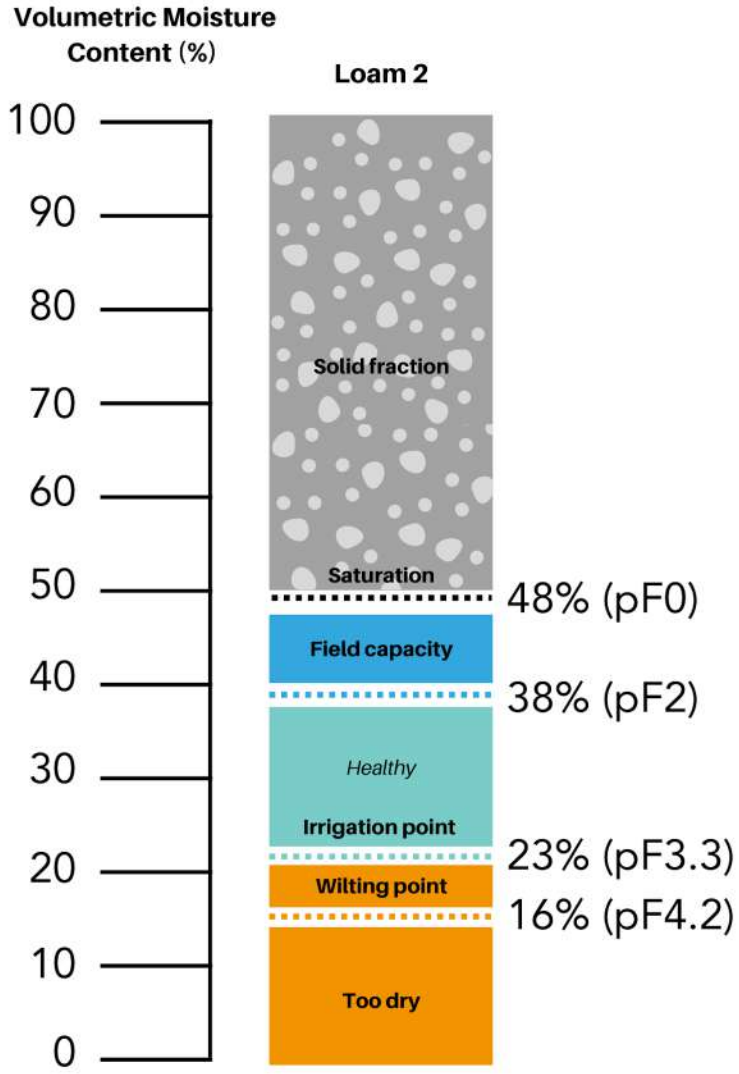


Composition

Clay - 26%
Silt - 47%
Sand - 28%
Organic Matter - 3%

Characteristics

Loam is a soil with a significant amount of clay, silt and sand. This results in a soil with good structure, as well as good water and nutrient holding capability.



Recommendations for thresholds

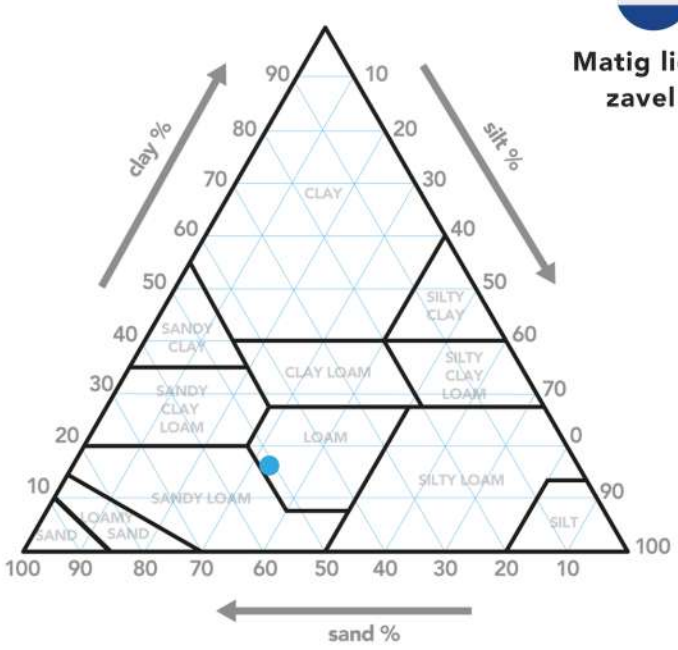
Setpoint high: 38%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses
Setpoint low: 23%
Irrigation point (pF3.3), prevents water stress on the plant.

All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.

LOAM 3
(2.6% Organic Matter)

SENSOTERRA

Matig lichte zavel 4 | Lhem 3 | Franca 3 | Limon 3

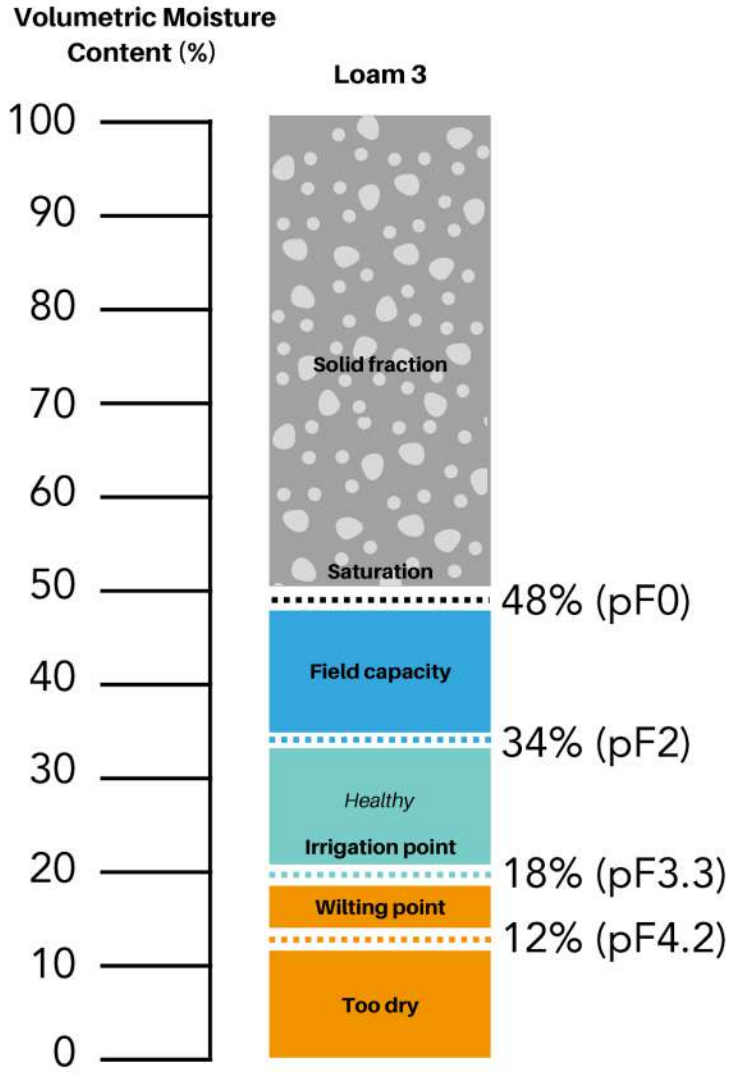


Composition

Clay - 15%
Silt - 33%
Sand - 52%
Organic Matter - 2.6%

Characteristics

Loam is a soil with a significant amount of clay, silt and sand. This results in a soil with good structure, as well as good water and nutrient holding capability.

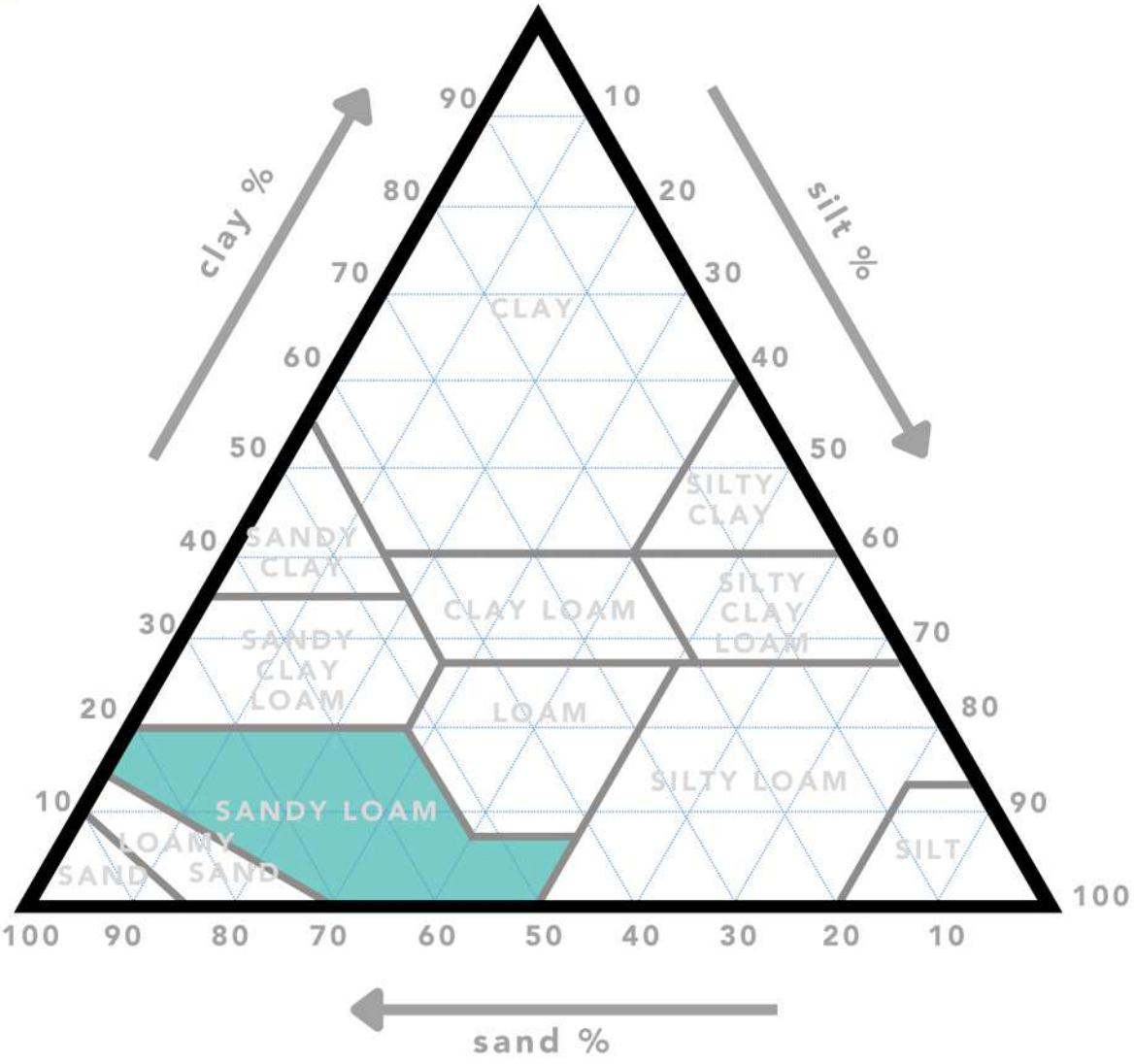


Recommendations for thresholds

Setpoint high: 34%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses
Setpoint low: 18%
Irrigation point (pF3.3), prevents water stress on the plant.

All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.

SANDY LOAM

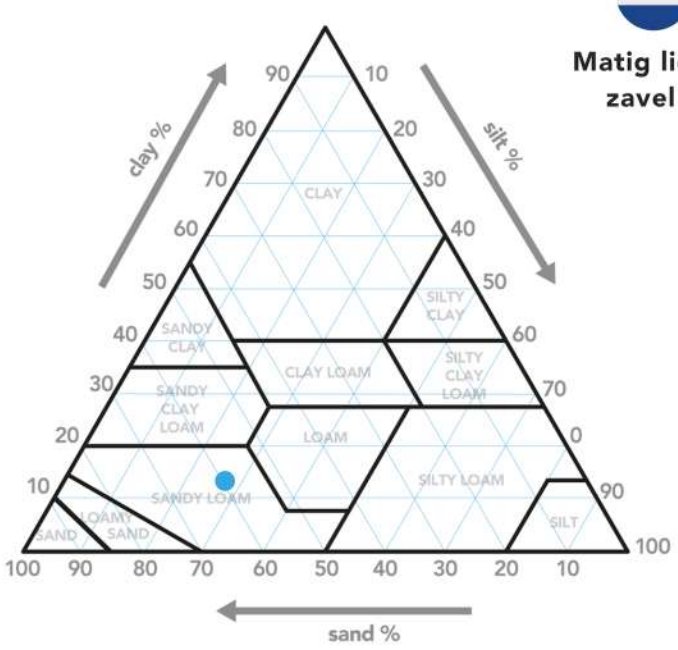

clay %
silt %
sand %
90
80
70
60
50
40
30
20
10
100
CLAY
SILTY CLAY
SANDY CLAY
CLAY LOAM
SILTY CLAY LOAM
SANDY CLAY LOAM
LOAM
SILTY LOAM
SANDY LOAM
LOAMY SAND
SAND
SILT

SANDY LOAM 1

(2.3% Organic Matter)

SENSOTERRA

Matig lichte zavel 1 | Sandiger Lhem 1 | Franco arenosa 1 | Limon sableux 1



Composition

Clay - 13%
Silt - 28%
Sand - 59%
Organic Matter - 2.3%

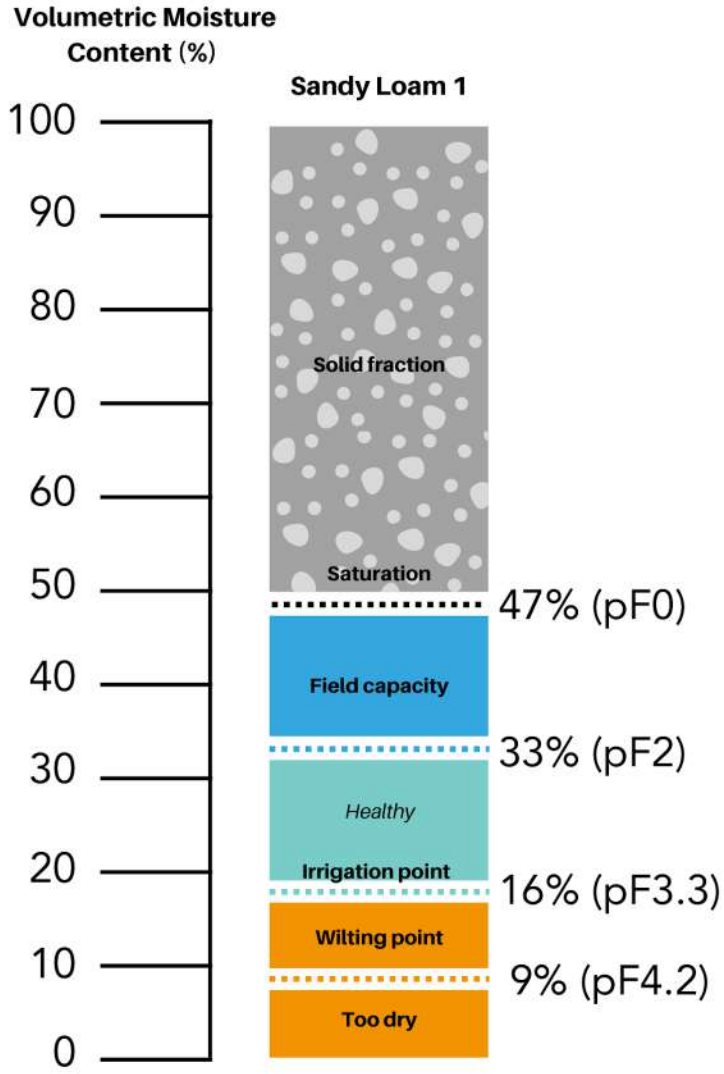
Characteristics

Loam is a soil with a significant amount of clay, silt and sand. This results in a soil with good structure, as well as good water and nutrient holding capability. Sandy loams have a higher percentage of sand than loam soils, resulting in a slightly better structure but inferior water holding capabilities compared to loam.

Recommendations for thresholds

Setpoint high: 33%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses
Setpoint low: 16%
Irrigation point (pF3.3), prevents water stress on the plant.

All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.

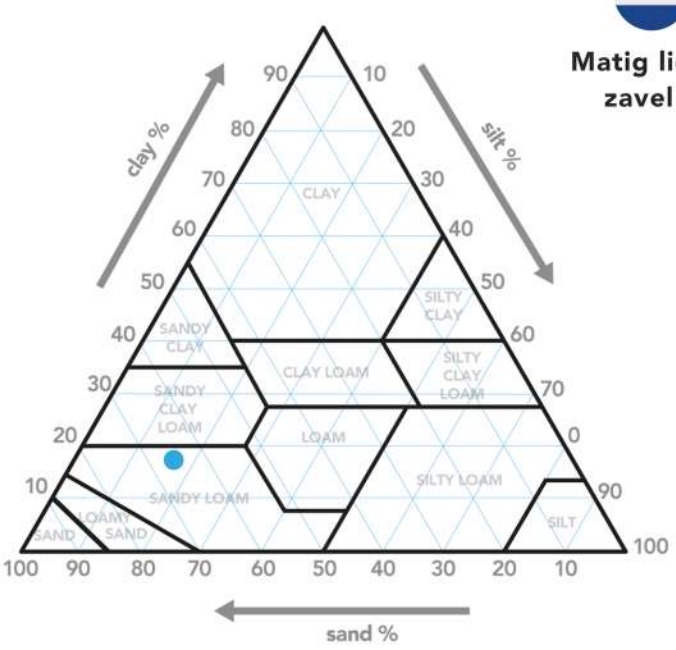


SANDY LOAM 2

(7.2% Organic Matter)

SENSOTERRA

Matig lichte zavel 2 | Sandiger Lhem 2 | Franco arenosa 2 | Limon sableux 2

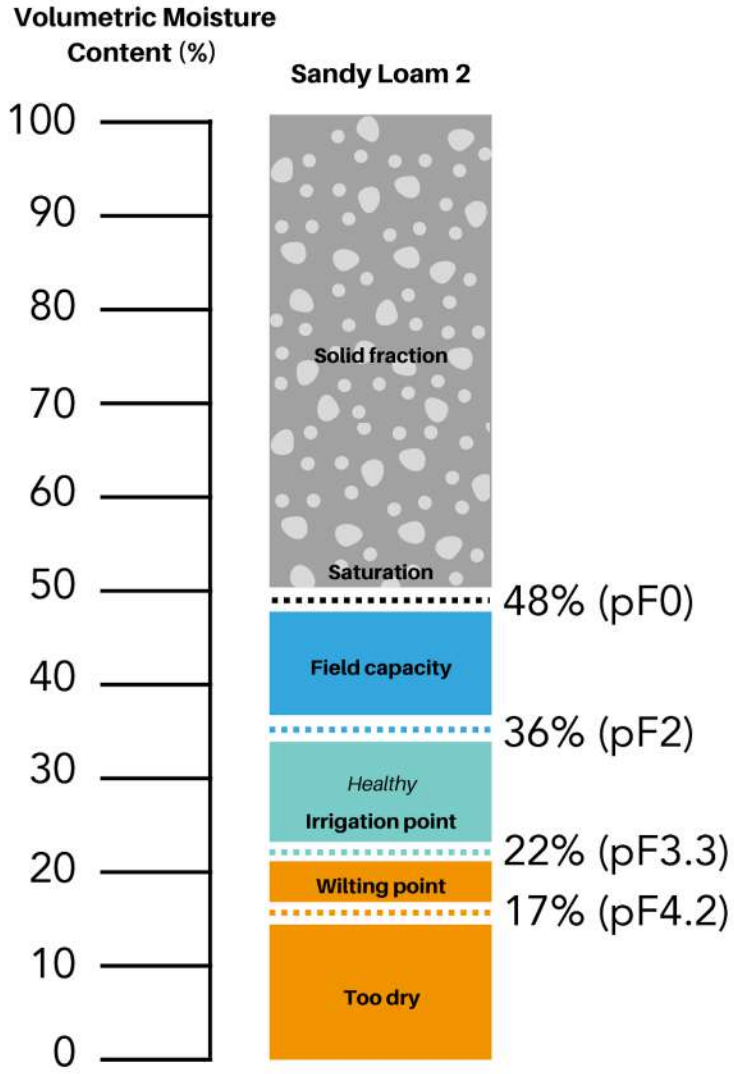


Composition

Clay - 17%
Silt - 18%
Sand - 65%
Organic Matter - 7.2%

Characteristics

Loam is a soil with a significant amount of clay, silt and sand. This results in a soil with good structure, as well as good water and nutrient holding capability. Sandy loams have a higher percentage of sand than loam soils, resulting in a slightly better structure but inferior water holding capabilities compared to loam.



Recommendations for thresholds

Setpoint high: 36%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses
Setpoint low: 22%
Irrigation point (pF3.3), prevents water stress on the plant.

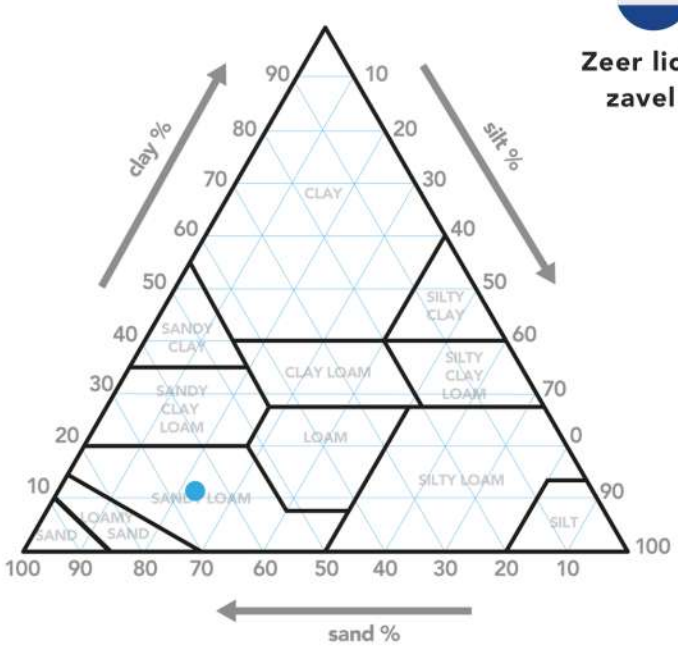
All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.

SANDY LOAM 3

(3.2% Organic Matter)

SENSOTERRA

Zeer lichte zavel 1 | Sandiger Lhem 3 | Franco arenosa 3 | Limon sableux 3

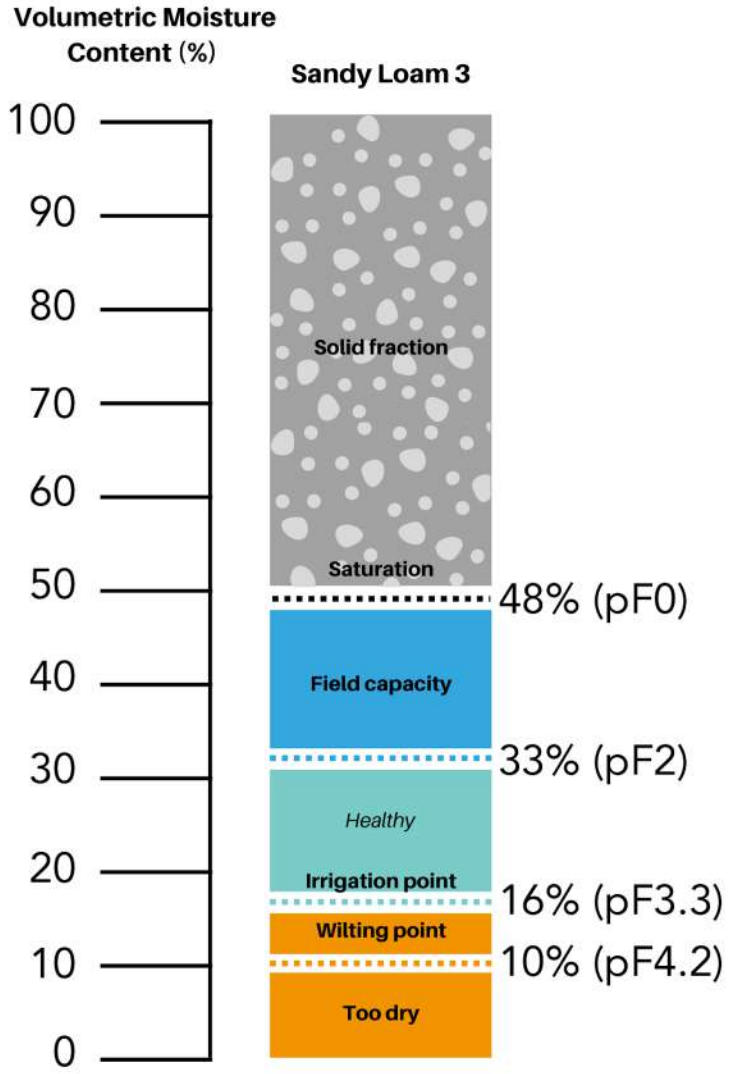


Composition

Clay - 10%
Silt - 26%
Sand - 64%
Organic Matter - 3.2%

Characteristics

Loam is a soil with a significant amount of clay, silt and sand. This results in a soil with good structure, as well as good water and nutrient holding capability. Sandy loams have a higher percentage of sand than loam soils, resulting in a slightly better structure but inferior water holding capabilities compared to loam.



Recommendations for thresholds

Setpoint high: 33%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses
Setpoint low: 16%
Irrigation point (pF3.3), prevents water stress on the plant.

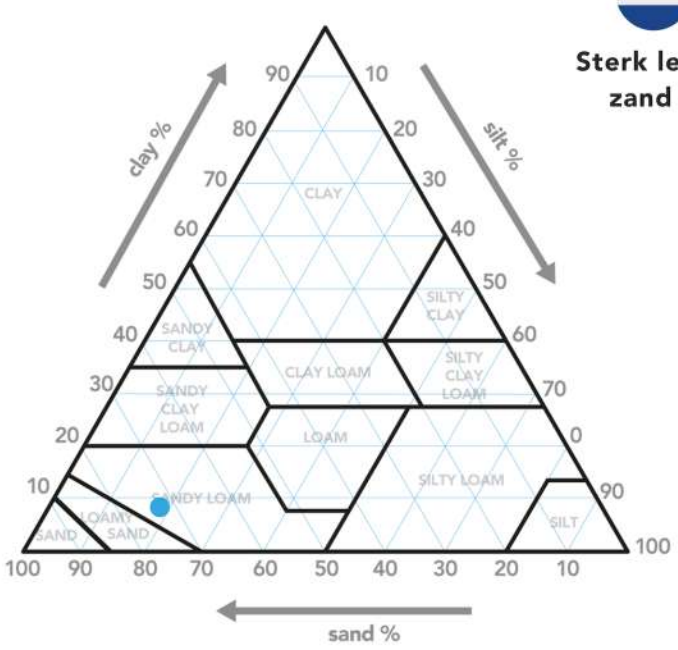
All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.

SANDY LOAM 4

(4.4% Organic Matter)

SENSOTERRA

Sterk lemig zand 1 | Sandiger Lhem 4 | Franco arenosa 4 | Limon sableux 4



Composition

Clay - 7%
Silt - 18%
Sand - 75%
Organic Matter - 4.4%

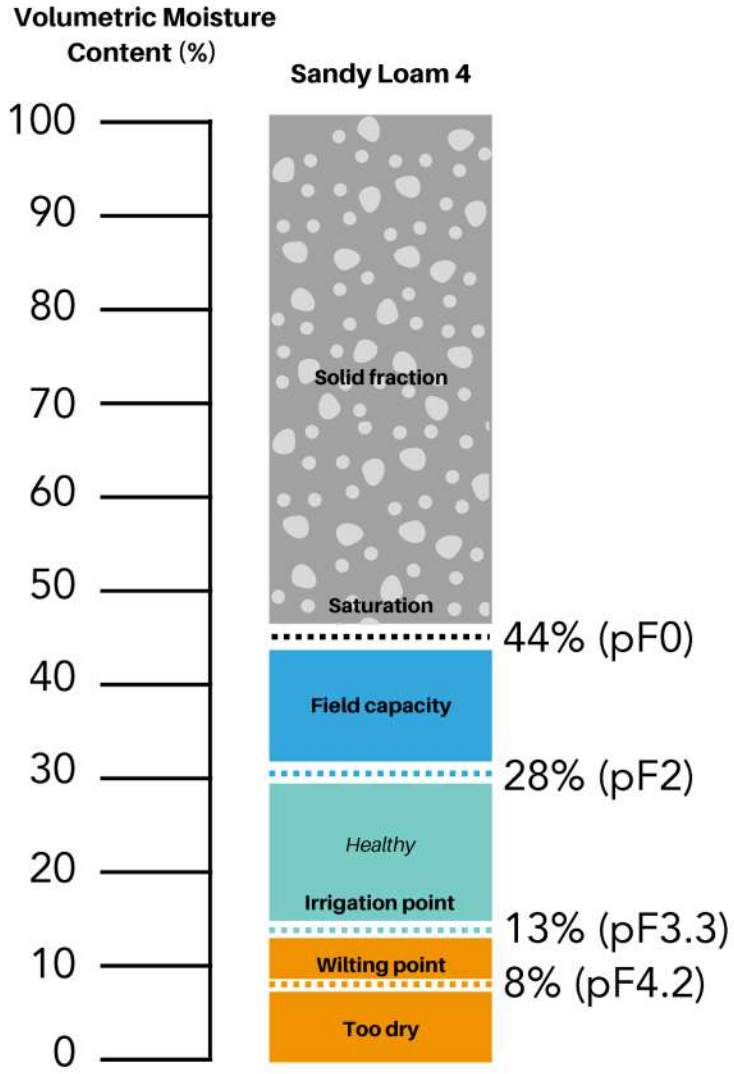
Characteristics

Loam is a soil with a significant amount of clay, silt and sand. This results in a soil with good structure, as well as good water and nutrient holding capability. Sandy loams have a higher percentage of sand than loam soils, resulting in a slightly better structure but inferior water holding capabilities compared to loam.

Recommendations for thresholds

Setpoint high: 28%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses
Setpoint low: 13%
Irrigation point (pF3.3), prevents water stress on the plant.

All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.

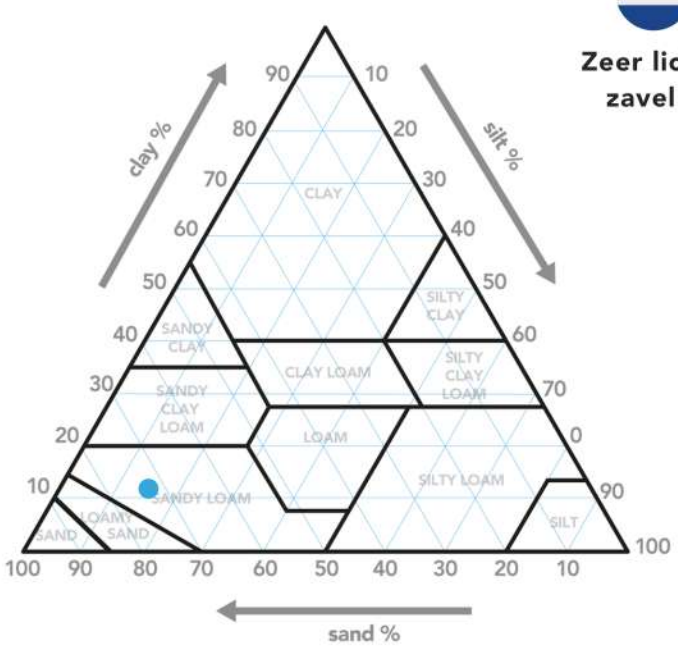


SANDY LOAM 5

(6.8% Organic Matter)

SENSOTERRA

Zeer lichte zavel 2 | Sandiger Lhem 5 | Franco arenosa 5 | Limon sableux 5

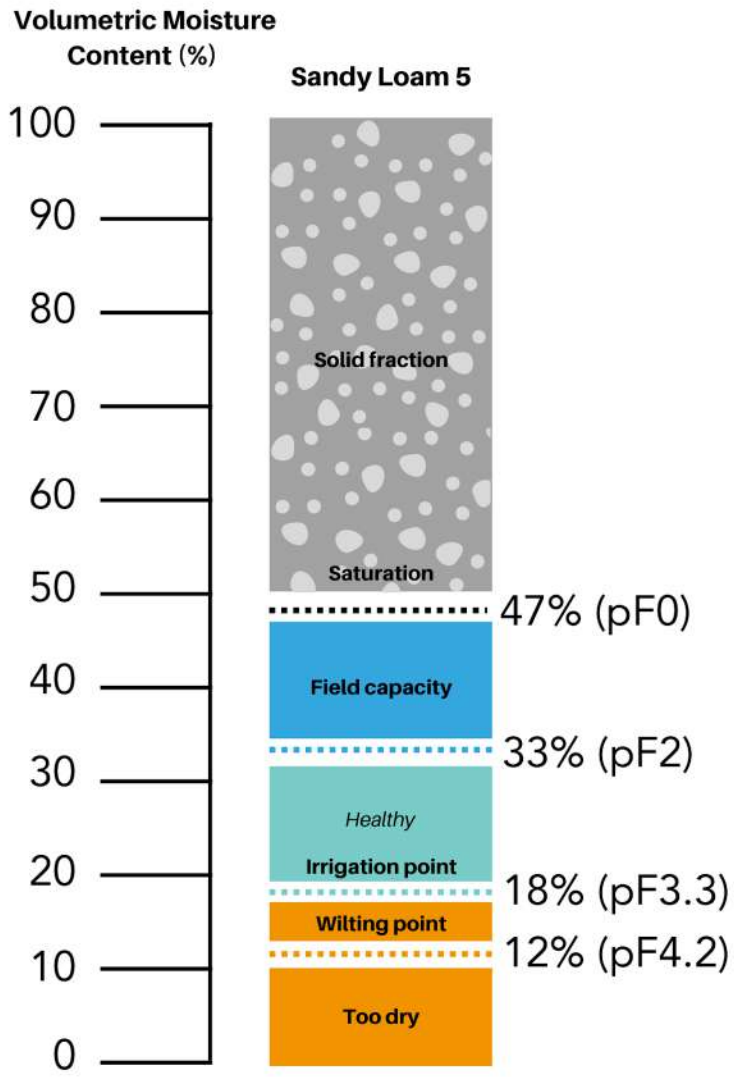


Composition

Clay - 11%	Sand - 74%
Silt - 15%	Organic Matter - 6.8%

Characteristics

Loam is a soil with a significant amount of clay, silt and sand. This results in a soil with good structure, as well as good water and nutrient holding capability. Sandy loams have a higher percentage of sand than loam soils, resulting in a slightly better structure but inferior water holding capabilities compared to loam.



Recommendations for thresholds

Setpoint high: 33%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses

Setpoint low: 18%
Irrigation point (pF3.3), prevents water stress on the plant.

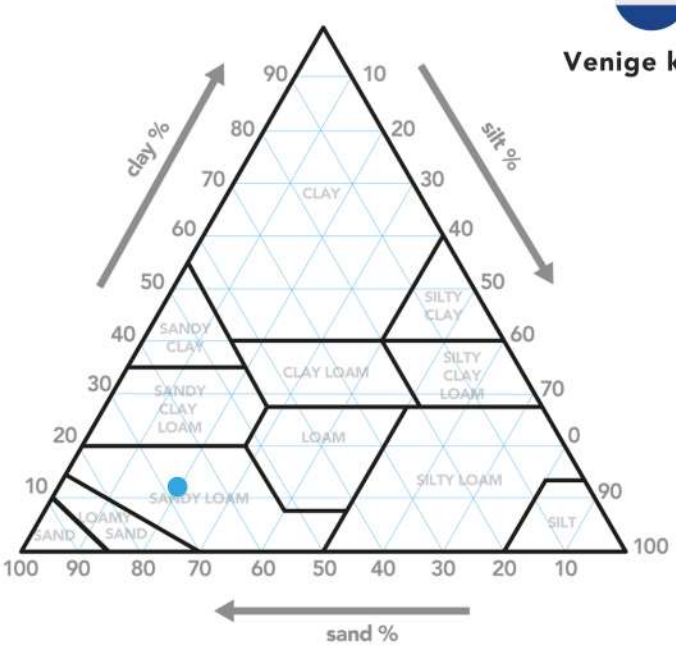
All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.

SANDY LOAM 6

(26% Organic Matter)

SENSOTERRA

Venige klei 1 | Sandiger Lhem 6 | Franco arenosa 6 | Limon sableux 6



Composition

Clay - 11%
Silt - 21%
Sand - 68%
Organic Matter - 26%

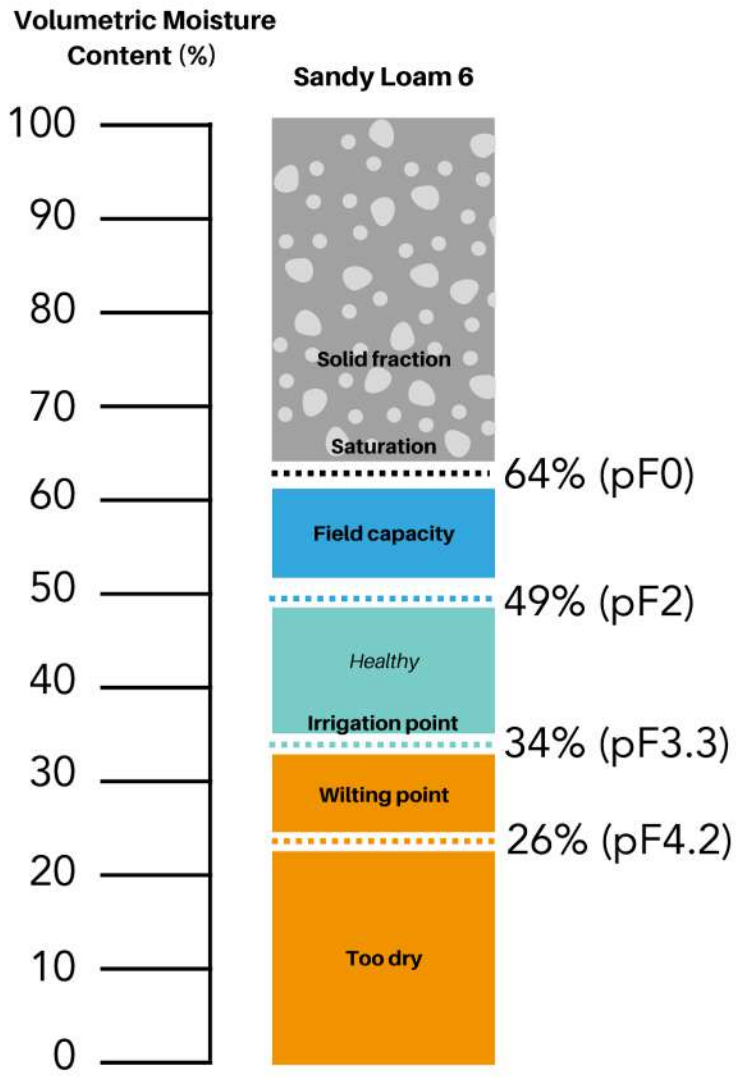
Characteristics

Sandy loam highly rich in organic matter is mostly used in greenhouse applications. This is a soil with good structure and water holding capabilities.

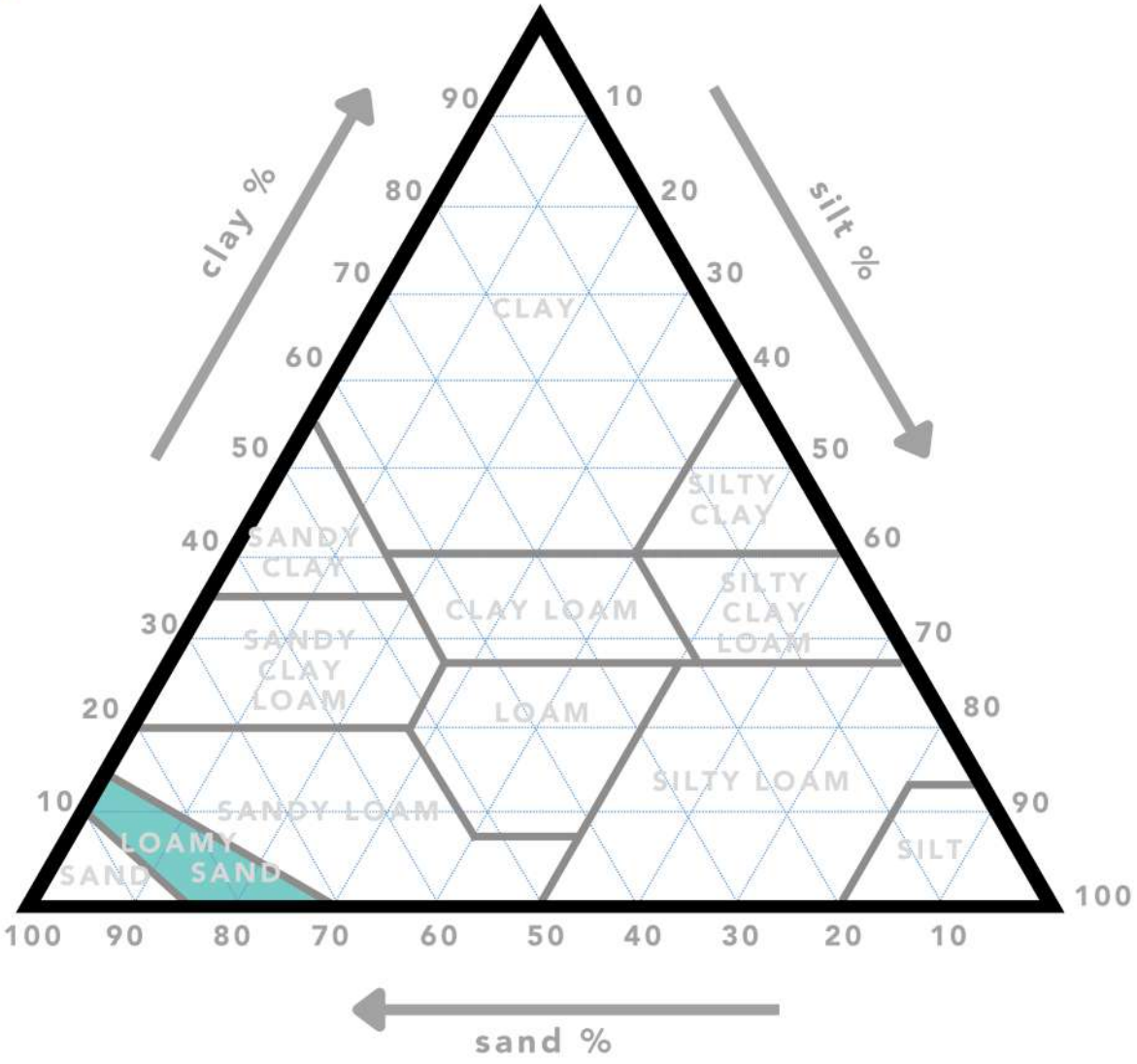
Recommendations for thresholds

Setpoint high: 49%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses
Setpoint low: 34%
Irrigation point (pF3.3), prevents water stress on the plant.

All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.



LOAMY SAND

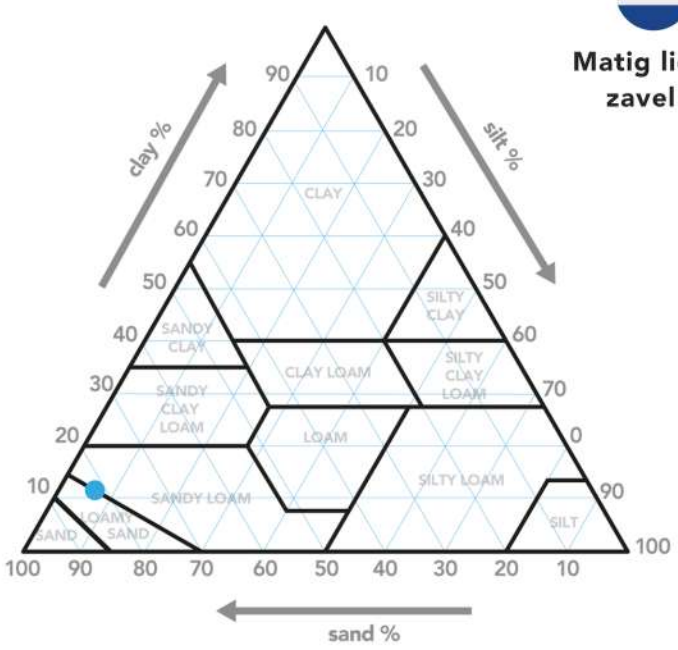

clay %
silt %
sand %
90
80
70
60
50
40
30
20
10
100
CLAY
SILTY CLAY
SANDY CLAY
CLAY LOAM
SILTY CLAY LOAM
SANDY CLAY LOAM
LOAM
SILTY LOAM
SANDY LOAM
LOAMY SAND
SAND
SILT

LOAMY SAND 1

(0.6% Organic Matter)

SENSOTERRA

Matig lichte zavel 2 | Lehmiger Sand 1 | Areno francosa 1 | Sable limoneux 1

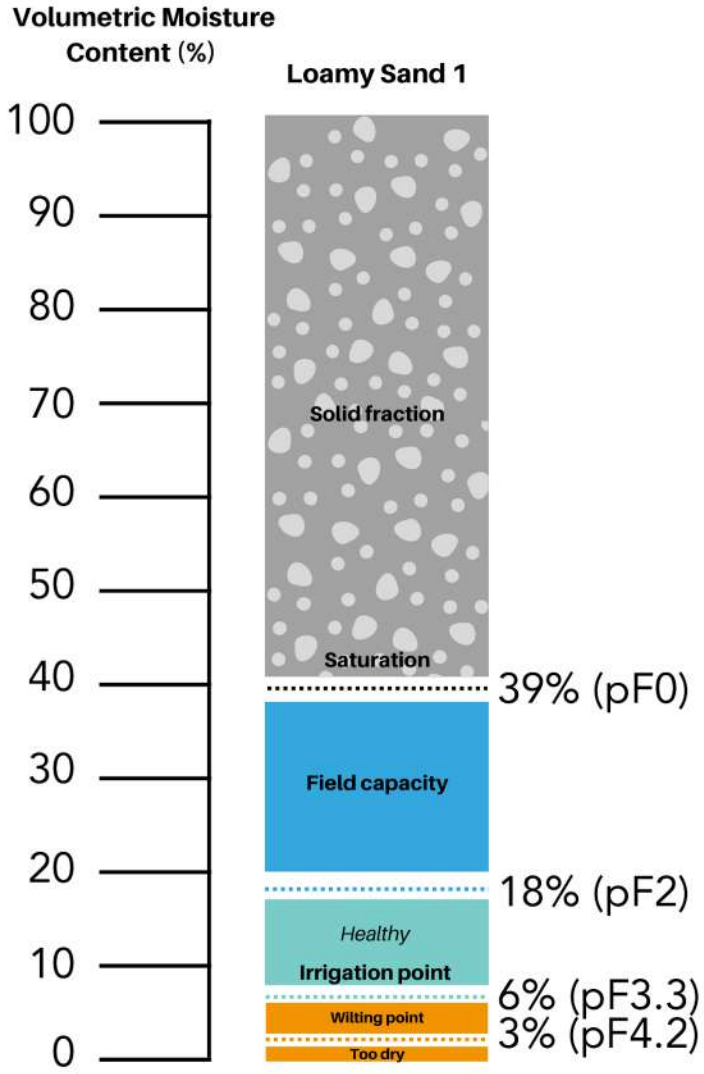


Composition

Clay - 12%	Sand - 82%
Silt - 6%	Organic Matter - 0.6%

Characteristics

Loamy sand soils have a high sand percentage, but the small proportion of silt and clay results in a better water and nutrient holding capability than sandy soils. These soils are easy to work with and to cultivate. They have rapid infiltration and good drainage.



Recommendations for thresholds

Setpoint high: 18%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses

Setpoint low: 6%
Irrigation point (pF3.3), prevents water stress on the plant.

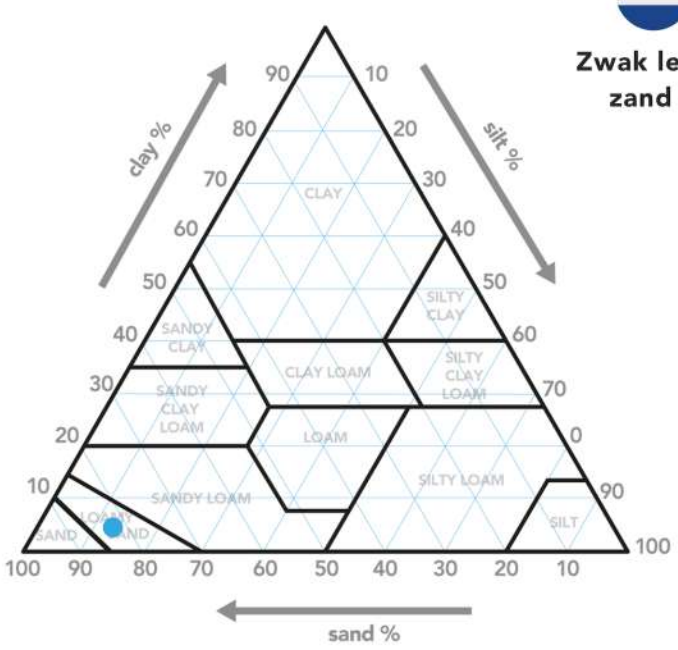
All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.

LOAMY SAND 2

(2.5% Organic Matter)

SENSOTERRA

Zwak lemig zand 1 | Lehmiger Sand 2 | Areno francosa 2 | Sable limoneux 2

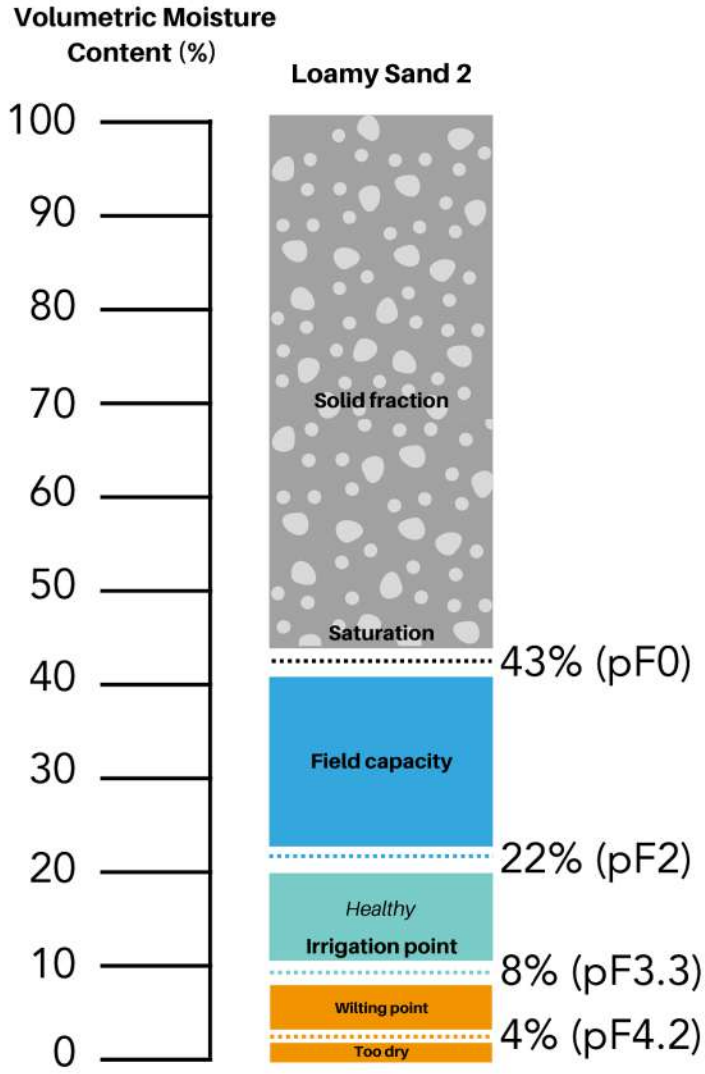


Composition

Clay - 3%
Silt - 14%
Sand - 83%
Organic Matter - 2.5%

Characteristics

Loamy sand soils have a high sand percentage, but the small proportion of silt and clay results in a better water and nutrient holding capability than sandy soils. These soils are easy to work with and to cultivate. They have rapid infiltration and good drainage.



Recommendations for thresholds

Setpoint high: 22%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses
Setpoint low: 8%
Irrigation point (pF3.3), prevents water stress on the plant.

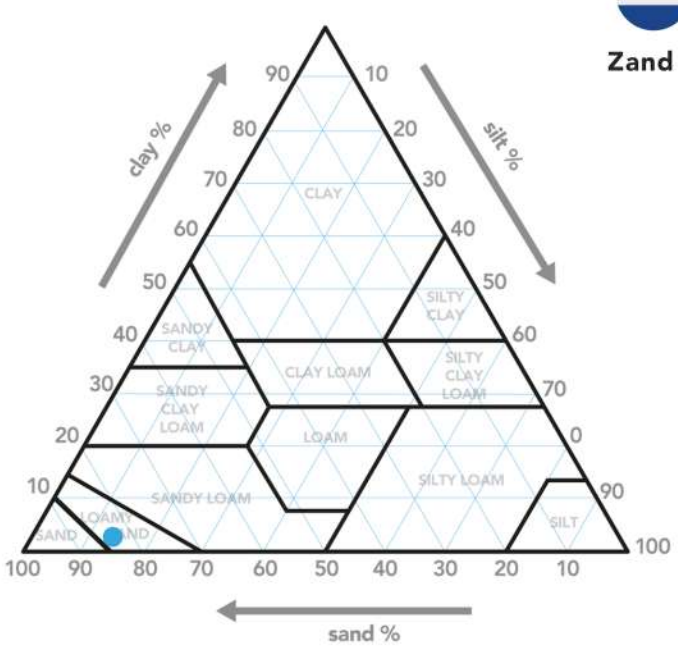
All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.

LOAMY SAND 3

(3.2% Organic Matter)

SENSOTERRA

Zand 6 | Lehmiger Sand 3 | Areno francosa 3 | Sable limoneux 3

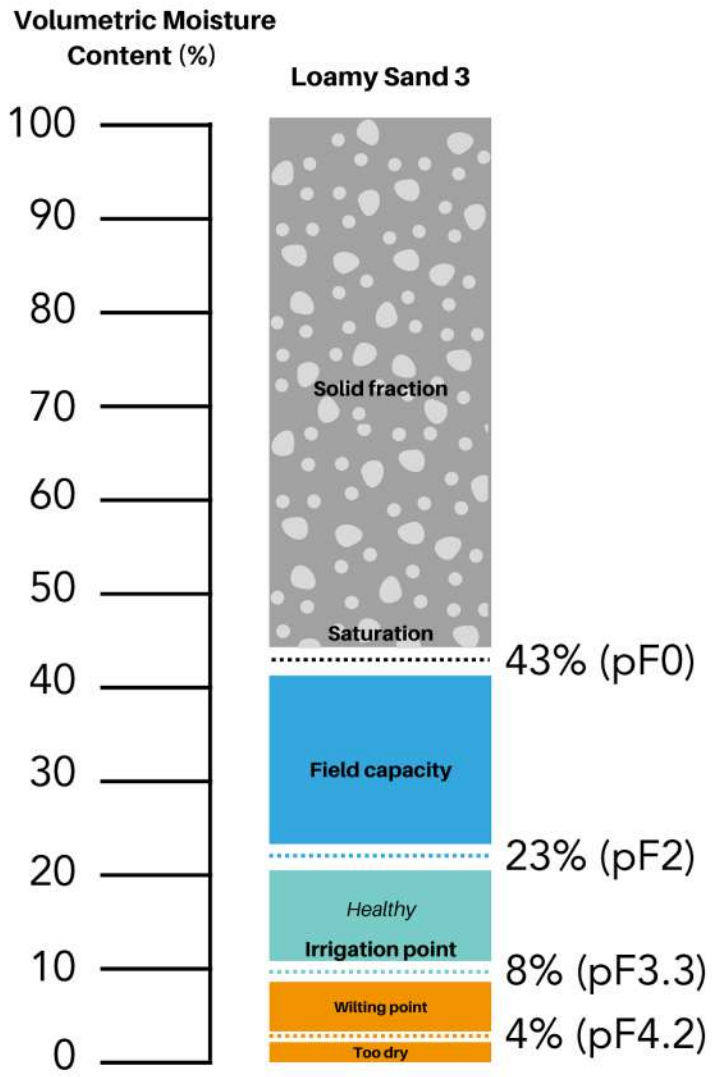


Composition

Clay - 2%
Silt - 13%
Sand - 85%
Organic Matter - 3.2%

Characteristics

Loamy sand soils have a high sand percentage, but the small proportion of silt and clay results in a better water and nutrient holding capability than sandy soils. These soils are easy to work with and to cultivate. They have rapid infiltration and good drainage.



Recommendations for thresholds

Setpoint high: 23%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses
Setpoint low: 8%
Irrigation point (pF3.3), prevents water stress on the plant.

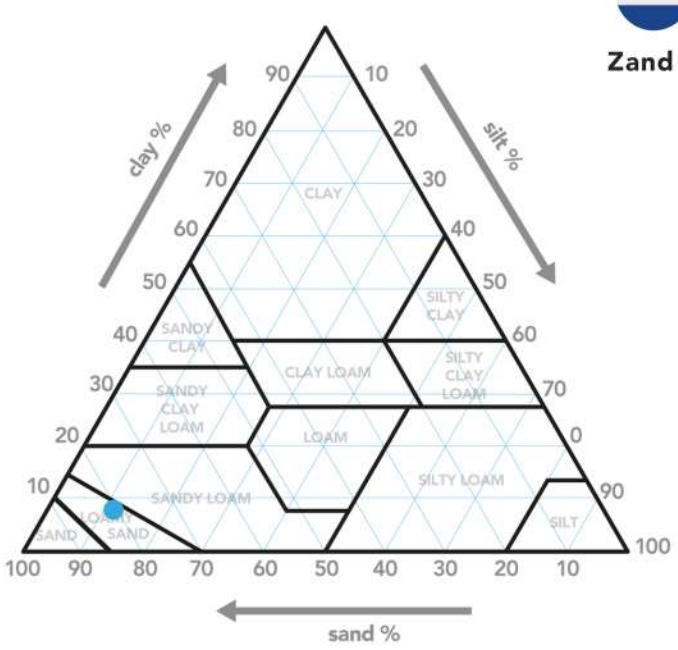
All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.

LOAMY SAND 4

(4.9% Organic Matter)

SENSOTERRA

Zand 7 | Lehmiger Sand 4 | Areno francosa 4 | Sable limoneux 4

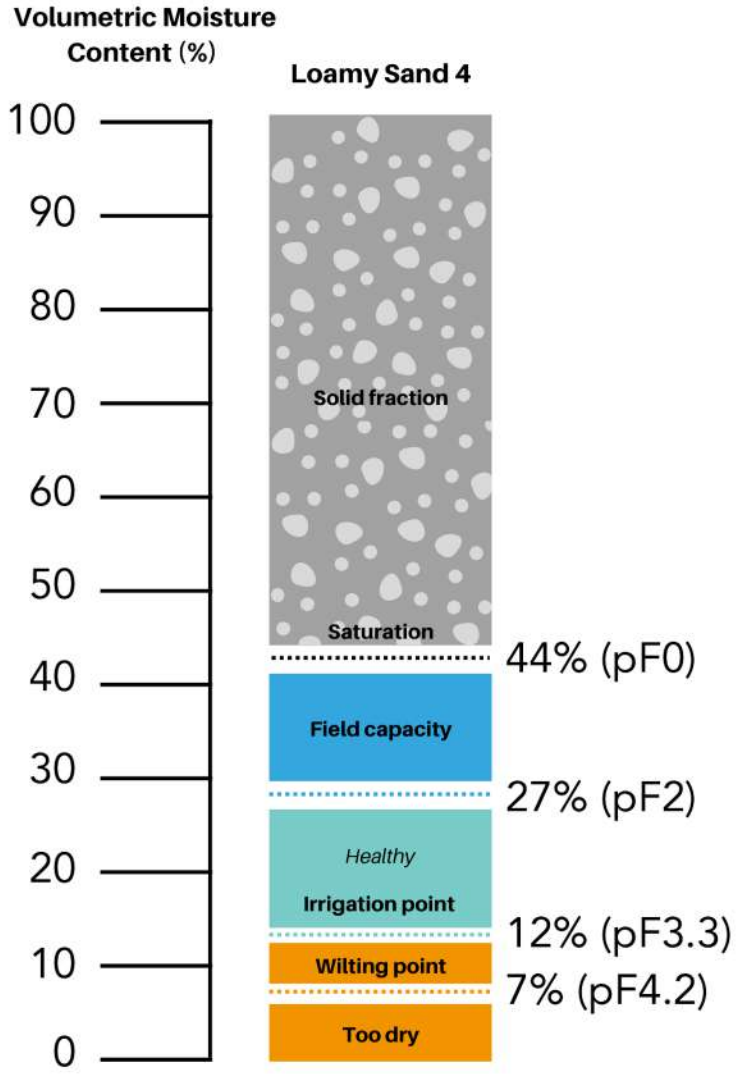


Composition

Clay - 7%
Silt - 12%
Sand - 81%
Organic Matter - 4.9%

Characteristics

Loamy sand soils have a high sand percentage, but the small proportion of silt and clay results in a better water and nutrient holding capability than sandy soils. These soils are easy to work with and to cultivate. They have rapid infiltration and good drainage.

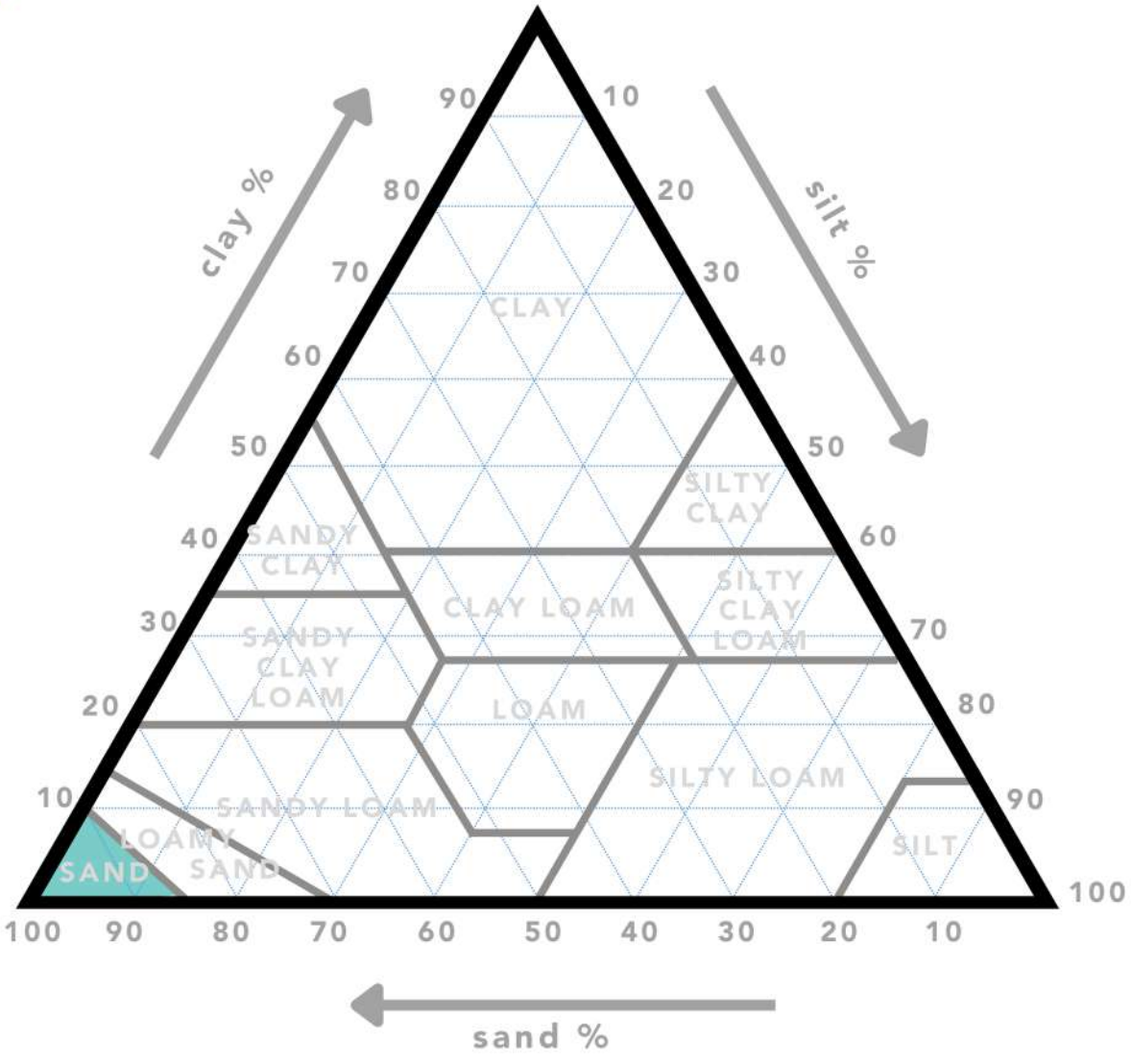


Recommendations for thresholds

Setpoint high: 27%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses
Setpoint low: 12%
Irrigation point (pF3.3), prevents water stress on the plant.

All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.

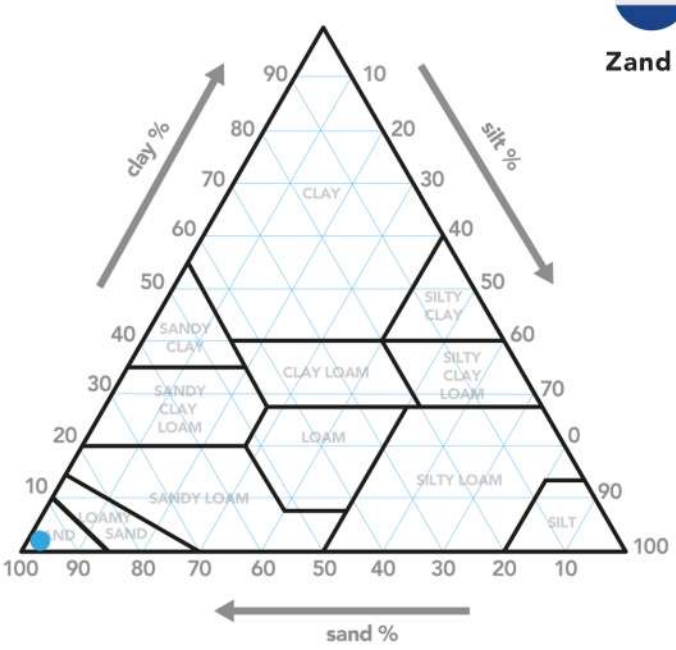
SAND


clay %
silt %
sand %
90
80
70
60
50
40
30
20
10
100
CLAY
SILTY CLAY
SANDY CLAY
CLAY LOAM
SILTY CLAY LOAM
SANDY CLAY LOAM
LOAM
SILTY LOAM
SANDY LOAM
LOAMY SAND
SAND
SILT

SAND 1
(0% Organic Matter)

SENSOTERRA

Zand 1 | Sand 1 | Arenosa 1 | Sable 1



Composition

Clay - 1%
Silt - 1%
Sand - 91%
Organic Matter - 0%

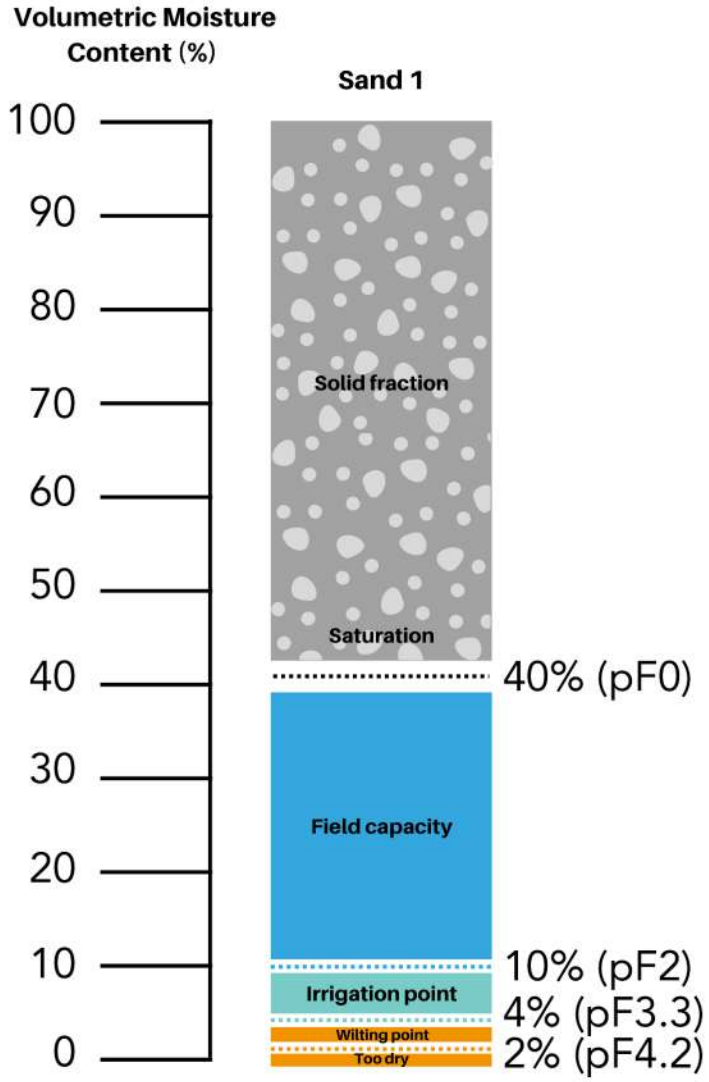
Characteristics

Sandy soils have a relatively large particle size resulting in a limited water and nutrient holding capacity. Also called light soils, sandy soils are easy to work with and to cultivate. They have rapid infiltration and good drainage.

Recommendations for thresholds

Setpoint high: 10%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses
Setpoint low: 4%
Irrigation point (pF3.3), prevents water stress on the plant.

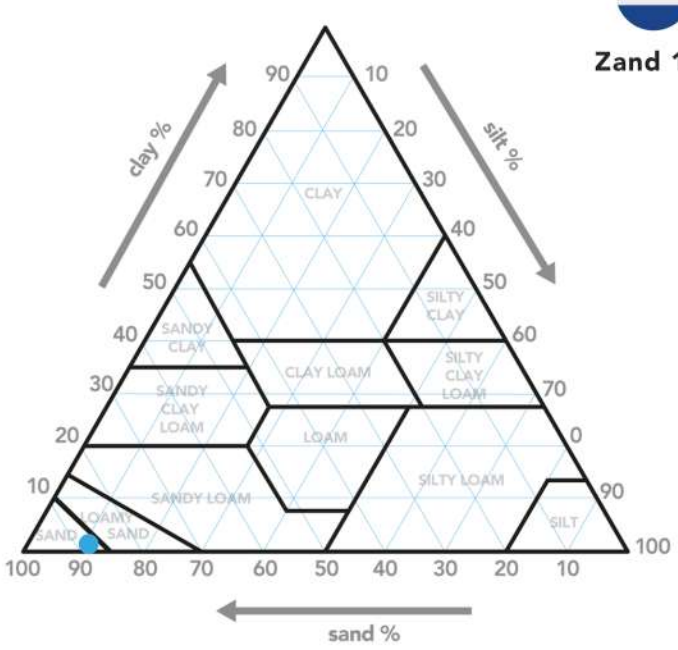
All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.



SAND 1.1
(0% Organic Matter)

SENSOTERRA

Zand 1.1 | Sand 1.1 | Arenosa 1.1 | Sable 1.1

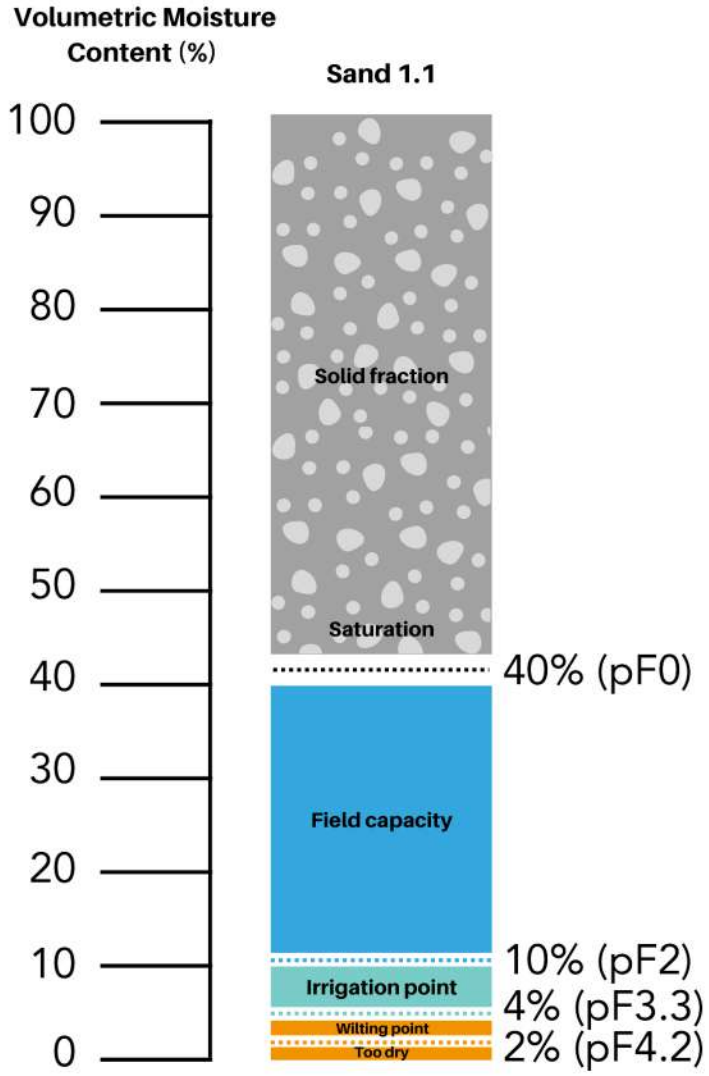


Composition

Clay - 0%
Silt - 12%
Sand - 88%
Organic Matter - 0%

Characteristics

Sandy soils have a relatively large particle size resulting in a limited water and nutrient holding capacity. Also called light soils, sandy soils are easy to work with and to cultivate. They have rapid infiltration and good drainage.



Recommendations for thresholds

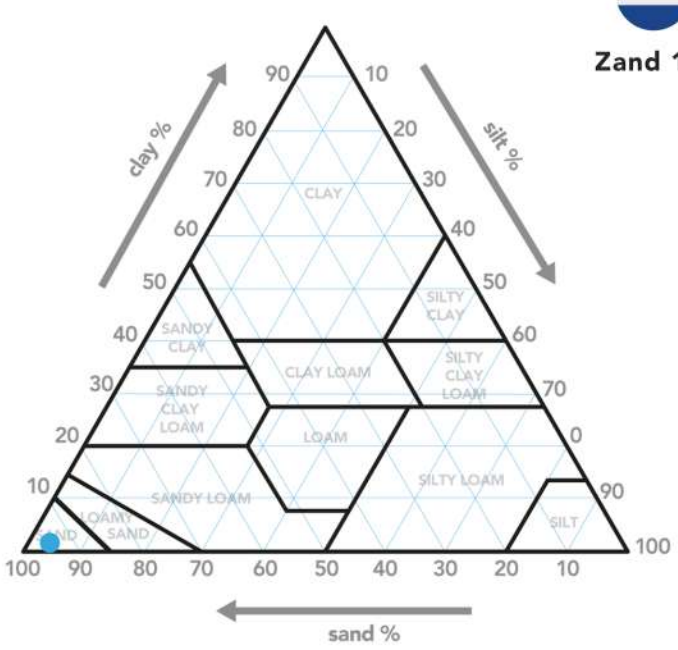
Setpoint high: 10%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses
Setpoint low: 4%
Irrigation point (pF3.3), prevents water stress on the plant.

All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.

SAND 1.2
(0% Organic Matter)

SENSOTERRA

Zand 1.2 | Sand 1.2 | Arenosa 1.2 | Sable 1.2

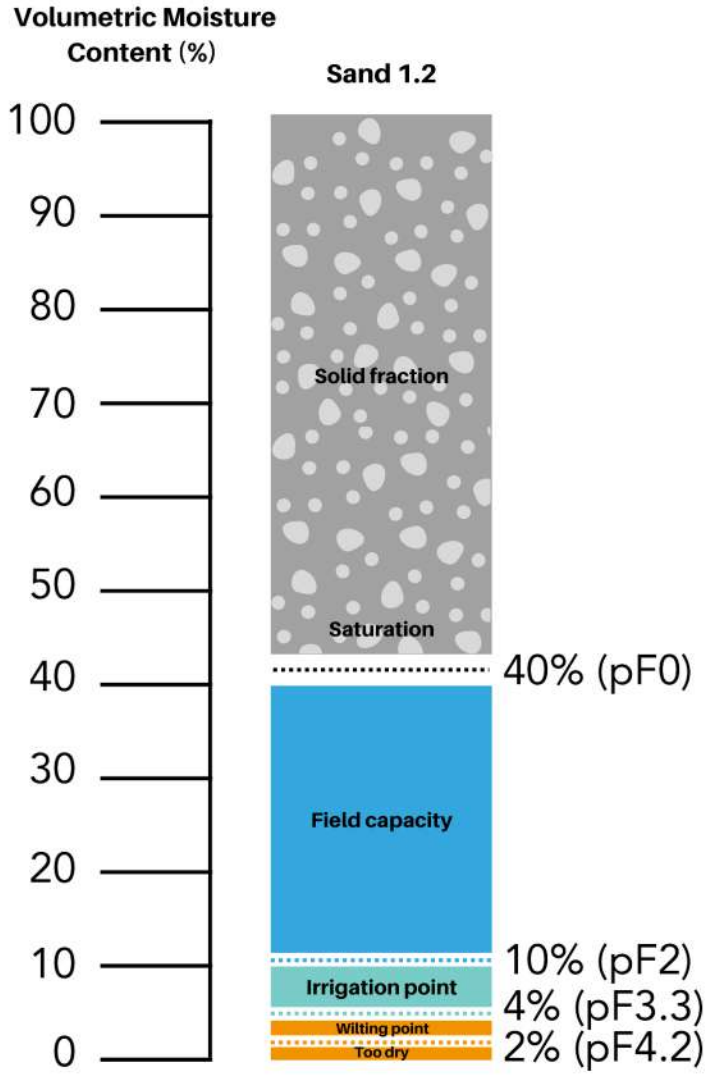


Composition

Clay - 0%
Silt - 2%
Sand - 98%
Organic Matter - 0%

Characteristics

Sandy soils have a relatively large particle size resulting in a limited water and nutrient holding capacity. Also called light soils, sandy soils are easy to work with and to cultivate. They have rapid infiltration and good drainage.



Recommendations for thresholds

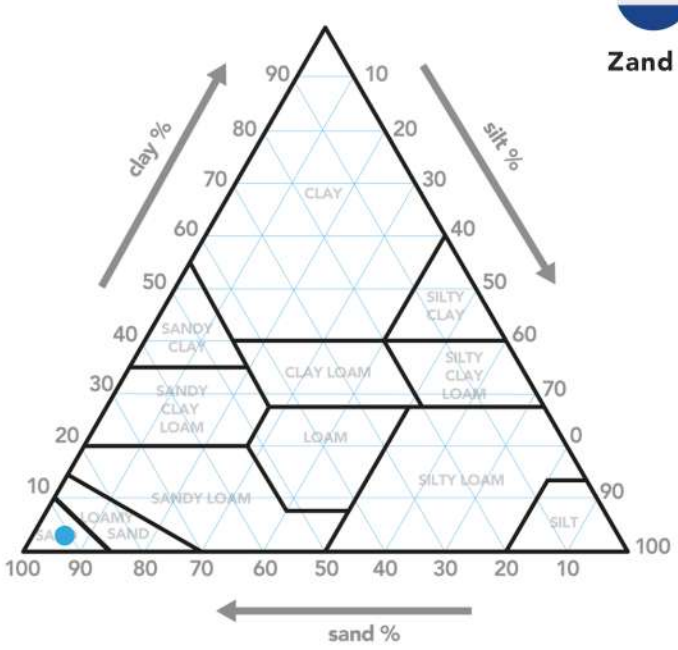
Setpoint high: 10%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses
Setpoint low: 4%
Irrigation point (pF3.3), prevents water stress on the plant.

All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.

SAND 2
(0.9% Organic Matter)

SENSOTERRA

Zand 2 | Sand 2 Geest Erde | Arenosa 2 | Sable 2

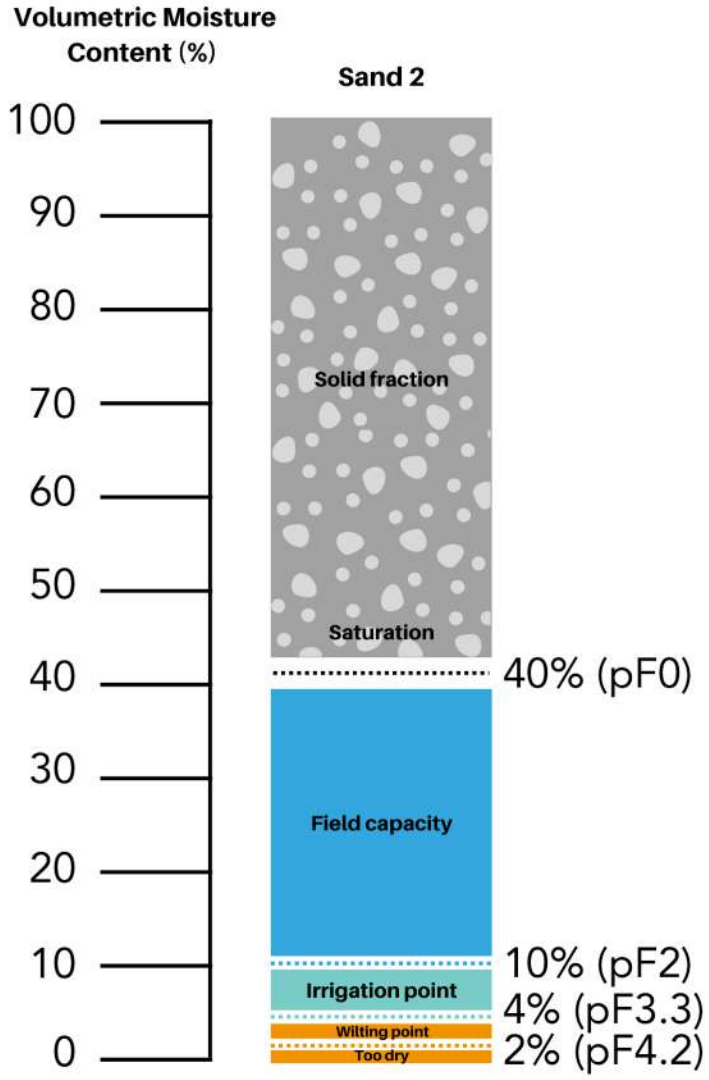


Composition

Clay - 2%
Silt - 6%
Sand - 92%
Organic Matter - 0.9%

Characteristics

Sandy soils have a relatively large particle size resulting in a limited water and nutrient holding capacity. Also called light soils, sandy soils are easy to work with and to cultivate. They have rapid infiltration and good drainage.



Recommendations for thresholds

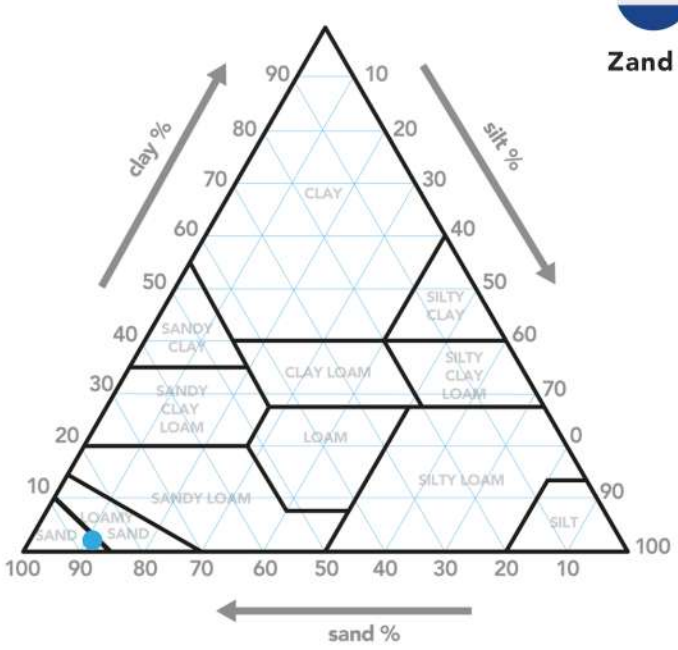
Setpoint high: 10%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses
Setpoint low: 4%
Irrigation point (pF3.3), prevents water stress on the plant.

All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.

SAND 3
(5.7% Organic Matter)

SENSOTERRA

Zand 3 | Sand 3 Baumerde | Arenosa 3 | Sable 3

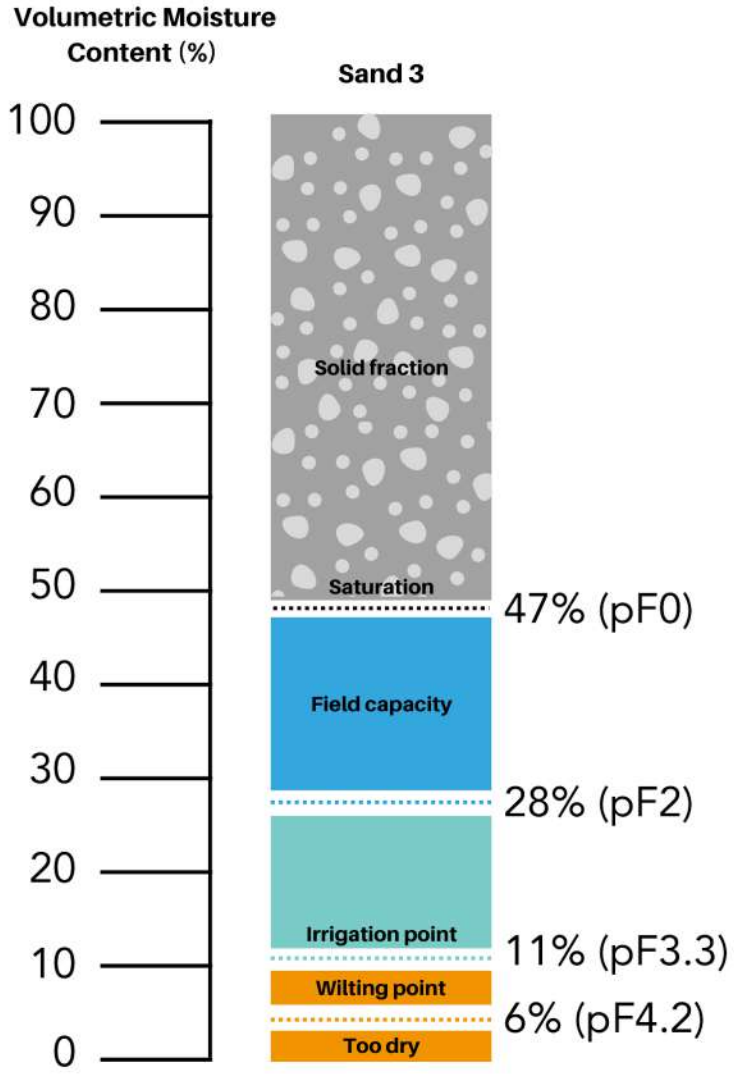


Composition

Clay - 1%
Silt - 12%
Sand - 87%
Organic Matter - 5.7%

Characteristics

Sandy soils have a relatively large particle size resulting in a limited water and nutrient holding capacity. Also called light soils, sandy soils are easy to work with and to cultivate. They have rapid infiltration and good drainage.



Recommendations for thresholds

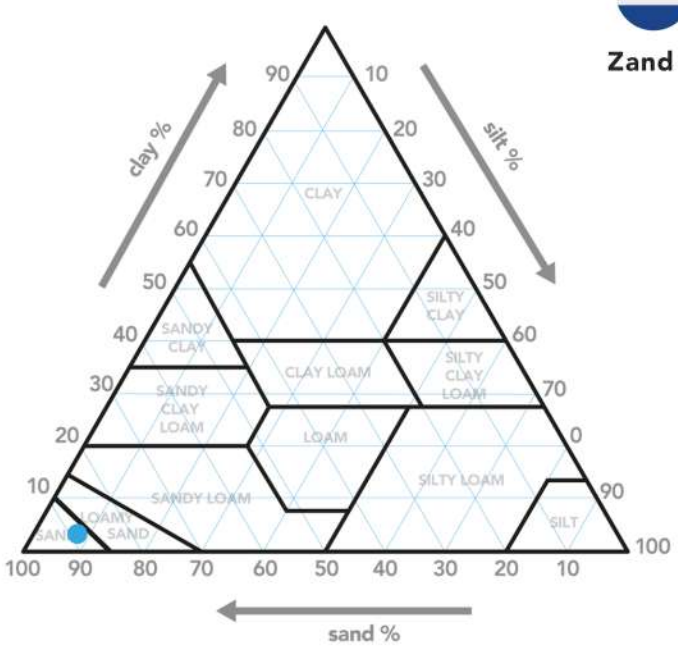
Setpoint high: 28%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses
Setpoint low: 11%
Irrigation point (pF3.3), prevents water stress on the plant.

All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.

SAND 4
(12% Organic Matter)

SENSOTERRA

Zand 4 | Sand 4 Baumerde | Arenosa 4 | Sable 4

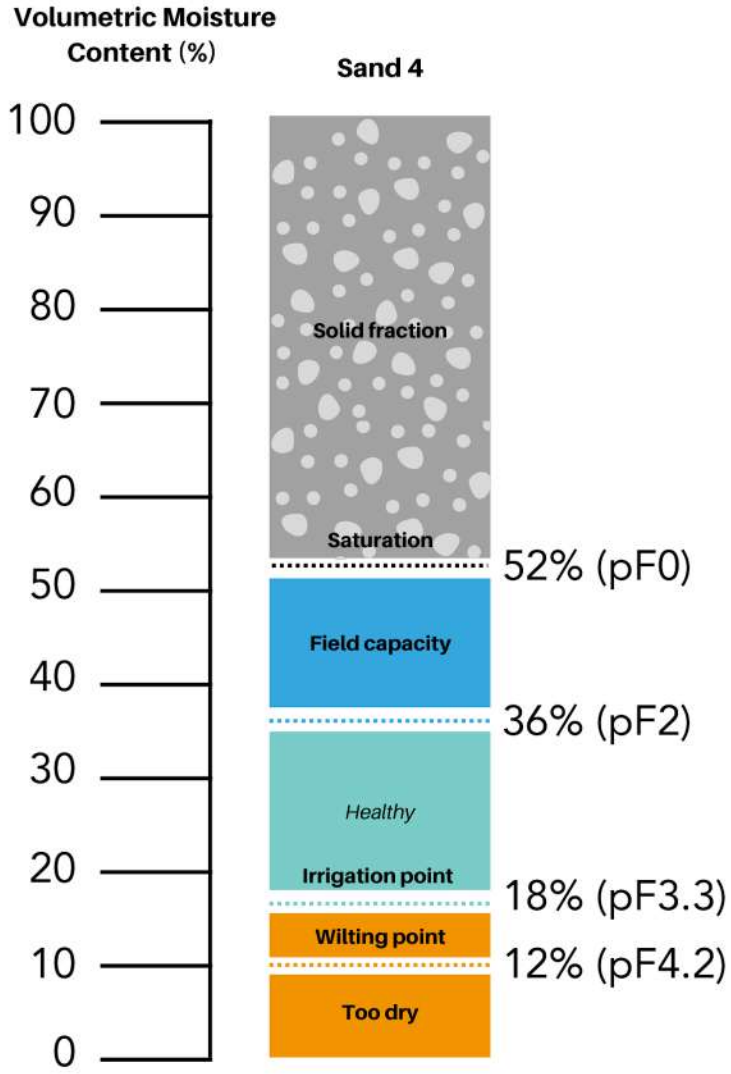


Composition

Clay - 1%
Silt - 9%
Sand - 90%
Organic Matter - 12%

Characteristics

Sandy soils have a relatively large particle size resulting in a limited water and nutrient holding capacity. Also called light soils, sandy soils are easy to work with and to cultivate. They have rapid infiltration and good drainage.



Recommendations for thresholds

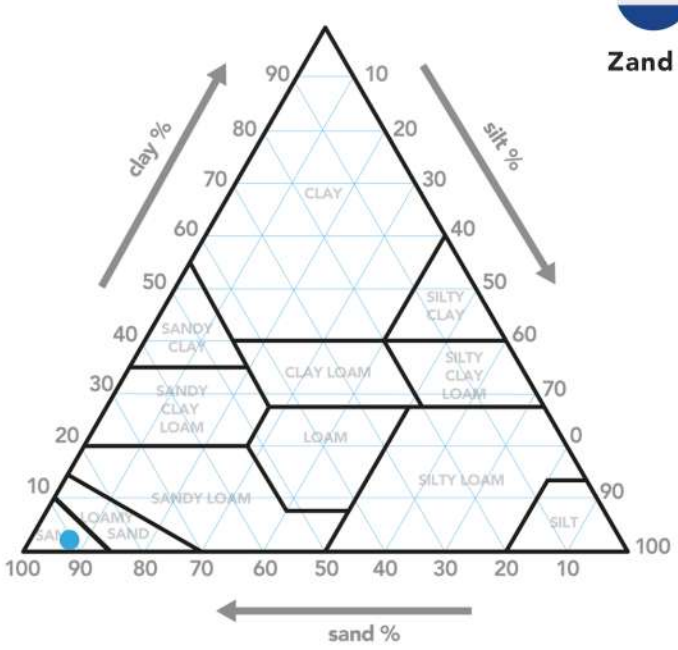
Setpoint high: 36%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses
Setpoint low: 18%
Irrigation point (pF3.3), prevents water stress on the plant.

All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.

SAND 5
(7.7% Organic Matter)

SENSOTERRA

Zand 5 | Sand 5 Pflanzenerde | Arenosa 5 | Sable 5

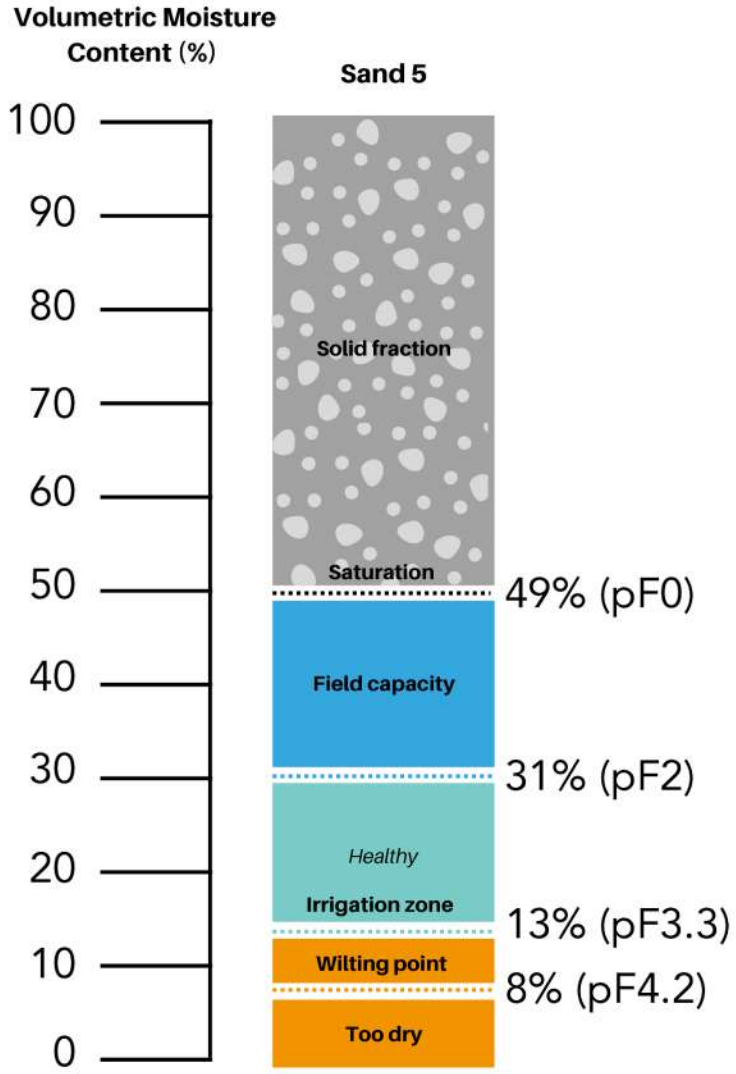


Composition

Clay - 1%
Silt - 10%
Sand - 89%
Organic Matter - 7.7%

Characteristics

Sandy soils have a relatively large particle size resulting in a limited water and nutrient holding capacity. Also called light soils, sandy soils are easy to work with and to cultivate. They have rapid infiltration and good drainage.

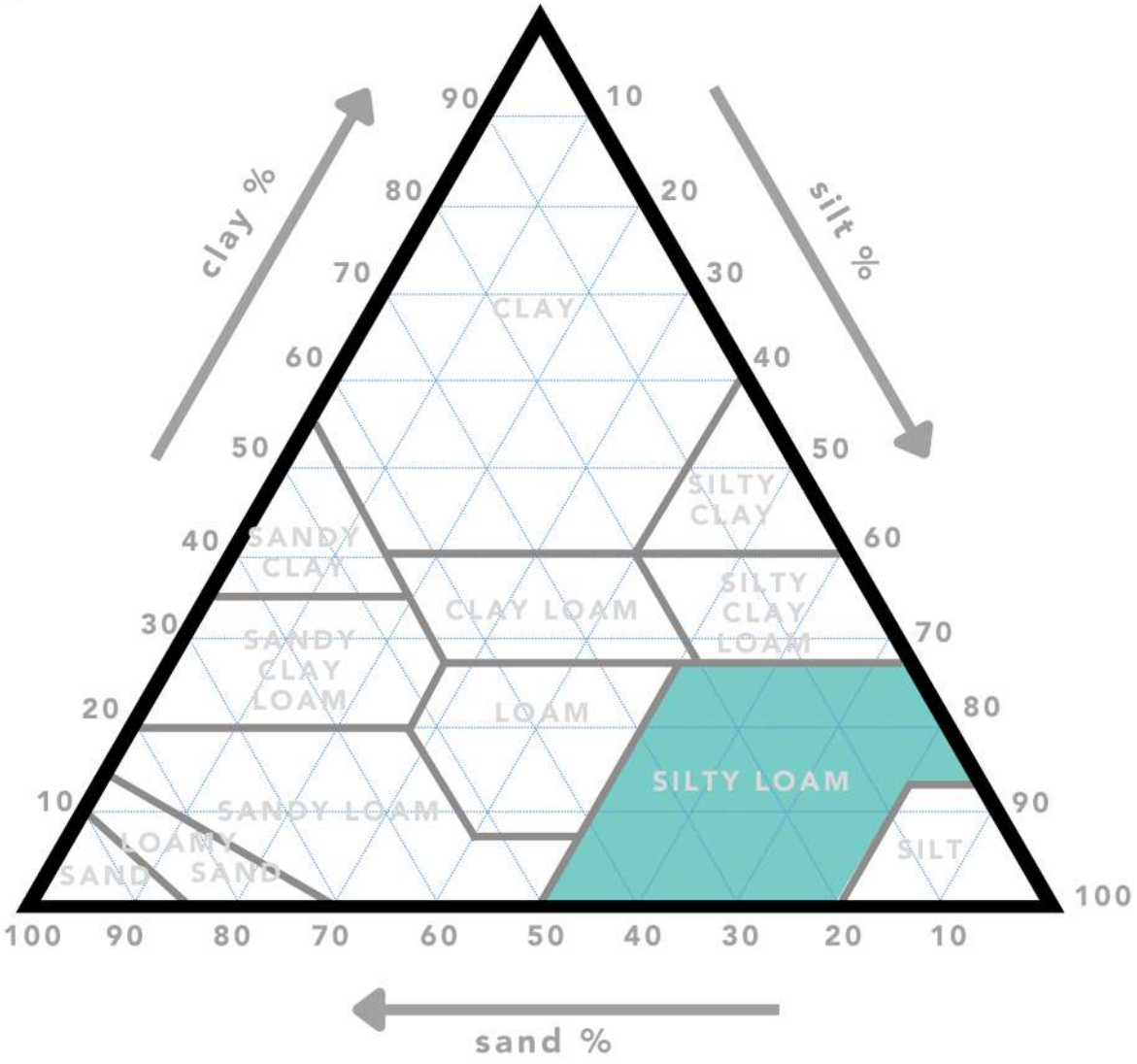


Recommendations for thresholds

Setpoint high: 31%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses
Setpoint low: 13%
Irrigation point (pF3.3), prevents water stress on the plant.

All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.

SILTY LOAM

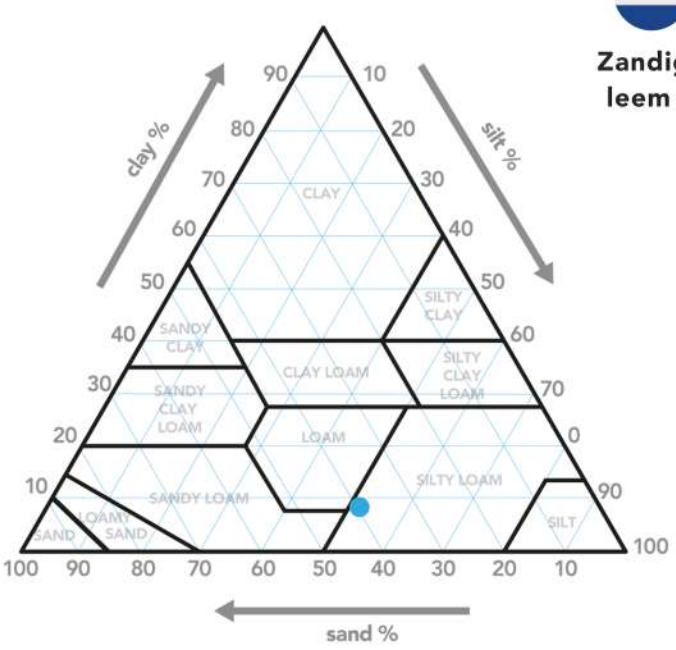

clay %
silt %
sand %
90
80
70
60
50
40
30
20
10
100
CLAY
SILTY CLAY
SANDY CLAY
CLAY LOAM
SILTY CLAY LOAM
SANDY CLAY LOAM
LOAM
SILTY LOAM
SANDY LOAM
LOAMY SAND
SAND
SILT

SILTY LOAM 1

(2.4% Organic Matter)

SENSOTERRA

Zandige leem 1 | Schlufflehm 1 | Franco limosa 1 | Limon fin 1

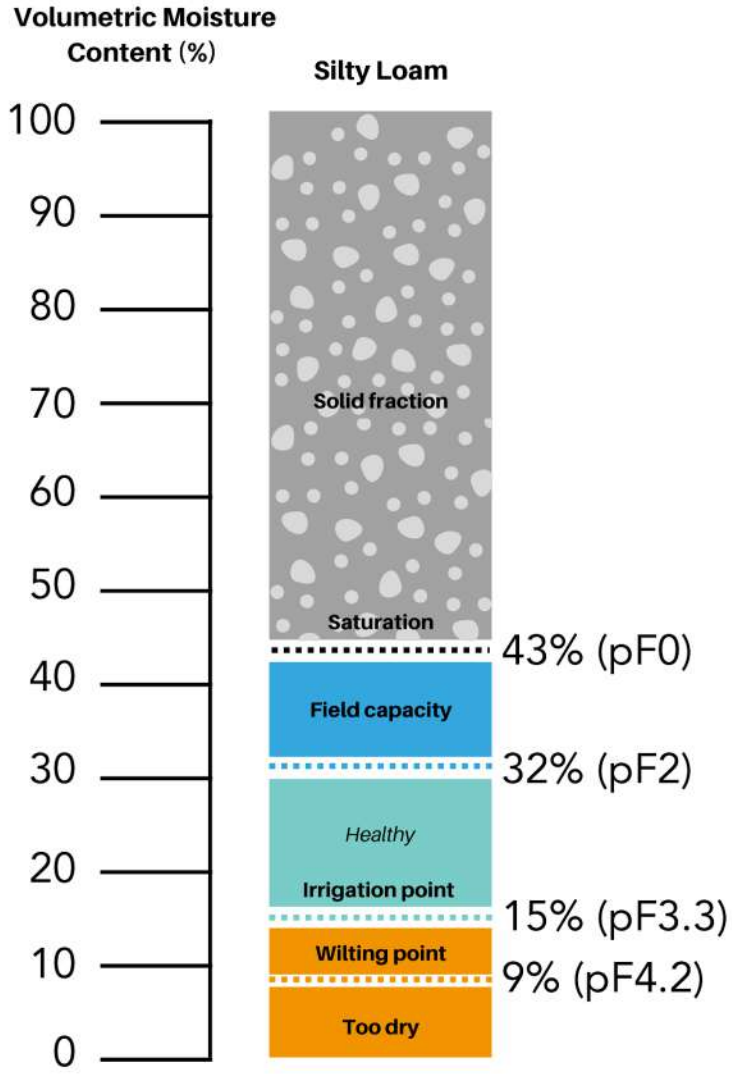


Composition

Clay - 9%
Silt - 51%
Sand - 40%
Organic Matter - 2.4%

Characteristics

Loam is a soil with a significant amount of clay, silt and sand. This results in a soil with good structure, as well as good water and nutrient holding capability. Silt loams have a higher percentage of silt than loam soils, resulting in a slightly inferior structure but better water holding capabilities compared to loam.



Recommendations for thresholds

Setpoint high: 32%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses
Setpoint low: 15%
Irrigation point (pF3.3), prevents water stress on the plant.

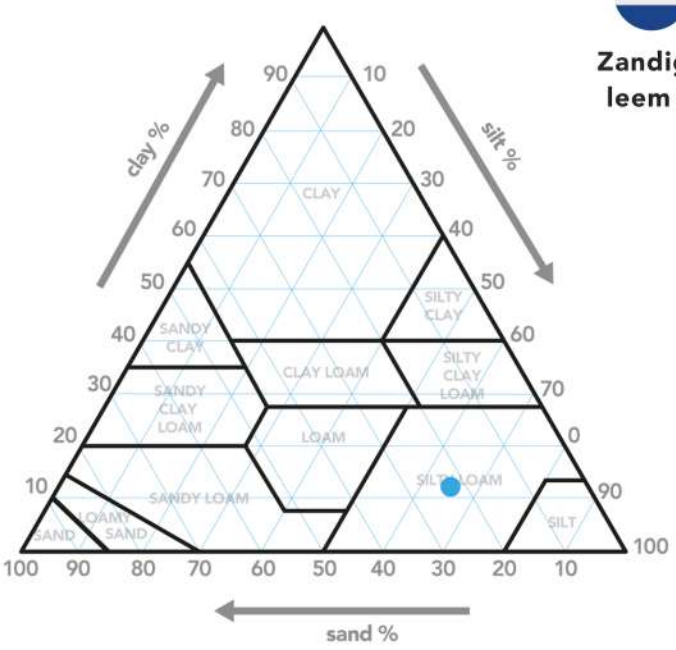
All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.

SILTY LOAM 2

(4.7% Organic Matter)

SENSOTERRA

Zandige leem 2 | Schlufflehm 2 | Franco limosa 2 | Limon fin 2

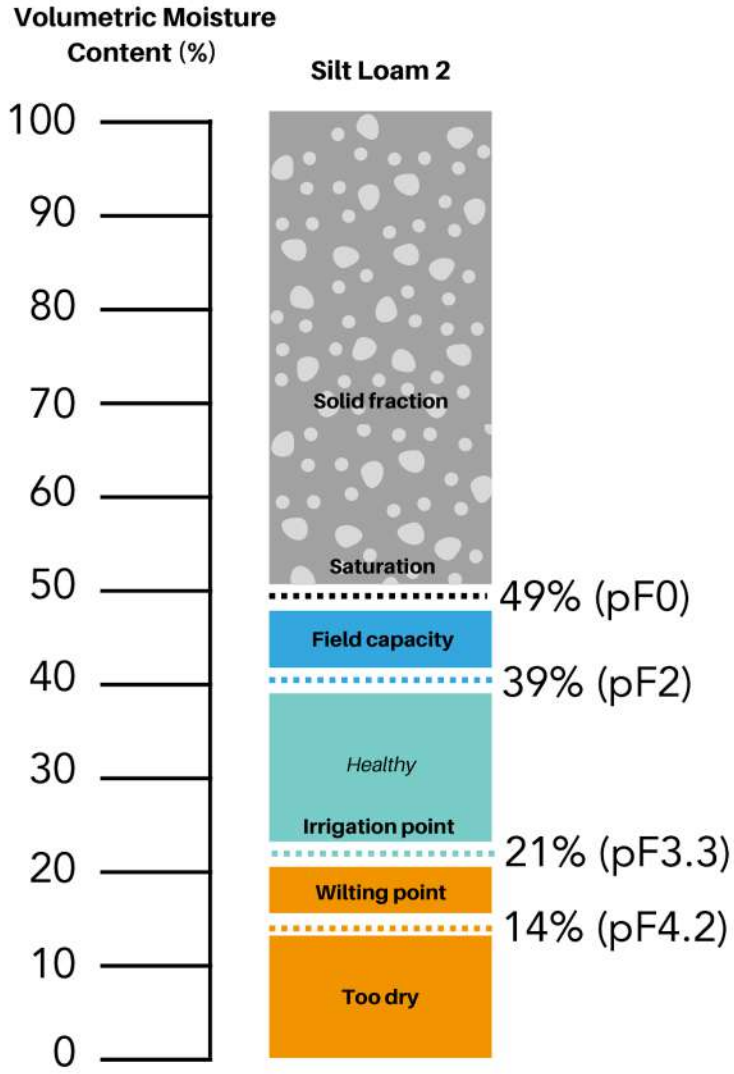


Composition

Clay - 12%
Silt - 65%
Sand - 23%
Organic Matter - 4.7%

Characteristics

Loam is a soil with a significant amount of clay, silt and sand. This results in a soil with good structure, as well as good water and nutrient holding capability. Silt loams have a higher percentage of silt than loam soils, resulting in a slightly inferior structure but better water holding capabilities compared to loam.

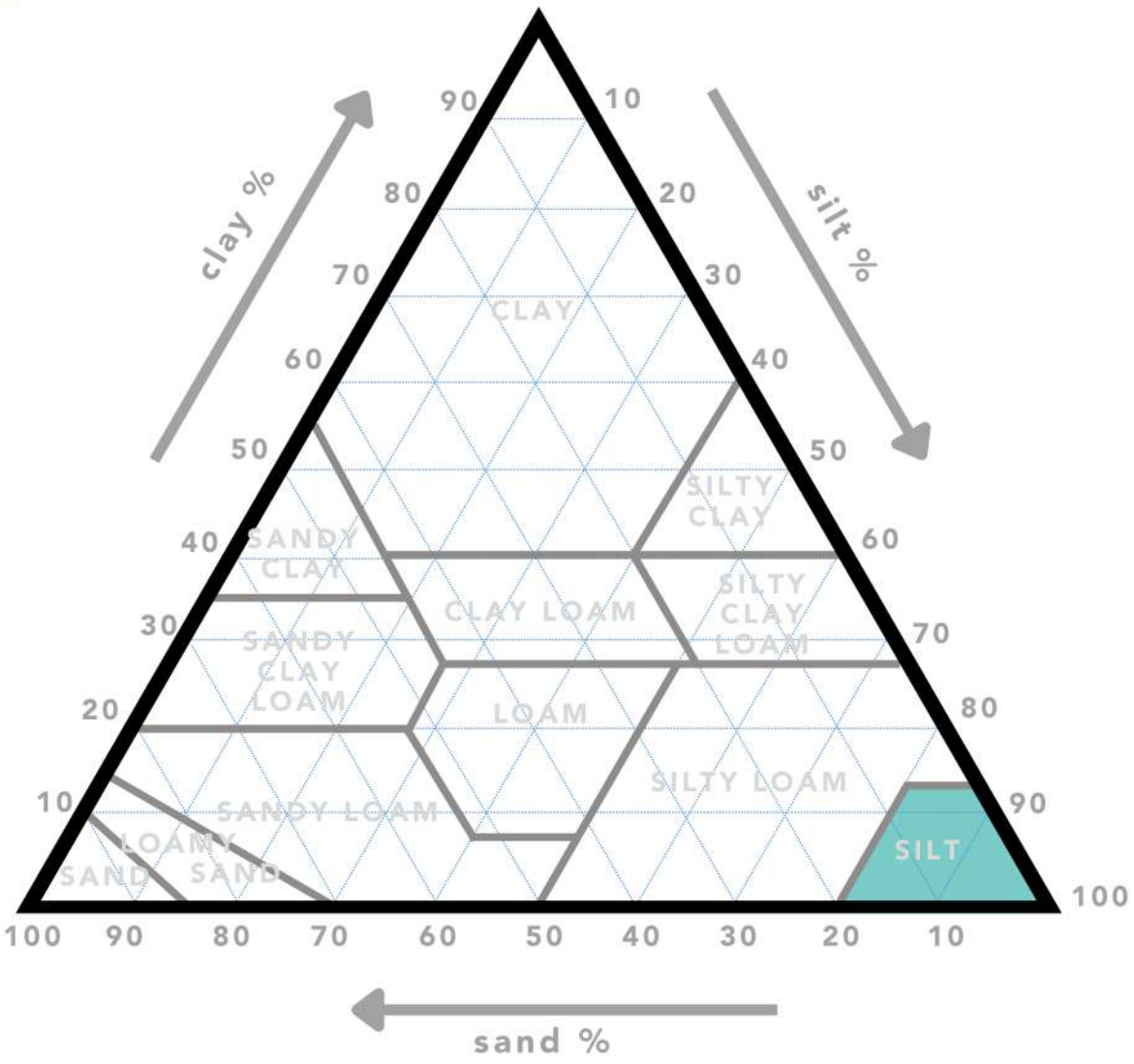


Recommendations for thresholds

Setpoint high: 39%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses
Setpoint low: 21%
Irrigation point (pF3.3), prevents water stress on the plant.

All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.

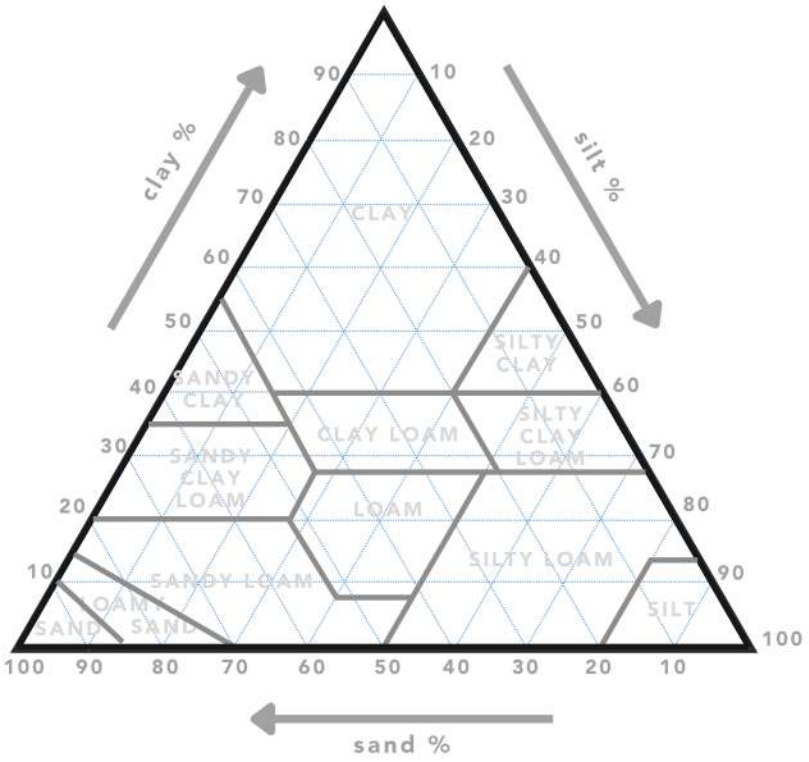
SILT


clay %
silt %
sand %
90
80
70
60
50
40
30
20
10
100
CLAY
SILTY CLAY
SANDY CLAY
CLAY LOAM
SILTY CLAY LOAM
SANDY CLAY LOAM
LOAM
SILTY LOAM
SANDY LOAM
LOAMY SAND
SAND
SILT

OTHER

- coco peat
- peat
- stone wool
- substrate & biochar

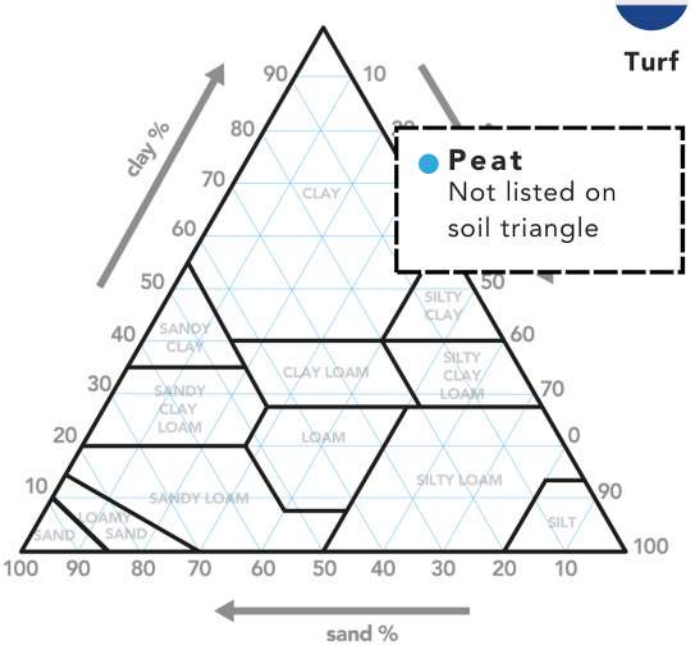
Not listed on soil triangle



PEAT
(100% Organic Matter)

SENSOTERRA

Turf Torf Turba Tourbe

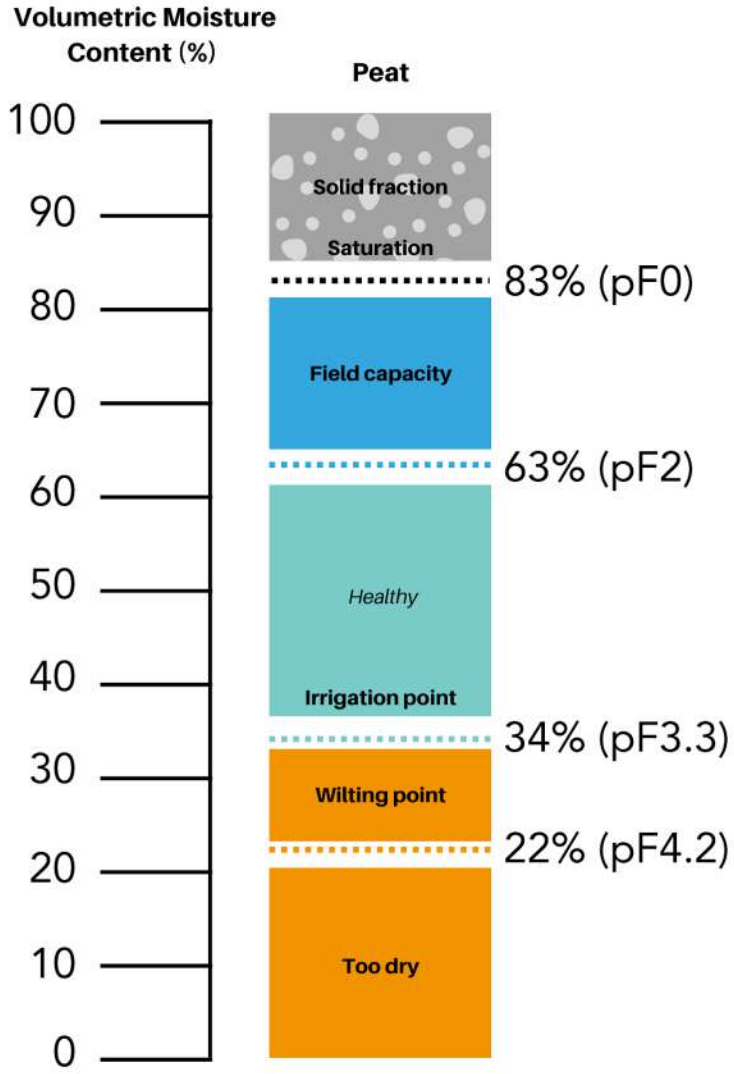


Composition

Clay - 0% Sand - 0%
Silt - 0% Organic Matter - 100%

Characteristics

Peat soils are very high in organic matter and have great water holding capacity. These soils have high compressibility and low bearing capacity. For these reasons they are best used as a soil base for planting. Peat basically contains only organic matter and hardly any mineral particles like sand, silt and/or clay.



Recommendations for thresholds

Setpoint high: 63%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses
Setpoint low: 34%
Irrigation point (pF3.3), prevents water stress on the plant.

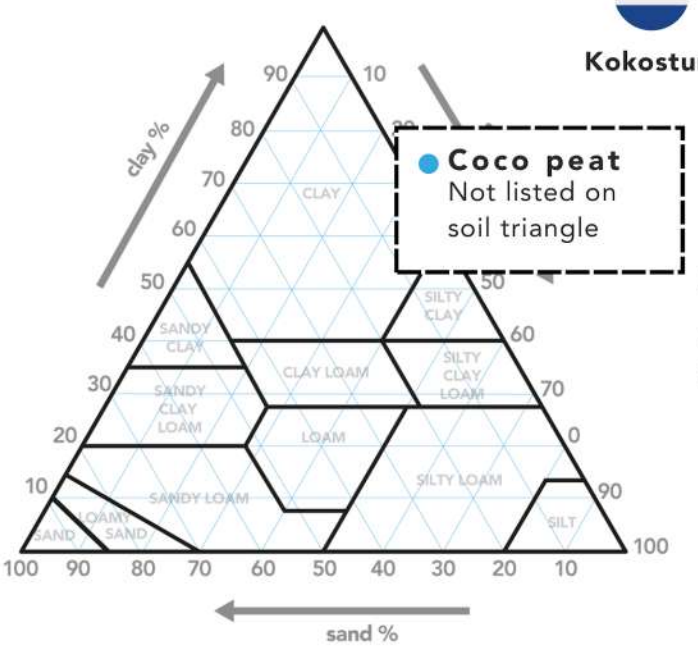
All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.

COCO PEAT

(100% Organic Matter)

SENSOTERRA

Kokosturf | Kokostorf | Turba de coco | Tourbe coco

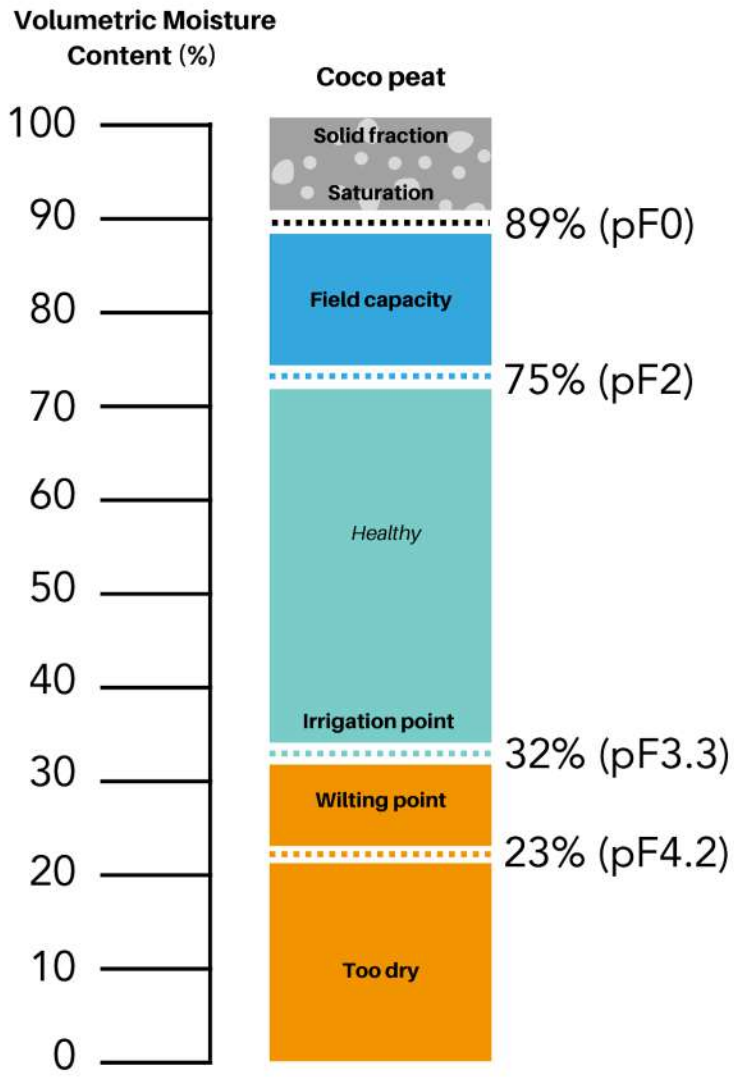


Composition

Clay - 0%
Silt - 0%
Sand - 0%
Organic Matter - 100%

Characteristics

Peat soils are very high in organic matter and have great water holding capacity. These soils have high compressibility and low bearing capacity. For these reasons they are best used as a soil base for planting. Substrate produced from buffered coco peat or buffered coco fibres.



Recommendations for thresholds

Setpoint high: 75%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses
Setpoint low: 32%
Irrigation point (pF3.3), prevents water stress on the plant.

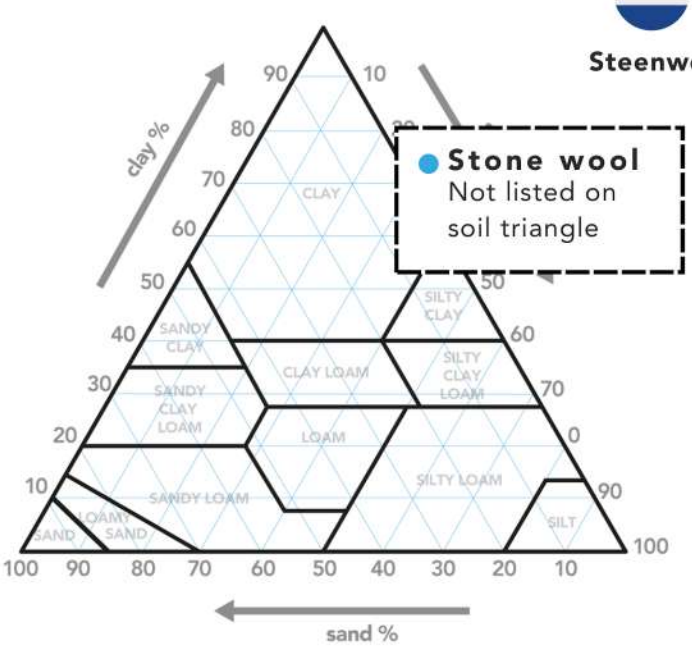
All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.

STONE WOOL

(100% Stone wool)

SENSOTERRA

Steenwol | Steinwolle | Lana de roca | Laine de roche

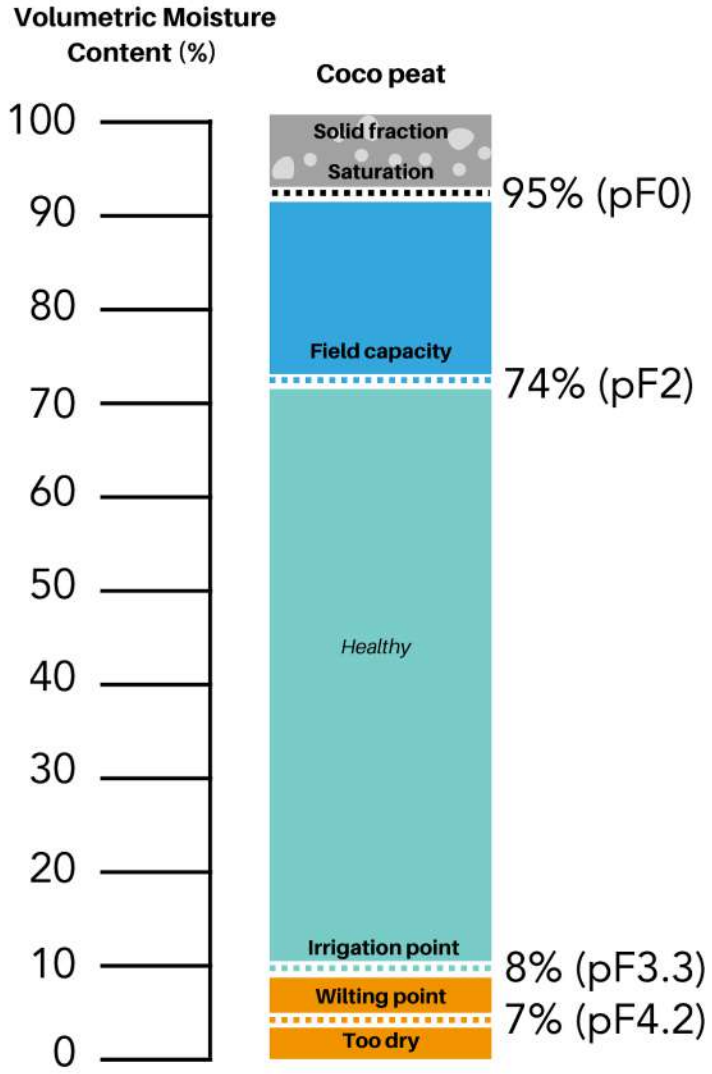


Composition

Clay - 0%
Silt - 0%
Sand - 0%
Organic Matter - 0%

Characteristics

Stone wool for use in water management and irrigation applications. Also termed rock wool and rockwell.



Recommendations for thresholds

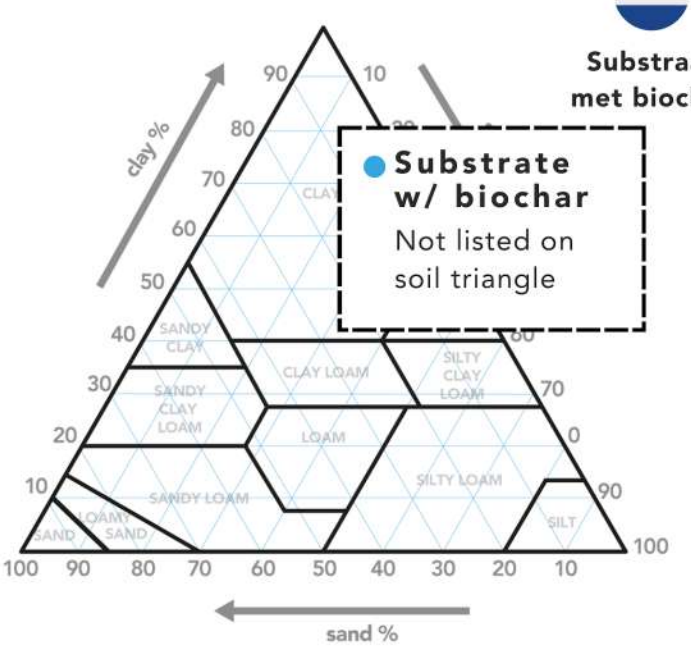
Setpoint high: 74%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses
Setpoint low: 8%
Irrigation point (pF3.3), prevents water stress on the plant.

All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.

SUBSTRATE W/ BIOCHAR
(2% Organic Matter)

SENSOTERRA

Substraat met biochar | Substrat mit biochar | Sustrato con biocarbón | Substrat avec biochar

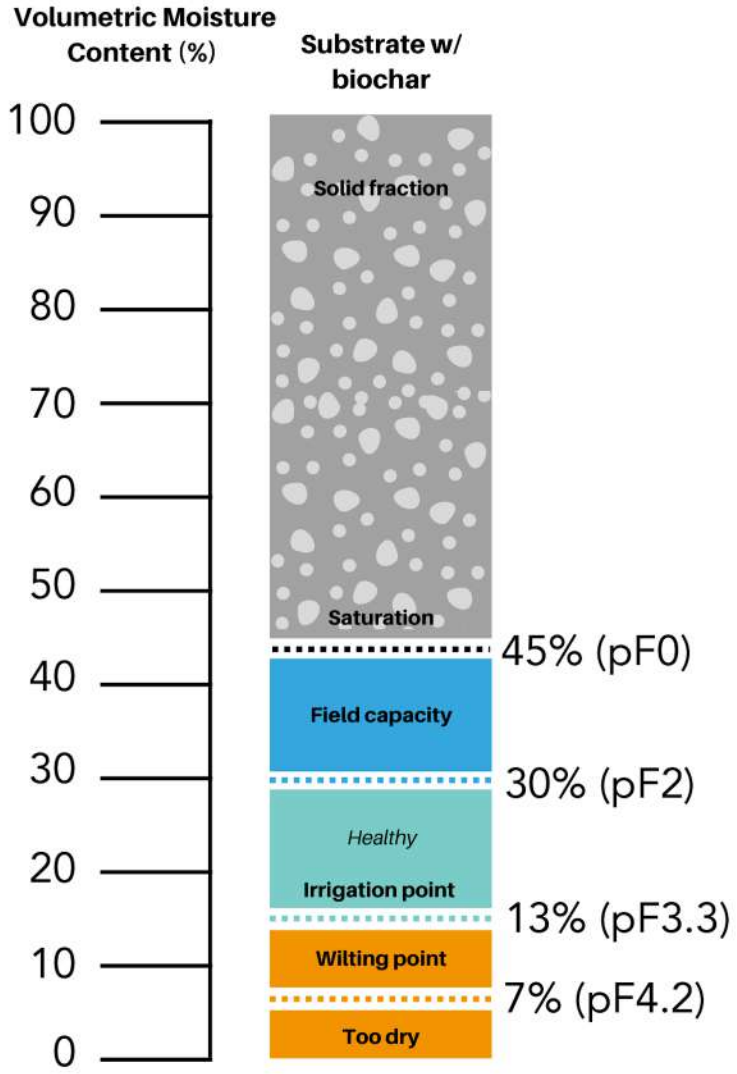


Composition

Clay - 8%
Silt - 32%
Sand - 60%
Organic Matter - 2%

Characteristics

Substrate with a significant percentage of biochar.



Recommendations for thresholds

Setpoint high: 30%
Field capacity (pF2) to prevent over irrigation and nutrient/input losses
Setpoint low: 13%
Irrigation point (pF3.3), prevents water stress on the plant.

All percentages are in Volumetric Water Content (VWC). Texture classes are based on USDA soil triangle.

SENSOTERRA

Wireless soil moisture sensors

SENSOTERRA

Sensoterra

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EPA WaterSense PARTNER

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