SPADE TEST SoilDoc – Interpretation of the observation

The spade test was developed to provide information about the condition of the soil and soil structure as intuitively, quickly and easily as possible. It is intended to help assess whether previous tillage operation and field traffic have caused soil problems or damage. However, the spade test can also be used to give insights for specific questions. These can be: Are topsoil and subsoil in a suitable condition for driving on or tillage? What requirements does the soil have with regards to supporting the choice of crop/cultivation method? What tillage operations are necessary to provide the crop with optimum conditions? How is the humus distributed in the topsoil?

Depending on the question you want to answer, it may not be necessary to fill out the entire form, but doing so may serve as a decision-making aid. The form can also be used to collect data from the same plot over several years to allow comparisons with previous conditions.

The aim of the spade test is to give as precise an indication as possible, whilst still being easy to use. Often a compromise must be found between both these objectives. Moreover, the soil is a very heterogeneous and variable system. With a little practice, you will quickly learn the necessary pragmatism for implementation. This assessment document supplements the intuitive assessment with some examples and further information.

Interpretation of the observations

The evaluation of a spade sample is influenced by numerous factors: the soil type, i.e. the content of clay, silt, sand and humus; the time of observation, the current soil moisture and the previous weather conditions; the current crop planted; the «history» of the soil (soil cultivation, backfilling, liming, humus management...). All these influences shape the current soil structure. It should therefore be noted that all the examples given here can only roughly describe what the individual parameters look like in a specific soil condition or for a specific problem.

Depending on the context, e.g. compaction at two locations may look different; the following evaluation examples are based on an «average», sandy-loamy soil in good condition, which is humus-rich, crumbly, porous and not compacted. The photo and Appendix 1 (example: soil in good condition) show what the description of such a soil might look like. Here the aggregates in the topsoil are small (usually 1–2 cm) and in the subsoil approx. 2–5 cm in size. Their shape is roundish in the topsoil, angular to rounded in the subsoil and they can be easily crushed with two fingers. The soil is evenly and intensively overgrown with roots. Soil life, including the growing plant roots, also requires a well-aerated soil for its survival, which can be recognized by its uniform black-brown or reddish-yellow colour. A black-brown colour is caused by humus, yellow, brown and red shades are caused by iron compounds in well-aerated soil, and a pleasant, earthy smell is also a sign of good aeration. In contrast, rust stains, grey and greenish discoloration, as well as a bad, rotten smell and rotten, undegraded crop residues indicate insufficient aeration – e.g. due to compaction. The example soil in good condition serves as a target condition for sustainable management and at the same time as an illustration of observable problems. An indication of problems in the soil structure is therefore given by parameters that were not classified in the optimum range as shown in Appendix 1.

In some cases, the natural and therefore intact properties of a soil do not correspond to the «optimum» parameter characteristics. For example, very clayey soils naturally exhibit large, angular and denser aggregates without any additional compaction. Or very silty soils naturally exhibit a very unstable structure. Sandy soils have only few and friable aggregates. Such special cases are also described below. It should also be noted that the subsoil often naturally has larger and more angular aggregates, meaning that the structure is less favourable. Coarse porosity and permeability can nevertheless be more advantageous in some cases.

Recognising damage to the soil structure, deriving long-term and short-term improvement measures

Damage to the soil structure can have very different impacts and causes. Accordingly, the possible solutions are also very different. Superficial and less pronounced soil damage can be fixed in a relatively short time and often through normal soil cultivation, whereas deep and very pronounced damage often requires several years of protection and improvement. In some cases, merely combating symptoms cannot solve a recognised problem and more far-reaching changes in the form of cultivation are necessary. It certainly makes sense to take the soil structure into account when making long-term decisions on a farm.

The following sections describe some specific soil structure problems. We briefly outline how these problems can arise and how they can be identified by the spade test. We include some non-exhaustive suggestions of measures and further information that are intended to provide initial pointers. Some basic measures to promote soil structure and stability are not described in each section, as they apply in all cases: The actual formation of an intact soil structure occurs via small-scale biological and chemical processes that take place over a long-time. This applies to the breakdown of compacted and massive soil zones as well as to the formation of soil aggregates that have been fragmented, e.g. by mechanical cultivation. These biological processes can be supported by the build-up of humus, soil cover and root penetration that is as continuous as possible, a reduction in tillage intensity and a correction of the pH value if it falls below 6.5 (measured in water). Protecting earthworms – important builders of soil structure – is challenging, as optimal conditions for tillage (slightly moist) are often also optimal conditions for earthworms. This means that they are often on the soil surface during tillage and suffer damage.

Compaction in the topsoil

Compaction is caused by heavy machinery or cultivation when the soil is too wet. Another reason may be that the soil has been driven on too quickly after a loosening tillage operation, which weakens soil stability. This means that the particularly sensitive, loosened part is excessively compacted, even if the machines used are not very heavy. Cattle trampling on wet soil can also lead to considerable compaction.

The following parameters on the form indicate compaction of the topsoil:

- Problem areas: patchy vegetation; stunted yellow plants; pooled water.
- During digging: D Undegraded or poorly degraded crop residues in the topsoil that are older than 6 months or rotten; difficulty in taking the spade sample because the spade penetrates poorly or it is difficult to detach the sample from the soil matrix F; few/no earthworms compared to the normal level for the season and K poorly developed roots; possibly rust stains E.
- J Solid aggregates in the topsoil that are G larger than 5 cm and have few pores.
- L Wet topsoil with only moist subsoil.

Measures

Do not drive on wet soils! A simple in-hand compaction test provides information (see *explanations and sample images*).

Equip and use machines in a way that protects the soil. Check compaction risk with terranimo.ch and bodenmessnetz.ch a) in damp conditions or b) on vehicles with wheel loads > 2.5 tonnes. Fit dual wheels or use a tyre pressure system. Use the smallest possible machines. Separate field and road transport as far as possible).

Support the dissolution of compaction through gentle loosening and intensive rooting.

Further information

- Estimate compaction risk: https://ch.terranimo.world/
- Current soil in Switzerland: https://bodenmessnetz.ch/
- Soil fertility: fibl.org → Infothek -Downloads & Shop → Fact sheet on the basics of soil fertility

Plough pan

Plough pans occur when working on soil that is too wet so the cultivation equipment smears the soil. The problem often arises when the surface dries quickly which might give the impression that the soil is dry throughout (e.g. in windy conditions and in the absence of vegetation). Another major risk is posed when driving on the subsoil – in the plough furrow or during soil removal work – as the subsoil is normally wetter than the surface and takes longer to dry out. It is therefore particularly sensitive to compaction. In addition, subsoils have a lower humus content meaning that they have lower biological activity. Subsoils are therefore less resistant to mechanical stress, especially if they are not proliferated by roots.

A plough pan can be recognised by the abrupt increase in firmness J and the angular shape of the aggregates H. It can also be seen as a clearly defined layer which has significantly fewer pores and roots than the layers above (and possibly also below) I, K. This layer accumulates the infiltrating water, which means that the underlying soil is often dry, while the layer itself dries less well L. This can also cause rust stains or grey-greenish discoloration E. Straw mattresses and rotten crop residues D on or in the layer and a sudden change in resistance when digging can be further indications.

Before tilling intervention, carry out a spade test to assess the condition of the subsoil (see explanations and sample images). Only work as deeply and intensively as necessary for the current crop. Vary the depth of tillage depending on the crop. Use an onland plough, avoid smear layers (e.g. with a rotary tiller) or compaction of the soil aggregates during tillage in too moist soil (e.g. with a roundabout harrow).

Loosen as described under «Compaction of subsoil». Earthworms help to break up compaction but are unfortunately active on the surface under the best tillage conditions (slightly moist soil) and are damaged by them.

Further information

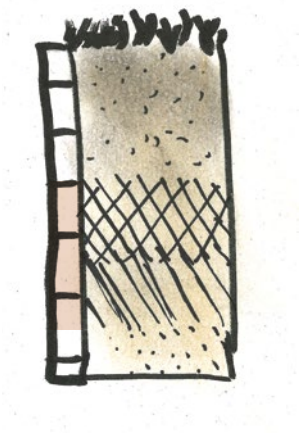
- Earthworms:
  Master builders of fertile soils: fibl.org → Infothek → Downloads & Shop → https://www.fibl.org/de/shop/1629-earthworms

Measures

SPATIAL SAMPLE SOIL TYPE: Assessment of properties (each layer separately; adapted scale for very clayey/very sandy soils on reverse)

SHIFT: No. Depth			G SIZE OF THE AGGREGATES					H FORM OF AGGREGATE			I POROSITY IN AGGREGATES			J STRENGTH OF THE AGGREGATES			K THROUGH-ROOTING				L FLOOR-MOISTURE			M VESS NOTE				
Shift no.	Depth of ..... cm	Depth up to ..... cm	mostly < than 1 cm	mostly 1 – 2 cm	mostly 2 – 5 cm	mostly > than 5 cm	> 10 cm	roundish	angular to rounded	sharp-edged	porous, many pores	Few pores, macropores and cracks possible	dense, no pores or only individual macropores / cracks	almost disintegrates by itself, unstable	can be crushed with little force, stable	can only be crushed with a lot of force, hard	many roots, evenly distributed, finely branched	ew roots, evenly distributed	unevenly distributed/root-free zones/kinked/root felt	no roots	dry, hard, dusty	moist, ~~soft~~, brittle	very moist to wet, mushy, plastic	Sq1: very good (crumbly)	Sq2: good (intact)	Sq3: mediocre (firm)	Sq4: bad (dense)	Sq5: very poor (very dense)
1	0	20		X				X			X				X		X						X					
2	20	30				X				X			X			X			X				X				X	
3	30	40			X				X			X			X					X	X				X			
4																												

Compaction in the subsoil



Compaction can already be felt when taking the spade sample. While the first 20 cm or so are easy to remove, it suddenly becomes more difficult for the spade to penetrate and the soil is difficult to remove. The entire lower section of the spade sample appears to be a single block or consists of G very large, H angular, J hard aggregates with almost no pores (or only isolated earthworm burrows) J. Water infiltration into this layer is inhibited, water accumulates directly above it or in the layer itself. Rust stains or even grey-greenish discolouration are possible E. Roots K often only grow above this zone; a root mat can also form directly on the compaction as the roots cannot penetrate and grow sideways.

Further Information

See chapter «Compaction in the topsoil» and «Plough pan».

From above, the soil often appears to be dry enough to withstand traffic or tillage. But the lower layers are often still wet and therefore in unfavourable conditions. For example, if the soil is bare (i. e. not covered by plants), a living root system in the subsoil will be lacking. As water drainage by live roots is important for the drying out of subsoils, they often remain wet for a long period. In this case, tillage operations will cause even more damage and subsoil compaction can occur. When driving on such field with very heavy machinery (e.g. harvesters with wheel loads > 5 t), the problem often remains for a long time, because the pressure reaches even deep soil layers. The topsoil regenerates somewhat faster, but the compaction in the deeper layers is often be seen even years later.

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Measures

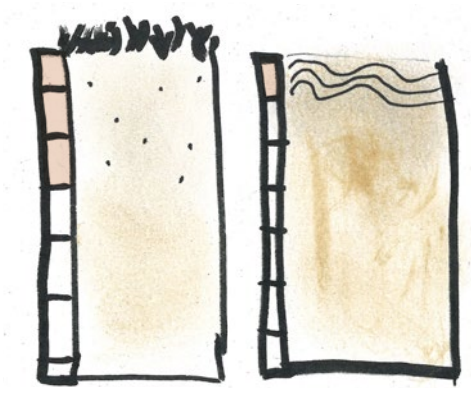
Adapt machinery to the load-bearing capacity of your soil. Large machines always carry a great risk. Sites with very clayey subsoils are particularly unsuitable for cultivation that relies on a lot of tillage, driving, late harvesting and heavy machinery. Choose a cultivation method appropriate to the site.

Subsoiling must be carefully considered. It can promote root penetration again and support structure formation but can cause even more damage if carried out under unfavourable conditions. Especially after loosening, the soil is very sensitive to stress and can easily be compacted again. A diverse green manure with deep-rooted plants such as daikon radish is sometimes preferable. The actual restoration of the structure must also take place via small-scale biological and chemical processes and therefore takes time. In principle, deep loosening should be an individual emergency measure, but not part of the annual soil work!

SPATIAL SAMPLE SOIL TYPE: Assessment of properties (each layer separately; adapted scale for very clayey/very sandy soils on reverse)

SHIFT: No. Depth			G SIZE OF THE AGGREGATES					H FORM OF AGGREGATE			I POROSITY IN AGGREGATES			J STRENGTH OF THE AGGREGATES			K THROUGH-ROOTING				L FLOOR-MOISTURE			M VESS NOTE				
Shift no.	Depth of ..... cm	Depth up to ..... cm	mostly < than 1 cm	mostly 1–2 cm	mostly 2–5 cm	mostly > than 5 cm	> 10 cm	roundish	angular to rounded	sharp-edged	porous, many pores	Few pores, macropores and cracks possible	dense, no pores or only individual macropores / cracks	almost disintegrates by itself, unstable	Can be crushed with little force, stable	can only be crushed with a lot of force, hard	many roots, evenly distributed, finely branched	few roots, evenly distributed	unevenly distributed/root-free zones/kinked/root felt	no roots	dry, hard, dusty	moist, soft, brittle	very moist to wet, mushy, plastic	Sq1: very good (crumbly)	Sq2: good (intact)	Sq3: mediocre (firm)	Sq4: bad (dense)	Sq5: very poor (very dense)
1	0	20		X				X			X				X		X								X			
2	20	40				X	X			X			X			X			X								X	
3																												
4																												

Unstable/damaged soil surface, loss of humus



Compared to permanently covered, rooted and unworked soils in natural areas, the biological balance in arable soils tends to be shifted towards humus depletion. Especially on farms without livestock, where mineral fertilisers are mainly used and there are few/no artificial meadows in the crop rotation, the soils are poor in humus and soil life. A low pH is also unfavourable for many soil organisms and can lead to their decline.

An optimal soil structure has a certain stability and firmness without being hard and impermeable. Finely worked, decalcified, humus-poor soil, on the other hand, has a tendency to seal over. This risk is particularly pronounced with high silt contents. An impermeable crust forms on the soil or in the uppermost centimetres, which inhibits the infiltration of rainwater and increases the risk of erosion. Erosion can be seen in grooves or gullies, but also in pebbles sitting slightly above the soil surface like on small chimneys (see photo). Erosion can also occur within the soil and block the pores and gaps that would be necessary for aeration and infiltration into deeper layers. Fillings and finely worked potato ridges often have low soil stability.

If individual layers in the spade test fall apart almost by themselves (J) and show no cohesion, this indicates poor soil stability; this also makes a soil more susceptible to external influences such as precipitation or cultivation. Such soils appear more like a collection of tiny, individual grains ((G) size of aggregates usually < 1 cm) that trickle from the spade when digging. The soil surface (B) is silted, or even a flat, closed crust that no longer shows any unevenness. Over several years, the soil has lost its black-brown colour and lightened.

Erosion gullies and alluvial topsoil material with a higher humus content (darker colouring of the soil) can be found at the base of the slope.

Measures

Add sufficient organic matter, mulch or incorporate green fertiliser. Allow for soil rest phases in the crop rotation. No intensive tillage when earthworms are active in the topsoil, i.e. a few days after rain in mild temperatures.

Always keep the soil surface covered (dense plant growth, mulch, etc.), apply lime if the pH value is below 6.5. Use coarse seedbed preparation, mulch, strip or direct sowing, reduce cultivation intensity (e.g. with the rotary harrow).

Further information

- Soil fertility: fibl.org → Infothek -Downloads & Shop → Fact sheet on the basics of soil fertility
- Earthworms:
  Master builders of fertile soils: fibl.org → Infothek → Downloads & Shop → https://www.fibl.org/de/shop/1629-earthworms

Evidence of excessively moist soil

Soils – especially those with a clay content > 25 % – tend to clump if they are worked when they are too wet. Rotating, PTO-driven machines then compress the soil together, static tine implements press the aggregates to form denser soil.

In the spade sample, a kneaded surface (B) with clumps (see photo) and possibly patchy vegetation can be observed. Clumps are dense clods. Rounded aggregates (H), that have been formed by mechanical processing and which can only be crushed with a lot of force (J) Such lumps or even sharp-edged large (> 5 cm) aggregates (G), are also found within the soil. Inside there are usually no roots (K). Rust spots can form inside the lumps (E) which indicate a lack of oxygen.

Measures

Observation of the conditions before tillage with spade test, in-hand compression test, bodefeuchtemessnetz.ch, Terranimo.ch. Sow green manure that develops a dense and strong root system.

Further Information

- Current soil in Switzerland: https://bodenmessnetz.ch/

SOIL SURFACE: Assessment of condition

(A) FLOOR COVERING (radius 1 m)	(B) OCCUPATIONDERSURFACE (if uncovered or slightly covered is to be removed)
[X] uncovered	[ ] Aggregates intact, easily recognisable, permeable surface
[ ] covered with plants (cultivated plants/meadow/weeds...) to .....%	[ ] Aggregates partly washed out, surface nevertheless rough/uneven
[ ] covered with mulch/manure/compost/crop residues to .....%	[X] Aggregates washed out, surface silty, caked, not very permeable
	[X] Closed crust, deposited sediments, compacted, very poorly permeable

General Remarks: Low humus content (approx. 2 %), pH 5, completely lime-free

SPATIAL SAMPLE SOIL TYPE: Assessment of properties (each layer separately; adapted scale for very clayey/very sandy soils on reverse)

Shift no.	Depth of ..... cm	Depth up to ..... cm	(G) SIZE OF THE AGGREGATES: Depth up to 1 cm	mostly 1–2 cm	mostly 2–5 cm	mostly > than 5 cm	> 10 cm	(H) FORM DER AGGREGATE: roundish, kneaded	angular to rounded	sharp-edged	(I) POROSITY IN AGGREGATES: porous, many pores	few pores, macropores and cracks possible	dense, no pores or only individual macropores / cracks	(J) STRENGTH OF THE AGGREGATES: almost disintegrates by itself, unstable	can be crushed with little force, stable	can only be crushed with a lot of force, hard	(K) THROUGH-ROOTING: many roots, evenly distributed, finely branched	few roots, evenly distributed	unevenly distributed/root-free zones/ kinked/root felt	no roots	(L) FLOOR-MOISTURE: dry, hard, dusty	moist, ~~soft~~, brittle	very moist to wet, mushy, plastic	(M) VESS NOTE: Sq1: very good (crumbly)	Sq2: good (intact)	Sq3: mediocre (firm)	Sq4: bad (dense)	Sq5: very poor (very dense)
1	0	10	X		X			X					X			X			X			X				X		
2	10	40				X				X			X			X			X			X					X	
3																													
4																													

Special case: clay soils

In very clayey soils (clay > 40 %), a good and natural soil structure presents itself somewhat differently than in sandy-loamy soils. The aggregates are somewhat larger (> 5 cm, G), denser I, sharper-edged (prism-shaped), firmer J and very plastic to mushy when moist. Sharp cracks form as the soil dries. Appendix 2 (example: clayey soil) illustrates how a spade sample on a clayey soil in good condition could look. If possible, look for a place that has not been disturbed for a long time (e.g. under a fence) to get an idea of the natural condition of the soil.

If an observation and comparison over a longer period of time is planned on a clayey soil, it is advisable to use a slightly adapted scale for some observation parameters. Changes may occur in a different area and are more difficult to record with the classic data sheet. On the back of the *form (document 2)* you will find an adapted scale for some parameters in clayey soils.

Due to the greater storage of water, clayey soils are much more susceptible to compaction and the waiting times before hazard-free tillage are much longer. Reduced tillage is particularly important here and certain methods and crops are unsuitable. However, clayey soils also have a higher potential to bind organic matter and nutrients.

Special case: sandy soils

Even in very sandy soils (sand > 60 %), the natural structural state is different to that of loamy soils. Here, in particular, no clear, rounded and crumbly aggregates form, but the soil quickly disintegrates into individual grains and appears unstable J. If, for example, the structure is built up over several years, it is advisable to record the observations on the size and strength of the aggregates in more detail. On the back of the *form (document 2)* there is an adapted scale for some parameters in sandy soils.

Sandy soils are less susceptible to compaction and dry out quickly, so that good conditions for cultivation prevail again quite soon after rainfall. They offer less storage for humus and nutrients and are therefore less intensively colonised by soil organisms than loamier soils. Nevertheless, these are very important sites for agriculture, but their natural soil structure must be categorised differently.

Imprint

Haute école spécialisée bernoise

agridea

FiBL

Agroscope

Project funded by the Federal Office for Agriculture, FOAG.

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The method was developed in co-operation with numerous partners and on the basis of known spade sampling methods. For more information visit our website.

Version July 2023, www.spatenprobe.ch

Appendix 1

SPADETEST SoilDoc – Form

① ② ③ ④

Not all parameters are observable/meaningful at all times – leave these fields blank.
Use the *explanations and sample images* for more detailed information on each letter.
The spade test is not conclusive in dry conditions (knee test or tensiometer values above 15 cbar)!

Parcel: Example | Datum: 3.3. | Culture/KW/NW, stage, preculture: artificial meadowim2.year

Last cultivation, date, depth, species: (sowing) (CW,) (cutting) (CW) (18.9.)

Coordinates: | ☒ Photo | Terrain: ☒ Level ☐ Slope ☐ Trough ☐ Crest 3 % inclination

Representativeness: ☒ Representative area ☐ Problem zone, ... % affected area

Problem description (only if ☒ Problem zone is ticked):

Bodenart*: ☐ Sand** ☐ loamy sand** ☒ sandy loam ☐ Loam ☐ loamy clay ☐ clay** ☐ very silty (> 50 %) ☐ peaty/organic (humus > 10 %) pH* 6

* if known, e.g. from oil or laboratory samples, feeler sample, etc.
** for very clayey/very sandy soils, there are adapted tools on the back and more information in the *assessment document* (document 4)

SOIL SURFACE: Assessment of condition

A FLOOR COVERING (radius 1 m)

- ☐ uncovered
- ☒ 90 % covered with plants (cultivated plants / meadow / weeds...)
- ☐ covered with mulch / manure / compost / crop residues to ..... %

B (NATURE) (OF) (SURFACE) (if uncovered or covering light is to be removed)

- (☒ Aggregates intact, easily recognisable, permeable surface) ← bad visible
- ☐ Aggregates partly washed out, surface nevertheless rough/uneven
- ☐ Aggregates washed out, surface silted, kneaded, less permeable
- ☐ Closed crust, deposited sediments, compacted, very poorly permeable

General Remarks: Soil-conserving cultivation: Vegetables (t.w. with mulch) alternating with KW)

OBSERVATIONS DURING THE EXCAVATION

(If necessary, specify with your own notes)

- ☒ Stones
- ☐ C Plough sole, depth ..... , thickness .....
- ☐ D unabgeb. Crop residues, straw mattress, depth .....
- ☐ E Rust stains or grey-greenish colour tones, depth .....
- ☒ F Earthworms (individuals / burrows / faeces) (many)
- ☐ Difficult to dig, high penetration resistance
- ☐ bad, foul odour

SPATIAL SAMPLE SOIL TYPE: Assessment of properties (each layer separately; adapted scale for very clayey/very sandy soils on reverse)

Shift no.	Depth of ..... cm	Depth up to ..... cm	G SIZE OF THE AGGREGATES: mostly < than 1 cm	mostly 1–2 cm	mostly 2–5 cm	mostly > than 5 cm	> 10 cm	H FORM OF AGGREGATE: roundish	angular to rounded	sharp-edged	I POROSITY IN AGGREGATES: porous, many pores	few pores, macropores and cracks possible	dense, no pores or only individual macropores/cracks	J STRENGTH OF THE AGGREGATES: almost disintegrates by itself, unstable	can be crushed with little force, stable	can only be crushed with a lot of force, hard	K THROUGH-ROOTING: many roots, evenly distributed, finely branched	few roots, evenly distributed	unevenly distributed/root-free zones/ kinked/root felt	no roots	L FLOOR-HUMID: dry, hard, dusty	moist, soft, brittle	very moist to wet, mushy, plastic	M VESS NOTE: Sq1: very good (crumbly)	Sq2: good (intact)	Sq3: mediocre (firm)	Sq4: bad (dense)	Sq5: very poor (very dense)
1	0	10		X				X			X				X		X					X		X				
2	10	35			X	(X)			X		X				X			X				X			X			
3																												
4																												

Imprint

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With the support of the Federal Office for Agriculture, FOAG.

The method was developed in co-operation with numerous partners and on the basis of the already known Spatenprobe method.
For more information visit our website.

Version July 2023, www.spatenprobe.ch

Appendix 2

SPADETEST SoilDoc – Form

① ② ③ ④

Not all parameters are observable/meaningful at all times – leave these fields blank.
Use the *explanations and sample images* for more detailed information on each letter.
The spade test is not conclusive in dry conditions (knee test or tensiometer values above 15 cbar)!

Plot: Example clayey | Datum: 3.3. | Culture/KW/NW, stage, preculture: artificial meadowim2.year

Last cultivation, date, depth, species: (sowing) (CW,) (cutting) (CW) (18.9.)

Coordinates: | ☒ Photo | Terrain: ☒ Level ☐ Slope ☐ Trough ☐ Crest 3 % inclination

Representativeness: ☒ Representative area ☐ Problem zone, ...% affected area

Problem description (only if ☒ Problem zone is ticked):

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SOIL SURFACE: Assessment of condition

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☐ uncovered
☒ 90 % covered with plants (cultivated plants / meadow / weeds...)
☐ covered with mulch / manure / compost / crop residues to .....%

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☐ Aggregates intact, easily recognisable, permeable surface
☐ Aggregates partly washed out, surface nevertheless rough/uneven
☐ Aggregates washed out, surface silted, kneaded, less permeable
☐ Closed crust, deposited sediments, compacted, very poorly permeable

General Remarks:

OBSERVATIONS DURING THE EXCAVATION

(If necessary, specify with your own notes)

☐ Stones
☐ C Plough sole, depth ..... , thickness .....
☐ D unabgeb. Crop residues, straw mattress, depth .....
☒ E Rust stains or grey-greenish colour tones, depth 25 cm, little
☒ F Earthworms (individuals / burrows / faeces)
☒ Difficult to dig, high penetration resistance
☐ bad, foul odour

SPATIAL SAMPLE SOIL TYPE: Assessment of properties (each layer separately; adapted scale for very clayey/very sandy soils on reverse)

Shift no.	Depth of ..... cm	Depth up to ..... cm	G SIZE OF THE AGGREGATES: mostly < than 1 cm	mostly 1–2 cm	mostly 2–5 cm	mostly > than 5 cm	> 10 cm	H FORM OF AGGREGATE: roundish	angular to rounded	sharp-edged	I POROSITY IN AGGREGATES: porous, many pores	few pores, macropores and cracks possible	dense, no pores or only individual macropores/cracks	J STRENGTH OF THE AGGREGATES: almost disintegrates by itself, unstable	can be crushed with little force, stable	can only be crushed with a lot of force, hard	K THROUGH-ROOTING: many roots, evenly distributed, finely branched	few roots, evenly distributed	unevenly distributed/root-free zones/ kinked/root felt	no roots	L FLOOR-HUMID: dry, hard, dusty	moist, soft, brittle	very moist to wet, mushy, plastic	M VESS NOTE: Sq1: very good (crumbly)	Sq2: good (intact)	Sq3: mediocre (firm)	Sq4: bad (dense)	Sq5: very poor (very dense)
1	0	10		X					X			X				X	X					X				X			
2	10	35				X				X		X	(X)			X		X				X	(X)				X		
3																													
4																													

Imprint

Haute école spécialisée bernoise

agridea

Agroscope

FiBL

With the support of the Federal Office for Agriculture, FOAG.

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For more information visit our website.

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Appendix 3

SPADETEST SoilDoc – Form

1 2 3 4

Not all parameters are observable/meaningful at all times – leave these fields blank.
Use the *explanations and sample images* for more detailed information on each letter.
The spade test is not conclusive in dry conditions (knee test or tensiometer values above 15 cbar)!

Plot: Example sandy | Datum: 3.3. | Culture/KW/NW, stage, preculture: artificial meadowim2.year

Last cultivation, date, depth, species: (sowing) (CW,) (cutting) (CW) (18.9.)

Coordinates: | ☒ Photo

Terrain: ☒ Level ☐ Slope ☐ Trough ☐ Crest 3 % inclination

Representativeness: ☒ Representative area ☐ Problem zone, ... % affected area

Problem description (only if ☒ Problem zone is ticked):

Bodenart*: ☒ Sand** ☒ loamy sand** ☐ sandy loam ☐ Loam ☐ loamy clay ☐ clay** ☐ very silty (> 50 %) ☐ peaty/organic (humus > 10 %) pH* 6

* if known, e.g. from oil or laboratory samples, feeler sample, etc.
** for very clayey/very sandy soils, there are adapted tools on the back and more information in the *assessment document* (document 4)

SOIL SURFACE: Assessment of condition

A FLOOR COVERING (radius 1 m)

☐ uncovered
☒ 85 % covered with plants (cultivated plants / meadow / weeds...)
☐ covered with mulch / manure / compost / crop residues to ..... %

B (NATURE) (OF) (SURFACE) (if uncovered or covering light is to be removed)

☐ Aggregates intact, easily recognisable, permeable surface
☐ Aggregates partly washed out, surface nevertheless rough/uneven
☐ Aggregates washed out, surface silted, kneaded, less permeable
☐ Closed crust, deposited sediments, compacted, very poorly permeable

General Remarks:

OBSERVATIONS DURING THE EXCAVATION

(If necessary, specify with your own notes)

☒ Stones
☐ C Plough sole, depth ..... , thickness .....
☐ D unabgeb. Crop residues, straw mattress, depth .....
☐ E Rust stains or grey-greenish colour tones, depth .....
☒ F Earthworms (individuals / burrows / faeces)
☐ Difficult to dig, high penetration resistance
☐ bad, foul odour

SPATIAL SAMPLE SOIL TYPE: Assessment of properties (each layer separately; adapted scale for very clayey/very sandy soils on reverse)

Shift no.	Depth of ..... cm	Depth up to ..... cm	G SIZE OF THE AGGREGATES: mostly < than 1 cm	mostly 1–2 cm	mostly 2–5 cm	mostly > than 5 cm	> 10 cm	H FORM OF AGGREGATE: roundish	angular to rounded	sharp-edged	I POROSITY IN AGGREGATES: porous, many pores	few pores, macropores and cracks possible	dense, no pores or only individual macropores/cracks	J STRENGTH OF THE AGGREGATES: almost disintegrates by itself, unstable	can be crushed with little force, stable	can only be crushed with a lot of force, hard	K THROUGH-ROOTING: many roots, evenly distributed, finely branched	few roots, evenly distributed	unevenly distributed/root-free zones/ kinked/root felt	no roots	L FLOOR-HUMID: dry, hard, dusty	moist, soft, brittle	very moist to wet, mushy, plastic	M VESS NOTE: Sq1: very good (crumbly)	Sq2: good (intact)	Sq3: mediocre (firm)	Sq4: bad (dense)	Sq5: very poor (very dense)
1	0	10	X					X			X				X		X					X		X				
2	10	35			X	(X)		X			X				X			X			X			X				
3																												
4																												

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