REFERENCE SHEET: SOIL HEALTH ASSESSMENT TOOLKIT

METHOD FOR MEASURING SOIL pH (2:1 RATIO WATER:SOIL)

MATERIALS:

1. **Two alternatives for measurement:**
   a. **Portable pH meter** for field use (this is more precise when checked or calibrated)
   b. **pH measurement strips** with a range of pH 4 to 8. These should be checked against a pH meter with the soils in a region of interest to check that they are giving precise results. Soil solutions that are created in pH testing are fairly weak compared to laboratory solutions where pH paper is typically used, and some paper strips may not read correctly.
2. **pH calibration solutions, with pH values of 4 and 7,** which are closest to the pH range of soils.
3. **Small plastic cups or beakers for conducting the test,** with volume 30 to 100 mL. A narrow shape of cup is better because it will give greater depth of soil solution for testing.
4. **Small balance** (with 1 g or 0,1 g precision) to weigh soils and water. A volume approach can be used, e.g. 7 mL of soil will weigh about 10 g for many soils, and this is precise enough for the test to work.
5. **Distilled water.** If it is hard to find distilled water, clean-caught rainwater or some brands of bottled water can be used. If bottled water is used the label should be consulted to ensure that the levels of total dissolved solids are low, and especially that levels of calcium and magnesium are low since these will be in the form of alkaline carbonates that make the test read higher than it should. <50 ppm TDS is good and <10 ppm is even better. If needed the method with bottled water can be compared to a test with distilled water as a control, in a moderately acidic soil to test whether there is an effect of the water source. Note that simply measuring the pH of a water used for testing is not a good approach to deciding whether to use a particular water, since water with very low TDS, and especially distilled water, is notoriously hard to measure for pH, with large fluctuations. You can then reach an incorrect conclusion about its suitability.

PROCEDURE:

1. **Weigh 20 +/- 0,5** g soil in a small plastic cup or other container (10g can also be weighed to economize on soil). If there is no balance, you can estimate this weight with a volume of 14 to 16 mL soil in a graduated cylinder or beaker.
2. **Add 40 ml distilled water** (or the alternatives for distilled water discussed above). If you use more or less soil, the relation of water to soil should always be kept at 2:1, e.g. only 20 mL water for 10 g soil.

3. **Mix the soil and water**, stirring for 2 minutes.

Stir the soil and water for 2 minutes.

Let sit one minute or more.

Record the pH meter reading once it stabilizes.

4. **Let the soil suspension sit for one minute or more**, stirring occasionally.
5. **Measure the pH using the pH meter.** Place the pH electrode in the upper liquid part of the suspension (the supernatant) and move or stir it gently to hasten the equilibration.
6. **Take the pH Reading once it has stabilised.** The reading may not stop fluctuating slowly, but the objective should be that the reading does not drift more than 0.1 pH unit over 20 or 30 seconds. By practicing you will get a sense of when the reading is still fluctuating quickly and when it is stable; some pH meters have a flashing pH display which stops blinking once the reading is approximately stable. Variations of 0.01 pH unit are not important in soils.
7. **Measuring with pH strips:** after letting the soil suspension settle for a few minutes (so that the color of strip is not overly affected by the soil color it will absorb from the suspension) the pH can also be read with a pH strip. Then the pH strip is compared to a color scale to find the result. If you wish to use pH strips it is important to conduct some preliminary tests comparing them to a pH meter and testing different times of immersion; some users have found that immersing for at least 10 seconds, and then comparing immediately to the colour chart, gives the best results.

INTERPRETING THE RESULTS:

General soil pH relation to crops and soil pH amendment: Most crops grow best, and nutrients in soils are most available, at a neutral or slightly acidic soil pH. Potatoes, tomatoes, and some adapted varieties of sorghum, maize, and other crops, can also grow well in acidic soils. Here are some points of interpretation and how to improve soil pH at different measured pH levels:

- Low pH levels (e.g. $< pH\ 5$) make nutrients less available and will negatively influence the growth of crop roots and thus also crop yields.
- Agricultural lime, ashes, and biochar (especially biochar made from non-woody materials like crop residues) can be used to lime (increase the pH level) of soils.
- Often the amounts recommended for improving low soil pH at a whole field level are too large to be affordable in the short term for smallholder farmers. However it is possible to impact soil pH and crop growth positively by applying smaller

quantities of liming materials only in the row (furrow) or in planting holes for crops.

- The table below gives very rough quantities of lime that can be applied to improve crop performance based on the pH test result and the soil texture (you can assess texture simply using the "feel methods" at https://smallholder-sha.org or other source). In the table you will find the quantities of agricultural lime or other liming materials to apply in 5 meters of crop row. If you use planting holes this quantity can be divided among the planting holes that cover 5m.

	Sandy soils, amount to apply to 5 m of crop line.	**Loamy soils, amount to apply to 5 m of crop line.**	**Clayey soils, amount to apply to 5 m of crop line.**
pH 4.5 or below	1 kg lime or ashes or 1 bucket biochar	1.5 kg lime or ashes or 1.5 buckets biochar	2.5 kg lime or ashes or 2 buckets biochar
pH 4.5 to 6.0	0.5 kg lime or ashes or 1 bucket biochar	0.75 kg lime or ashes or 1.5 buckets biochar	1.25 kg lime or ashes or 1.5 buckets biochar