SUBSTRATE QUALITY – requirements and procedures

Schedule

Lesson 1 and Lesson 2
- introduction
- determination of the grain size composition and preparation of fine earth
- preparation for determination of reduced volumetric weight
- preparation for determination of the weed seeds content
- preparation of the biological test
- determination of chloride content
- preparation of samples for pH measurement

Lesson 3 and Lesson 4
- evaluation of the weed seeds content (after 7 days)
- evaluation of the biological test (after 7 days)
- evaluation of the reduced volumetric weight
- pH measurement
- determination of substrate salinity (by measuring the electrical conductivity)
- elaboration of the laboratory exercise report (protocol)

1. GRAIN SIZE COMPOSITION

1.1 Requirements: container planted seedlings (sowing) - max. 5 mm fraction

container planted transplants - max. 15 mm fractions

1.2 Procedure:

Sieve the substrate at volume of 1 litre through screens with mesh sizes of 15 a 5 mm. Using a measuring cylinder, determine the volume of fractions greater than 15 and 5 mm (to eliminate the gaps due to volume measuring of the substrate or of the fractions, tap the bottom of the measuring cylinder with your palm three times); calculate the fraction percentages. Then prepare approx. 250 g of fine earth for further analysis by sieving the substrate through a 2 mm screen. Put fine earth in a polyethylene bag, marked with the substrate number and name (check the sufficient quantity of the substrate by weighing).

1.3 Adjustments:

Crushing, sieving, further composting.

2. REDUCED VOLUMETRIC WEIGHT

2.1 Requirements: sowing - up to 180 $g.l^{-1}$

containerized plants - max. 220 $g.l^{-1}$

2.2 Procedure:

In a pre-weighed beaker (note the weight!), mix the substrate with water into a slushy substance of 50 ml (the water must not flow out of the substance). Let the substance dry in the dryer (at 105°C), weigh it, and convert the value to 1 litre of the substance. (The drying is to be managed by the lecturer, the weight will be measured in the following seminar.)

2.3 Adjustments:

Mixing with crushed bark or other substrate with a minimum portion of dust particles.

3. CONTENT OF WEED SEEDS

3.1 Requirements: sowing - up to 2,500 germinating seeds per 1 m^3

containerized plants - max. 15 000 germinating seeds per 1 m^3

3.2 Procedure:

Take a plant pot and pour approx. 1-2 cm layer of expanded clay into it; add sand (approx. 2 cm below the upper edge); after that, add 100 ml of the substrate (the substrate layer must not be higher than 7 mm); move the pot into a water container (irrigation by capillary action). Label the pot with the substrate number. After seven days, we will count the number of germinated seeds of weed plants, which will be then adjusted to 1 m^3 if the substrate.

3.3 Adjustments:

Chemical or thermic disinfection.

4. BIOLOGICAL TEST (TOXIC CONTENT)

4.1 Requirements:

The test can reveal whether or not there are phytotoxic substances present in the substrate. However, we are not able to find out why. There are no precise phytotoxicity criteria for a defined amount of germinated seeds so a subjective estimation is to be applied.

4.2 Procedure

Take a plant pot and pour the substrate into it (approx. 2 cm under the upper edge). Count 50 pieces of lettuce seeds on a clean pad. Pour them into a glass bowl and gently sow them into the substrate. Label the pot with the substrate number and put the pot into a container with water (irrigation by capillary action).

After 3 to 7 days it is possible to evaluate the number of germinated seeds and the quality of the plants (lettuce is extremely sensitive to presence of phytotoxic substances).

4.3 Adjustments:

If the substrate is of no use, it is necessary to find out the cause and decide on its disposal.

5. ACIDITY (pH)

5.1 Requirements: conifers 4.5-5.5 pH/H_2O

deciduous 5.0-6.0 pH/H_2O

5.2 Procedure:

Weigh 10 g of fine earth into a beaker and add 25 ml of H_2O. Occasionally shaking, after 24 hours measure the acidity, using a pH meter or indicator papers. During the first seminar, weight the defined volume of fine earth to a beaker labelled with the name and number of the substrate, and close it with aluminium foil. The water will be provided by the teacher, the pH measurement will take place during the next seminar.

5.3 Adjustments:

Adjustment to increase the pH value - liming (by 1.0 pH - 200 g $CaCO_3.m^{-3}$)

Adjustment to decrease the pH value - irrigation with technical phosphoric acid

- irrigation with 2% ammonium sulphate solution

-mixing with another substrate

6. CHLORIDE CONTENT

6.1 Requirements: max. 50 $mg.l^{-1}$

6.2 Procedure:

6.2.1 Preparation of aqueous extract

Move 100 g of fine earth to a plastic bottle, add 500 ml of distilled water and shake on a shaker for 3 minutes. Filter the suspension through a folded filter.

6.2.2. Determination of chloride:

Pipette 25 ml of aqueous extract of the substrate into a titration flask, add 2 ml of 5% potassium chromate and titrate with 0.02 N silver nitrate solution until the solution turns from yellow to orange-brown. Calculate the chloride content according to the formula:

$$\text{mval } Cl^- \text{ in 100 g of earth} = \frac{a \cdot N \cdot 100}{g}$$

a…consumption of $AgNO_3$ in ml

N…normality of $AgNO_3$

g…weight of the fine earth in grams corresponding to the pipetted volume of the extract

Conversion from mval Cl^- to mg Cl: mg Cl = mval Cl^- . 35.46

Since the chloride content in the substrate is shown in v $mg.l^{-1}$, you need to calculate the volume of the amount of the substrate. Using the specific weight of the substrate (the value to be provided by the lecturer), calculate the volume of the 100 g of the substrate; after that, calculate the chloride content in 1 litre of the substrate.

6.3 Adjustments:

Leaching/extracting salts with water, mixing with another substrate.

7. SALINITY (ELECTRIC CONDUCTIVITY)

7.1 Requirements: max. 2.2 $mS.cm^{-1}$

7.2 Procedure:

7.2.1 Preparation of extract:

Move 100 g of fine earth to a plastic bottle (size 1 l), add 500 ml of boiled distilled water and shake on a shaker for 3 minutes. Filter the suspension through a folded filter.

7.2.2 Measuring procedure:

Use a digital conductometer. For the conductivity measurement, fill the measuring vessel with the examined extract, into which the conductometer sensor is then immersed to the level as marked for maximum permissible submersion; stir gently and read the value after 2 minutes.

7.3 Adjustments:

Leaching with water, mixing with another substrate.