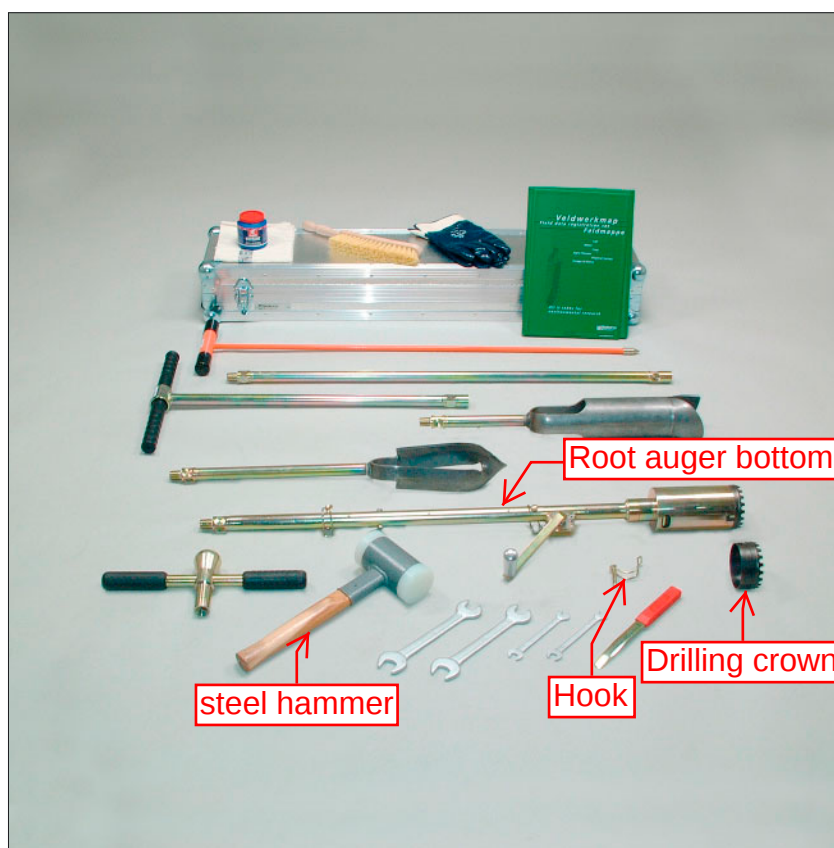


OPERATING INSTRUCTIONS

05.02 BI-PARTITE ROOT AUGER SET



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On these operating instructions



If the text follows a mark (as shown on the left), this means that an important instruction follows.



If the text follows a mark (as shown on the left), this means that an important warning follows relating to danger to the user or damage to the apparatus. The user is always responsible for its own personal protection.

Introduction

The bi-partite root auger is part of the root auger set for sampling to a depth of 2 m. It includes an Edelman auger, a Riverside auger, an impact-absorbing hammer and various accessories. The root auger lends itself to taking undisturbed, uniform soil samples of maximal 15 cm. The root auger can be used in almost any type of soil.

Generally speaking, it is essential to trees to have a complex and extensive root system. This root system allows exploitation of a large soil volume, which in turn renders full absorption of water and nutrients. A well-developed root system will reveal the features of a soil profile, such as moisture content, nutrients, air and the presence of layers that are hard to root.

Rootage research is essential in understanding the rootability, depth and complexity of root systems in differing soil layers. It also helps to locate physical or chemical barriers in the soil profile. Rootage information also allows attuning to optimal fertilisation and soil cultivation.

1. Description

The root auger set contains bottom parts with auger bodies belonging to the root auger, Edelman auger and the Riverside auger. In addition, it contains a standard upper part with detachable handle, a short upper part with beating head, an impact-absorbing hammer, a utility probe, a spare drilling crown and accessories.

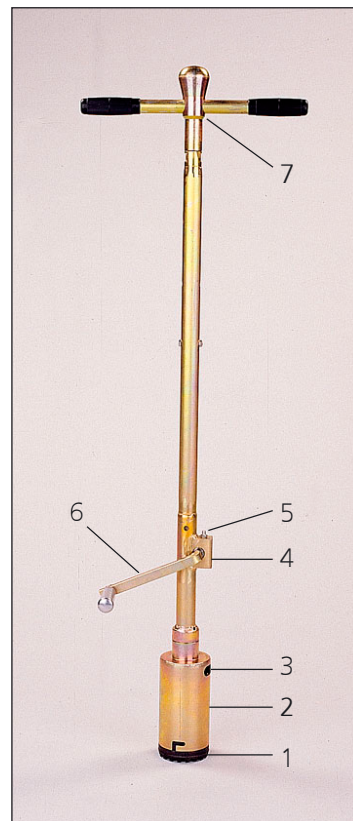
An extension rod can be attached to the root auger to allow augering to a depth of 2 m. The rod is attached to the auger by a conical thread connection. The complete root auger set is contained in an aluminium transport case.

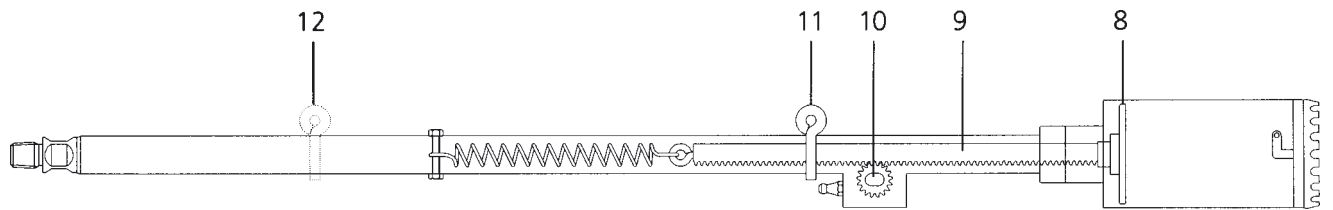
1.1 Root auger

The auger body (see figure) consists of a steel cylinder (2) holding an exchangeable, toothed drilling-crown (1). The drilling crown is made from hardened steel and its toothing allows cutting through the rooted soil. The top end of the cylinder is closed and has a breather hole (3). The auger body is sturdy and as such suitable for use in hard soils. The cylinder's diameter is 8 cm, its operational depth is 15 cm and its volume is 750 cc. Constant volume and surface values are essential in comparing the root density of differing soil samples.

To the bottom part (see figures on this and next page), a gear casing (4) with grease nipple (5) is attached to grease the extruder unit. A detachable crank handle (6) can be fitted to the gear casing. It is used to operate the extruder unit. The extruder unit consists of an extruder (8) and a combined gear rack and gear-wheel (9, 10).

At a distance of 5 cm above the gear casing, a pin (11) is driven right through the handle. The pin can be removed and held in a dummy hole (12). The pin blocks the extruder in its lower position to prevent damage during hammering in. It has a bracket to clamp it onto the auger.





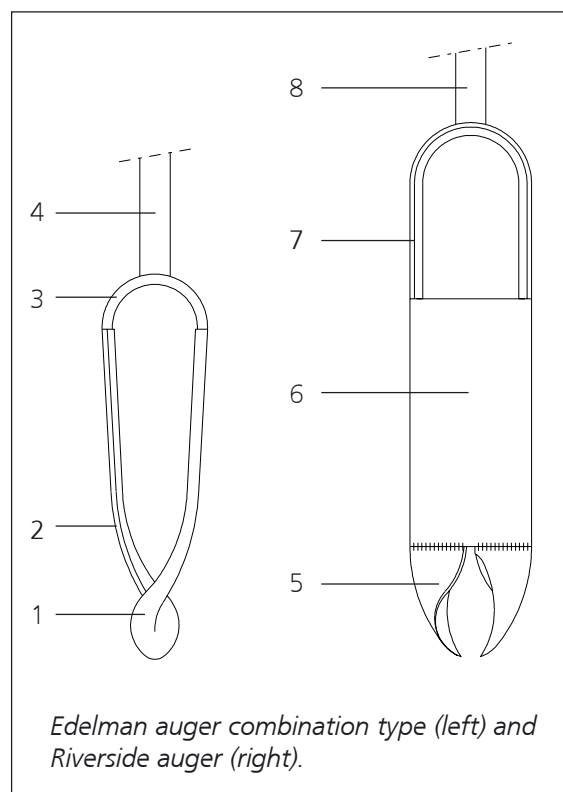
A short upper part with beating head is used to drive or hammer the auger into the soil. A special impact-absorbing hammer is used to pound the auger. The steel hammer is impact-absorbing because its head contains lead bullets flowing in the direction of the stroke upon impact. Its nylon cups prevent damage to the auger.

1.2 Edelman auger and Riverside auger

The Edelman auger in the set (see figure) is a combination type auger. Its auger body is conical in shape and consists of two blades (1) joined in a bit (2). The top of the blades is welded to a bracket (3), which is connected to the auger rod (4). The blades are vaulted and when entering the soil the sample is dug up and evenly guided into the inside of the auger body. The vaulting of the blades not only promotes digging up but also ensures a firm grip of the sample while permitting easy emptying of the auger body.

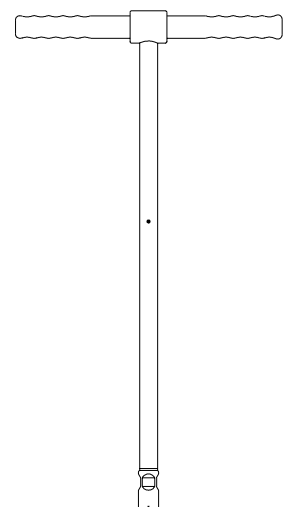
The Edelman auger combination type in the set has a 10-cm diameter (measured diagonally between the blades at the broadest part of the auger body) and the blade width measures 50 mm.

The blades permit a good hold of moderately cohesive soils, while cohesive soils can easily be removed.



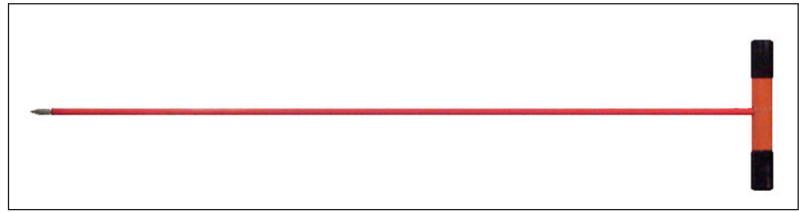
The auger body of the Riverside auger (see figure) has an open tube (6) with two beak-like bits at its base (5) and a bow bracket (7) at its top, which connects to the auger rod (8). The extremities of the bits are skewed and scrape the soil, pressing the sample evenly into the tube. The diameter of the auger bits slightly exceeds the tube's diameter so as to reduce friction between soil and tube to a minimum. The Riverside auger in this set has a 10-cm diameter.

The standard upper part (see figure) has a detachable, synthetic handle and is used with the Edelman auger and the Riverside auger.



1.3 Utility probe

The fibre glass utility probe measures 105 cm and has a 19-mm cone diameter. It is fully insulated and can be safely used to check for cables, tubes and pipes.



2. Safety



Prior to augering use the utility probe to check for cables, tubes and pipes (inquire at your municipality or other relevant organisations). If necessary, select another spot to auger.



Locking the extruder and removal of the crank handle will prevent any play in, and damage to, the combined gear rack and gear-wheel when pounding the root auger.



If force of impact is needed, always use the impact-absorbing hammer. It is safe and causes no damage to the root auger. Avoid using a regular steel hammer. It will damage the auger. A bouncing hammer may cause injuries.



Fill up the borehole with soil or bentonite plugs after augering. This will prevent humans or animals to trip into the hole and incur injuries. It will also allow impermeable layers to recover.



Do not force, or pound on, the Edelman or Riverside auger. This may cause serious damage.

3. The use of augers

3.1 Root auger



Prior to augering, use the utility probe to check for cables, tubes and pipes (inquire at your municipality or other relevant organisations). If necessary, select another spot to auger.

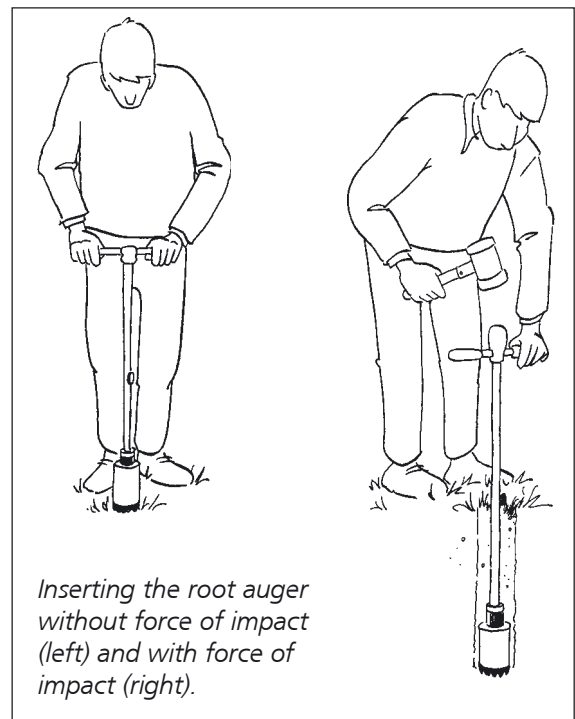
1. Connect the bottom part and the upper part. When using the root auger, select the short upper part with beating head. Select the standard upper part with synthetic handle for the Edelman or Riverside auger. If necessary, use one or more extension rods. Use spanner 20x22 to tighten and loosen the connections.

2. Prior to inserting the root auger into the soil, slide the pin into the lower hole (approx. 5 cm above the gear casing). Remove the crank handle.



Locking the extruder and removal of the crank handle will prevent any play in, and damage to, the combined gear rack and gear-wheel when pounding the root auger.

3. Position the auger vertically on the surface (see figure below) or insert it into the pre-augered hole (paragraph 3.2).



4. Insert the root auger into the soil.

- ☐ Without force of impact. In lighter soils, the bi-partite root auger can be hand-screwed into the soil. Turn it clockwise and push it gently 15 cm into the soil. The drilling crown cuts out soil with roots.



Always rotate the auger clockwise!

- ☐ With force of impact. In harder soil types, the bi-partite root auger is driven into the soil using the impact-absorbing hammer. Hold the auger with one hand by the handle (see figure, previous page). Use the impact-absorbing hammer to drive the auger into the soil for max. 15 cm.



If force of impact is needed, always use the impact-absorbing hammer. It is safe and causes no damage to the root auger. Avoid using a regular steel hammer. It will damage the auger. A bouncing hammer may cause injuries.

5. Cut off the sample by rotating the auger

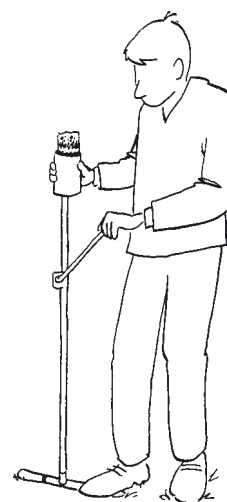


Cutting off a full sample will prevent loss of sample material. Rotate the auger a full circle without pressing it down.

6. Hoist the root auger with sample while gently rotating it. Keep your back straight and your knees bent to prevent injuries. Turn the auger upside down (put the beating head in the borehole) and remove the sample by operating the extruder.

7. Remove the pin and put it into the dummy hole. Insert the crank handle into the gear casing and push the sample out of the auger cylinder (see figure). Now, the sample can be examined (e.g. break the sample and count the roots on the fractured surface).

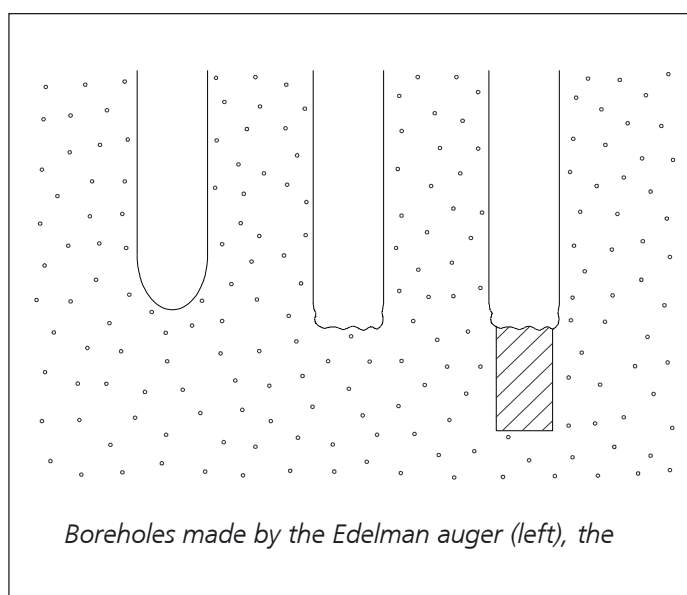
8. Clean the augers after use with running water. Use the bent spatula to remove dirt between the extruder and the top of the cylinder. Disconnect the rod from the auger to clean the threads.



Fill up the borehole with soil or bentonite plugs after augering. This will prevent humans or animals to trip into the hole and incur injuries. It will also allow impermeable layers to recover.

Some remarks:

- ☐ For sampling at greater depth, use the Edelman and/or Riverside auger to pre-auger.
- ☐ Boreholes made by the Edelman auger have a conical shape (see figure). The Riverside auger is used to level the borehole before applying the root auger.
- ☐ It is recommended to ream the borehole using the Edelman or Riverside auger after sampling with the root auger. Hoisting the root auger causes coating on the walls of the borehole, which impedes further sampling. Reaming the borehole reduces friction.



3.2 Edelman auger and Riverside auger

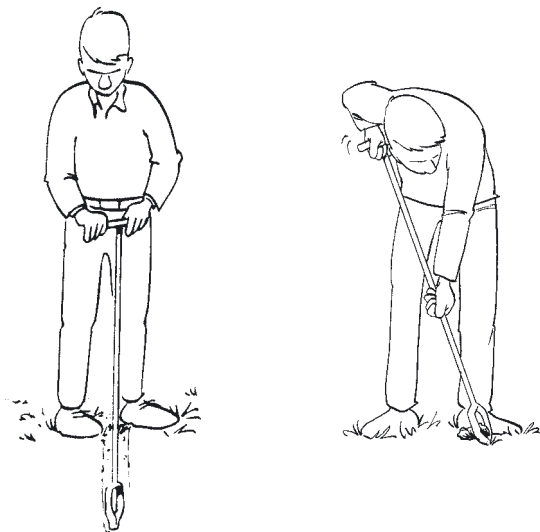
Edelman auger, combination type.

1. Hold the auger by the synthetic handle and rest it on the ground (see figure).
2. Rotate it clockwise while gently pushing it into the soil. Upon $2\frac{1}{4}$ rotations (360°), the auger should have dug 10 cm. The auger body will be filled up to its bracket with slightly disturbed soil material. Depending on the type of soil additional rotations may be necessary.

Do not overfill the auger body. Superfluous material will coat the auger hole, which hinders further sampling and removal of the sample



Do not force, or pound on, the Edelman or Riverside auger. This may cause serious damage.



3. Rotate the auger to cut off the sample. Turn it a full circle (360°) without pressing down. Hoist the auger gently rotating it. This will prevent loss of sample.
4. To release the cohesive material hold the auger askew on the surface (see figure), rotate the auger 180° while pressing it into the ground. The sample should detach itself and can be taken out by hand, or by lightly tapping the auger. Moderately cohesive material will detach itself immediately.

Riverside auger.

Revolve the auger into the soil. The soil material will be fed evenly, but strongly disturbed, into the body. Compaction will cause the material to remain in the body. Pull out the auger. Tap it gently on the surface and the moderately cohesive sample will detach itself. To remove cohesive material, use a bent spatula.

Maintenance.

To avoid excessive oxidation when storing the Edelman and Riverside auger bodies, apply Vaseline.

4. Applications

The bi-partite root auger can be used in almost any kind of soil, regardless of the resistance of penetration. The standard set allows sampling to a depth of 2 m. The samples are practically undisturbed and equal in size and volume. This is relevant when comparing the root density of different soil samples.

The bi-partite root auger is used in:

- ☐ Research into rootability, depth and complexity of root systems in soil layers.
- ☐ Root sampling in urban areas (little space is required, it will suffice to lift one paving stone).
- ☐ Sampling of compost, in combination with the Edelman auger.

The Edelman auger combination type is suitable for universal soils. The Riverside auger is suitable in hard, rigid soils and in gravelly soils. Both augers are often applied in exploratory augering and in obtaining rough estimates of the extent of rootage. In addition, they are used in pre-augering the soil layers under examination, and in reaming the borehole. The Riverside auger is suitable for levelling the bottom of the borehole.

In the table below, the various applications are listed:

Type of auger	Application
Bi-partite root auger	Almost any type of soil; rootage research; compost sampling.
Edelman auger, combination type	Universal soils: exploratory augering; rootage rough estimates; pre-augering; reaming.
Riverside auger	Hard, rigid soils such as dry clay, gravelly soils; levelling the borehole bottom; pre-augering; reaming.

5. Troubleshooting

- ☐ Thick and tenacious roots in loose soils cause the auger to seize. Select another spot for augering.
- ☐ The drilling crown is worn out or damaged after hitting upon concrete or stone. It is rendered useless, and should be replaced by the spare drilling crown. The drilling crown is attached to the auger cylinder by a stiff bayonet connection. Use pliers to detach the crown.
- ☐ Narrowing of the borehole causes the root auger to seize. Use the Edelman auger and/or the Riverside auger to ream the borehole.
- ☐ The root auger's cylinder is not fully filled with sample material; the bottom of the borehole was not level. Use the Riverside auger to level the borehole bottom.
- ☐ The extruder is not working properly. Clean the apparatus and grease the mechanism by using the grease nipple (5).

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