ELSEVIER

Geoderma 87 (1999) 305–310

GEODERMA

A method for the collection of soil monoliths from stony and gravelly soils

E. Barahona *, A. Iriarte

Departamento de Ciencias de la Tierra y Química Ambiental, Estación Experimental del Zaidín, CSIC, Profesor Albareda 1, 18008 Granada, Spain

Received 26 May 1997; accepted 20 April 1998

Abstract

Monolith collection of soils with large amounts of coarse fragments, or of wet soils, pose specific problems which are directly related to their lack of physical stability. The purpose of this paper is to outline a procedure for soil monolith collection which is highly appropriate for these cases. A permanent backing is prepared on site with gypsum plaster before detaching the profile from the soil face. The soil is initially stabilized with an aqueous suspension of vinyl latex. A permanent backing is prepared on site by casting a gypsum plaster slurry between the soil section and a backing board. This will fill all voids and anchor the coarse fragments protruding from the soil exposure. Once the plaster has set, the soil monolith can be safely dug out and transported. Little finishing is needed afterwards in the laboratory. The procedure has been successfully demonstrated in a variety of soils in Spain.

Keywords: soil monoliths; soil profiles; stony soils; gravelly soils; wet soils

1. Introduction

Numerous methods have been described for the collection of soil profiles. In many of them, a metal frame or a box must be driven into the soil face (Berger and Muckenhirn, 1945; Jager and Schellekens, 1963; Jager and van der Voort, 1965; Van Baren and Bomer, 1979). This process is difficult if coarse fragments are abundant in the soil.

* Corresponding author. Fax: +34-958-129600; E-mail: enrique.barahona@eez.csic.es

0016-7061/99/$ - see front matter
PII: S0016-7061(98)00046-9

Another difficulty often encountered with coarse textured soils is their tendency to slump when the profile is cut out from the soil exposure. This has been prevented by bandaging the profile with strips of cloth around the box, metal frame or an accessory board as the operation proceeds (Smith and Moodie, 1947; Smith et al., 1952; Van Baren and Bomer, 1979).

In any case, it is nearly impossible to avoid some disturbance of the soil material when fixing the back surface of the soil monolith, which is frequently irregular, to the flat surface of the backing board which constitutes the final support of the mounted profile. Ottersberg and Byron (1987) describe a method to collect large soil profiles in which the empty space between the soil and the backing board is filled with polyurethane foam, which also acts as a binder.

The aim of this paper is to outline a very efficient method in which the filling and binding is accomplished with gypsum plaster.

2. Materials and methods

The main steps to be followed are sketched in Fig. 1 and treated in detail below. Water:gypsum plaster ratios are given in volume, and are only approximate since they could vary with the quality of the gypsum plaster. Vinyl latex:water ratios are also approximate and should be tested before use.

2.1. Trimming and stabilising the soil exposure

The soil exposure is trimmed to leave a moderately smooth and flat surface. A section with the desired width is selected and stabilised by spraying it with a dilute suspension of vinyl latex (white glue) in water (about 1 part vinyl latex: 2 parts water). If the soil material is sufficiently coherent, undiluted vinyl latex can be directly applied with the aid of a brush. In any case, top soil and plants should also be liberally sprayed. The latex is allowed to dry before going on to the next stage. If drying is not feasible, the drying stage can be skipped, but glueing is necessary because gypsum plaster adheres badly to some soils, especially to clayey ones. If the soil tends to slump or drag, and the glue is fresh, an additional stabilization should be made by splashing or pouring a gypsum plaster slurry (1:2) down the soil section and allowing the slurry to set. This will make later operations easier.

2.2. Preparation of the backing board

A plywood board, about 1.5 cm thick, previously cut to an appropriate size (usually 20–30 cm wide and up to 130 cm long), is prepared as a permanent

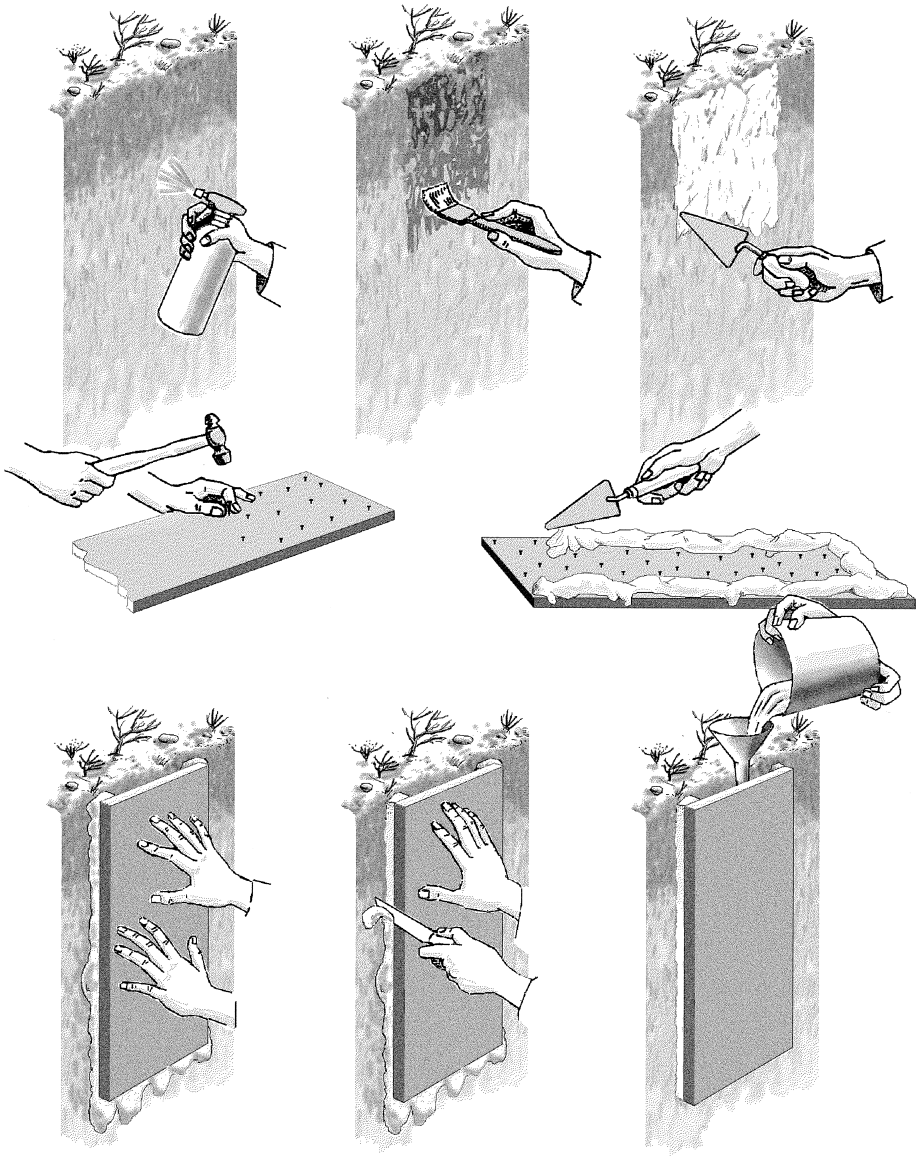

Fig. 1. A sketch of the steps to be followed in the method.

backing for the profile by driving small nails (approx. 25 mm shaft and 4 mm head) into one side at 10–20 cm intervals, allowing their heads to protrude a few millimetres above the board surface. The nail heads will serve as anchor points between board and plaster. Alternatively, boards can be pre-treated in the laboratory by glueing one side and sprinkling on them some coarse sawdust while the glue is still fresh. In this way, a rough surface will be obtained with excellent adherence to the gypsum plaster.

2.3. Fixing the board to the soil exposure

Prepare a gypsum plaster paste (1 part water: 2–3 parts gypsum plaster powder) and, with the aid of a trowel, apply a coat of about 5 mm thick to the soil exposure. Pores or cracks should be completely sealed. If the latex has not dried, this coat should be somewhat thicker (10–15 mm) since its setting will help to drying the latex, thus enhancing the adherence between soil and plaster.

Prepare additional plaster paste and heap it along the bottom and side edges of the nailed side of the board.

Put the board in place and press it against the soil face, then cut the excess of plaster squeezed from beneath the board with a knife before the plaster becomes too hard. If pores or holes appear when cutting the plaster, prepare a small batch of fresh paste and seal them.

By following this procedure, one obtains a sort of box fixed to the soil section, the empty central part of which will be filled with plaster slurry. Prepare the plaster slurry (1:2) in a bucket and pour it into the monolith box using a wide mouthed funnel. The slurry should have a creamy but flowing consistency, and the filling should be done in several stages, allowing the plaster to set each time in order to avoid the excessive build up of hydrostatic pressure.

2.4. Removal of the monolith from the exposure

Once the plaster has sufficiently hardened (about half an hour) dig carefully into the soil, between the bank and the monolith, until the latter can be detached. The thickness of the soil adhering to the backing board should be kept to a minimum in order to avoid excessive weight. If the soil is too moist, bandaging the monolith as the digging proceeds will prevent slumping. During transportation, the monolith should lie on a rigid board or metal frame so as to avoid sagging.

2.5. Stabilizing and finishing the monolith in the laboratory

The monolith is allowed to dry, trimmed to reduce its thickness and to expose the natural structure, cleaned with a stream of oil-free air and stabilised by spraying it repeatedly with a diluted aqueous vinyl latex suspension (1:4). The soils should not be allowed to become glossy. Monoliths stabilized in this way display a colour very similar to that of the natural dry soil. If the moist colour is wanted, another organic solvent stabilizer, such as vinylite resin, should be used.

Minor damage can be repaired with undiluted vinyl latex and loose soil material. The top surface of the soil and the vegetation should be liberally sprayed to prevent leaves and litter from falling off. The profile sides are finished by painting them with a mixture of vinyl latex and soil material. Plaster visible at the bottom of cracks can be hidden with dull black paint.

2.6. Some useful tips

Setting time and consistency of water–gypsum plaster mixtures could vary substantially from one gypsum plaster batch to another and should, therefore, be checked in the laboratory when a new batch or brand is used. A short setting time can pose problems, especially when working with large batches of plastic paste. It can be lengthened at will by adding citric acid (Usually, 5 ml of 5%

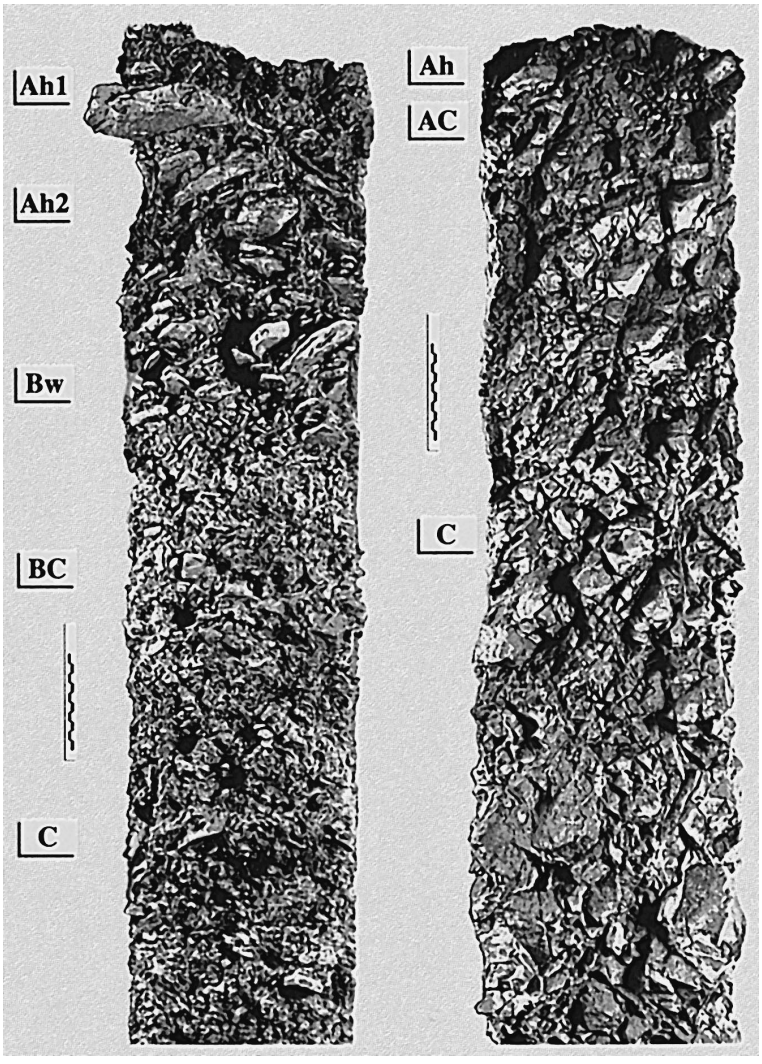

Fig. 2. Two soil monoliths taken from very coarse gravelly soils. The first is a Typic Cryumbrept formed on micaschists (Sierra Nevada, Spain). The second is a Typic Xerorthent developed on milonitized dolostones (Sierra Almijara, Spain). Scale is 10 cm long.

citric acid solution per liter of tempering water). This addition will not noticeably affect the hardness of the cured plaster.

There is a great variety of polyvinyl acetate based products that are on the market under the generic names of latex or glue. Those of good quality will yield a flexible dried residue. The product used for the final stabilization should also be colorless, transparent and not overly glossy when dry.

3. Conclusions

This method is especially advantageous for taking monoliths from coarse-textured, gravelly and stony soils, since coarse fragments protruding from the soil exposure will be embedded and anchored in the plaster. Even rocky soils have been successfully taken (Fig. 2). Nevertheless, excellent results have also been obtained with fine-textured soils and also with very moist and even wet soils (Plaster setting is not impaired by wetness; on the contrary, it will help to dry the soil as the $CaSO_4$ dihydrate forms).

Other advantages of the procedure can be summarised as follows.

(1) The materials needed are cheap and easily available.

(2) The plaster will acquire a very hard consistency in 1 or 2 h and, as a consequence, 1 or 2 monoliths can be easily taken in a single day.

(3) Little finishing is needed in the laboratory.

References

Berger, K.C., Muckenhirn, R.J., 1945. Soil profiles of natural appearance mounted with vinylite resin. Soil Soc. Am. Proc. 10, 368–370.

Jager, A., Schellekens, A.C.F.M., 1963. Handleiding voor het conserveren van zware en/of natte bodemprofielen. Boor en Spade XIII, 61–66.

Jager, A., van der Voort, W.J.M., 1965. Het nemen en conserveren van bodemmonolieten van zand gronden en gerijpte kleigronden boven en beneden de grondwaterspiegel. Soil Survey Paper No. 2. Soil Survey Institute, Wageningen, The Netherlands, 13 pp.

Smith, H.W., Moodie, C.D., 1947. Collection and preservation of soil profiles. Soil Sci. 64, 61–69.

Smith, H.W., Mc Creery, R.A., Moodie, C.D., 1952. Collection and preservation of soil profiles: II. Soil Sci. 73, 243–248.

Ottersberg, R.J., Byron, T.M., 1987. An improved procedure for collection and preservation of soil profiles. Soil Sci. Soc. Am. J. 51, 1388–1390.

Van Baren, J.H.V., Bomer, W., 1979. Procedures for the collection and preservation of soil profiles. Technical Paper No 1. International Soil Museum, Wageningen (ISRIC) 23 pp.