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Discussion on Soil Sampling Technology Based on the Experience of Yuanzegou Small Watershed

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Abstract Based on the experience of soil sampling in Yuanzegou small watershed, several matters needing attention in soil field sampling are summarized. This paper focuses on the layout of sampling points, soil sample collection, soil sample preparation and matters needing attention about potential factors in soil field sampling, with a view to providing reference for undergraduates, master students or non-subject experimenters who are about to carry out experiments in this discipline.

Key words Soil science, Field sampling, Matters needing attention

1 Introduction

The study of soil science is inseparable from the analysis of soil samples, and soil sampling is not only the foundation of soil research, but also the main source of errors in soil research[1]. The field sampling error is mainly human error, and the laboratory tester can only be responsible for the analysis results of the samples. If the samples sent do not meet the requirements, then any precision instruments and analytical techniques will be meaningless. Therefore, great attention should be paid to the standard and accuracy of sampling when taking soil samples in the field.

Yuanzegou small watershed (37°15′ N, 110°21′ E), located in the middle of the Loess Plateau, is a typical loess hilly gully watershed with an area of 0.58 km^2, of which the gully area is 0.31 km^2, accounting for 53.4% of the total watershed area. The main land use types in the basin are farmland, 7-year abandoned grassland, 30-year abandoned grassland and red jujube orchard[2]. Soil samples were taken for 3 times in the basin from 2015 to 2016, and more than 1 800 soil samples were taken. The indicators included soil organic matter, total phosphorus, total nitrogen, available phosphorus, available potassium, alkali-hydrolyzable nitrogen, grain composition and soil moisture. Based on the experience of field layout and sampling in Yuanzegou and the errors in the experiment, the matters needing attention in the field experiment of soil science are summarized in order to provide reference for undergraduates, master students or non-subject experimenters who are about to carry out experiments in this discipline.

2 Sampling point layout

There are generally three kinds of layout points, namely, diagonal method, serpentine method, and chessboard method. Generally, 5 - 9 points are taken, and the soil is generally taken with plastic self-sealing bags. The distribution of sampling points should be "uniform" and "random". The selection of sampling sites should avoid special places such as roadsides, ditches, ridges, excavation site, and composting site. The number of sampling points is generally determined according to the size of the sampling area, land use, fertilization and so on.

In the case of irregular sampling in a small watershed, when there is a DEM map, it is necessary to mark the sampling points to be taken on the DEM map and record the longitude and latitude of the first sampling. When sampling many times in a large area, in addition to using GPS to locate its longitude, latitude and elevation, it is also necessary to use other markers to mark, such as inserting chopsticks at the sampling point, and tying a ribbon on the branches and leaves of a shrub.

3 Soil sampling

3.1 Sampling tool When taking both soil and root system, we should choose root drill or Luoyang shovel, and generally choose shovel when we need to dig soil profile.

3.2 Sampling method Due to the influence of natural factors such as topography, geomorphology and man-made factors such as tillage and fertilization, the distribution of soil nutrients is uneven. Therefore, mixed soil samples must be collected at multiple points, and then taken after complete mixing to increase its representativeness and scientificalness. After the sampling point was determined, the topsoil of 2 to 3 mm was scraped off and buried vertically with a soil drill or small shovel to the desired depth. Three soil samples were randomly taken near each point to ensure the consistency of the soil depth and quality of each point. The soil samples of the three points were concentrated in the soil plate, and after each layer was evenly mixed, impurities were picked out

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and gravel, roots and other materials were preliminarily selected. Due to the different determination of experimental indexes, the preservation methods of soil samples are different. For example, when determining the physical and chemical properties of soil, the soil samples for the determination of nitrate nitrogen and ammonium nitrogen need to be fresh soil samples, while soil total nitrogen, total phosphorus and organic matter are air-dried soil samples. Preservation method of fresh soil samples: when taking soil samples, part of the soil samples were put into a sample bottle, sealed with a sealing film and stored in an ice box, and brought back to the laboratory for freezing at −20 ℃[3]. Preservation method of air-dried soil: part of the soil sample (300 − 400 g) is put into a self-sealing bag and brought back to the laboratory for air-drying treatment. When it is necessary to measure the soil weight and water content, a part of the soil sample (30 − 40 g) was taken into an aluminum box with a diameter of 50 mm and brought back to the laboratory to determine the soil weight and water content[4].

3.3 Sampling interval In the field experiment, the soil samples are mainly taken before the experiment to determine the background value of soil; sampling in each growth period of crops is used to determine the changes of soil nutrients; sampling is carried out before and after crop harvest or before applying base fertilizer to make fertilization plans.

For different land use, different vegetation, different rainfall, different underlying surface conditions in the field small watershed sampling, the sampling time interval needs to be based on the relevant literature, so as to sample as much as possible. When there are multiple samples at the same sampling point, it is necessary to ensure the consistency and correspondence of the sample number, especially when the number of samples is large.

3.4 Sampling depth The sampling depth is generally determined according to the goal of the study. In order to study the nutrient distribution of field crops, the tillage layer soil of 0 − 60 cm is generally adopted. As to the cultivated land for planting forest trees and fruit crops, the collection depth is 0 − 100 cm. For crops with deep roots, or when studying soil moisture, dry layer, or deep nutrient storage, the soil that needs to be collected is deep, up to 10 m or even 20 m. To determine the sampling depth, it is also necessary to collect soil samples at multiple levels, and the soil layer spacing is generally selected according to the measured indicators. For the determination of soil nutrients or soil moisture, the 0 − 60 cm soil layer is dense, such as 0 − 5 and 5 − 10 cm. For the soil layer below 1 m, it is usually separated by the depth of 1 m, such as 1 − 2 and 2 − 3 m. The specific soil spacing needs to be determined according to the specific experimental scheme.

3.5 Soil sample label It is very important to fill in the labels of soil samples correctly. Field sampling, especially large-scale sampling, involves hundreds or even thousands of soil samples. If the labels are not correctly marked and filled in, the time-consuming and laborious sampling will become meaningless. The information of the label mainly includes date, number, sampling location, sampling depth, soil sample name, sampler and so on. The soil sample label should be in duplicate, one in the self-sealed bag and one affixed to the outside of the self-sealed bag. At the same time, this content will be registered in a special book and on the computer for later inquiry. The label can be filled in before the soil sample is taken, or on the spot if there is enough manpower.

4 Soil sample preparation

4.1 Soil sample treatment Fresh soil samples were laid flat on kraft paper and placed in a cool, ventilated and clean room. It is strictly forbidden to be exposed to the sun or polluted by acid, alkali gas and other substances, and let them dry naturally. Large clods were turned over and crushed at any time, and roots, leaves, insects, new organisms, invaders, *etc.* were removed, which can reach the air drying requirement after 7 − 14 d.

4.2 Grinding and sieving When measuring different soil indexes, the required soil particle size was different, such as 2, 1, 0.149 mm. During the physical analysis, 100 − 200 g of air-dried soil samples were taken, placed on kraft paper and crushed with a wooden stick, so that all of them passed through No. 10 sieve (2 mm). The unscreened clods left on the sieve should be poured on kraft paper and continue to be crushed until all of them passed through the sieve and they should not be discarded or omitted. A part was separated by the quartering method, ground and sifted with a No. 18 sieve (1 mm). The clods left on the sieve without being sifted should be poured on kraft paper and crushed until all of them passed through the sieve, and they should not be discarded or omitted. If necessary, we should continue the screening operation as above. When screening soil samples, we must strictly follow the principle of screening, and must not blindly pursue speed.

5 Potential factors

To determine soil fertility, considering some data needed in later determination, such as root system, rainfall and air temperature, we should read a lot of literature in the early stage of the experiment, and try our best to consider the required indexes comprehensively on the basis of our own selected topics. The field sampling involves not only time but also distance. Often some experimental stations or sites are hours away from schools or work units or even not in the same province, it is often difficult to supplement the experiment later.

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