



Effect of Soil Particle Sizes on Determination of pH, Oxidizable Organic Carbon and Available Phosphate

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Authors' contributions

This work was carried out in collaboration among all authors. Author AT designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors HKT and ST managed the analyses of the study. Author RKB managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Soil analysis is integral part of present agricultural farming, where soil samples are particularly determines with 2 mm sieved soil. It is highly related that finer particles pass through 80 mesh (0.2 mm) size had better interaction with concentrated chemical solution or extractant. Total 136 number of soil sample were collected from different agricultural land of Terai region of West Bengal to conducted the study on effect of soil particle sizes passes through 20 mesh (2 mm) and 80 mesh (0.2 mm) sieve on soil pH, oxidizable organic carbon and available phosphate. Thus, each sample was portioned into two particle size classes. Such as '80 mesh soil particles' and '20 mesh soil particles'. The pH, oxidizable organic carbon (OCC) and available phosphate contents of two particle sizes of each soil sample were determined and compared. The maximum difference of 0.2 unit was recorded in case of pH analysis with both sieve sizes. The mean organic carbon content of soil particles that passed through 20 mesh 80 mesh sieve was 0.674 and 0.683 respectively, which

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further signifies organic carbon content value of 80 mesh soil particle size was slightly greater than that of 20 mesh soil particle size. The value of P content by different sieve size had maximum difference $0.2 \text{ kg P}_2\text{O}_5 \text{ ha}^{-1}$ and for some soils there was no difference. The difference mean of phosphate values of two particle sizes was 0.134 only. This difference is neglected for crop production. Thus, soil sieved through two sieve sizes 20 mesh 80 mesh sieve had no effect with soil pH, little influence on OCC and negligible effect on available phosphate content.

Keywords: Mesh sieve; particle size; pH; oxidizable organic carbon; available phosphate.

1. INTRODUCTION

Soil analysis is well known for addressing soil quality and fertilizer recommendation in present scenario for agricultural practices. Physico-chemical properties of soil is governed mainly by the exchange of mineral elements between the substrate medium and the substrate solution, with organic materials contributing the most to the chemistry of substrates. The binding material or chelating substance that holds the nutrient at different rate may also depends on soil aggregates and particle sizes [1,2]. In routine soil analysis, the soil samples were particularly determines with 2 mm sieved sized. But in case of organic carbon sample analysis may allow for further grinding. It is highly related that finer particles pass through 80 mesh (0.2 mm) size had better interaction with concentrated H_2SO_4 and $\text{K}_2\text{Cr}_2\text{O}_7$ solution as compared to bigger sieve sizes (2.0 mm & 0.5 mm). Jackson [3] had also studied and mentioned the use of 2 mm sieve for all soil analyses. For SOC it's advisable to mill the soil to achieve a more homogeneous sample (especially when you use less than 500 mg of soil). Indeed 2 mm sieve sample is also preferred for estimation of oxidizable organic carbon by Walkley and Black (1934) method. But for soil total carbon, soil sample must pass through 100-150 mesh sieves (0.100-0.150 mm openings) instead of 2.0 mm. In soil, micro aggregates form into macro aggregates through polysaccharides of plant or microbial origin and fungal hyphae. That might be further varies with nutrient when passed through different sieve because of their particle sizes If one grinds soil samples up to 0.2 -0.25 mm size most of the macro aggregates breakdown to micro aggregates (<250 μm). Probably grinding to pass through 80 mesh (0.2 mm) makes the soil more homogeneous, and facilitates better interaction between soil and the reagents added and less variability in C values. Several workers also ground the samples from 0.5 to 0.15 mm range to achieve the fineness, through grinding of 2 mm sieve sample passed soil [4,5]. There

are several researches on size distribution of soil carbon in aggregates of different size because the size of the aggregates is related to their carbon stock. Walkley and Black (1934) method depends on the surface area reaction thus particle with varying sizes may have some effect on surface areas, which eventually depends how samples has been prepared. In contrary to physical properties, there is little information available regarding the influence of particle size on the chemical properties of soil. Therefore, the present investigation was carried out to compare the effect of soil particle size passed through 20 mesh (2 mm) and 80 mesh (0.2 mm) sieve on determination of soil pH, oxidizable organic carbon and available phosphorus.

2. MATERIALS AND METHODS

A total 136 number of experimental soil sample (0-15 cm depth) was collected from different agricultural land of Terai region of West Bengal during 2011-12 and laboratory experiment was conducted at department of Agricultural Chemistry and Soil Science, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur. These samples were properly labelled and visible plant and animal residues were removed. The soil samples were air dried in shade, pulverized and passed through 80 mesh (0.2 mm) and 20 mesh (2 mm) sieves. Thus, each sample was portioned into two particle size classes. Such as '80 mesh soil particles' and '20 mesh soil particles'. The pH, oxidizable organic carbon and available phosphate contents of two particle sizes of each soil sample were determined. The values for two particle sizes were compared.

2.1 Methodology Used

2.1.1 pH

pH was determined by glass electrode method in 1:2.5: soil: water suspension using a Systronics pH meter as described by Jackson [3].

2.1.2 Organic carbon

Organic carbon was determined by wet digestion method of Walkley and Black (1934) as described by Jackson [3].

2.1.3 Available phosphorus

The available phosphates of soils were extracted with Olsen extractant (Olsen et al. 1945) and soils having pH <6.0 were extracted by Bray and Kurtz No. 1 extractant (Bray and Kurtz, 1945).

3. RESULTS AND DISCUSSION

3.1 Effect of Particle Sizes on Soil pH

The pH values of 136 numbers of soil samples screened through 20 mesh and 80 mesh sieve are presented in Table 1. Results showed that for a given soil the pH values of two sieve sizes did not differ largely. The pH value was ranges from 3.24 to 6.87 and 3.12 to 6.90 for 20 mesh and 80 mesh sieve respectively. The maximum difference for both the particles sizes i.e. 20 mesh and 80 mesh was 0.2 units. Now, 29.41, 30.15, 22.79 and 17.65% of total samples the sieve sizes showed differences of 0.01 – 0.05, 0.06 – 0.10, 0.11 – 0.15 and 0.16 – 0.20 units respectively. Ji [6] found that there was no significant difference on soil pH of 0.9 mm soil particle and 2 mm particle size soil. A difference of 0.2 unit pH or less cannot largely

influence the crop growth and yield. The difference which is almost negligible is clearly depicted by box plot (Fig. 1). The mean pH values of two soil particle sizes were same (4.71). Hence, soil particles of any sieve size of 20 to 80 mesh can be used to determine the pH for the purpose of agronomic practices such as liming, selection of fertilizer and their application method etc.

3.2 Effect of Particle Sizes on Oxidizable Organic Carbon

The effect of particle sizes on oxidizable organic carbon contents of soil ranges from 0.39 to 1.35 and 0.32 to 1.33 for 20 mesh and 80 mesh sieve respectively. Results showed that for a given soils the organic carbon content of two sieve sizes viz. 20 mesh and 80 mesh differed slightly. The difference was 0.01 – 0.13. Mean organic carbon content of soil particles that passed through 20 mesh 80 mesh sieve was 0.674 and 0.683 respectively. Now 55.58, 36.76 and 7.35% of the total soil samples, the two different sieve sizes showed the unit differences of 0.01 – 0.05, 0.06 – 0.10 and 0.11 – 0.15 respectively (Table 2). The organic carbon content of 80 mesh soil particle size was slightly greater than that of 20 mesh soil particle size. Now again for better comprehension about distribution and variability of organic carbon it's also illustrated in box plot (Fig. 2). Similar research was also mentioned by Xu et al. [7]; Ross et al. [8].

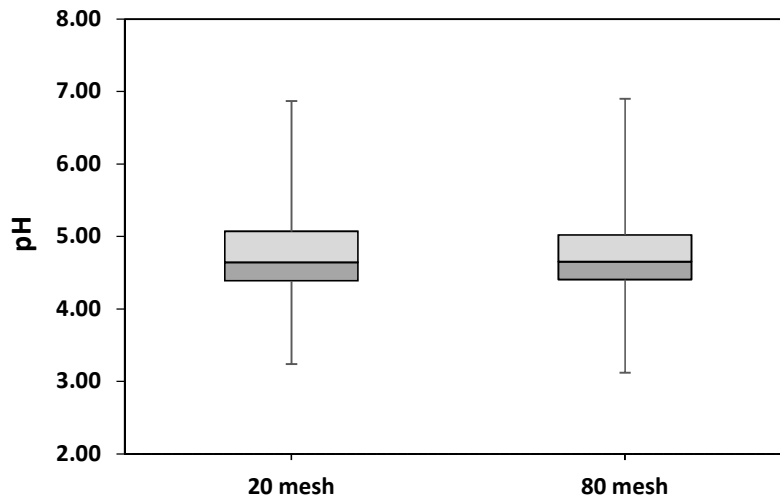


Fig. 1. Box plot represents soil pH affected by two different mesh size soil particles

Table 1. Effect of particle sizes on soil pH values

Difference of pH values	Number of sample	% of total sample
0.01 – 0.05	40	29.41
0.06 – 0.10	41	30.15
0.11 – 0.15	31	22.79
0.16 – 0.20	24	17.65

Table 2. Effect of particle sizes on oxidizable organic carbon values

Difference of oxidizable organic carbon values	Number of sample	% of total sample
0.01 – 0.05	76	55.88
0.06 – 0.10	50	36.76
0.11 – 0.15	10	7.35

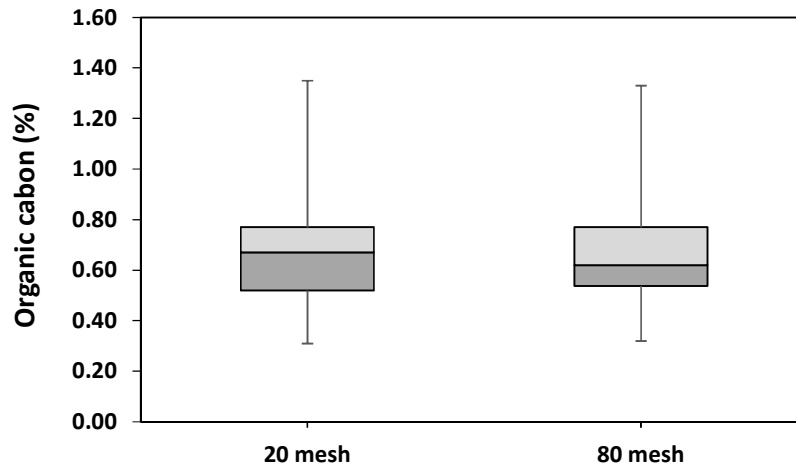


Fig. 2. Box plot represent soil oxidizable organic carbon as affected by two different mesh size soil particles

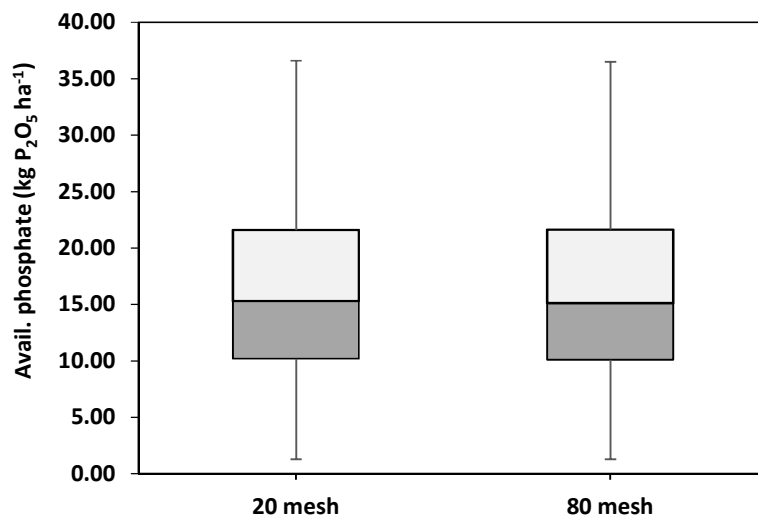


Fig. 3. Box plot represent soil available phosphate as affected by two different mesh size soil particle

Table 3. Effect of particle sizes on soil available phosphate values

Difference of available phosphate values	Number of sample	% of total sample
0.00 – 0.05	62	45.58
0.06 – 0.10	51	37.50
0.11 – 0.15	11	8.08
0.16 – 0.20	12	8.82

3.3 Effect of Particle Size on Available Phosphate

Available phosphate values of 136 numbers of soil samples screened through 20 mesh and 80 mesh sieve are presented below in Table 3. Their difference was 0.009 which is very less even as compare to pH and organic carbon values. The effect of particle sizes phosphate contents of soil are ranges from 4.2 to 36.6 and 4.15 to 36.5 for 20 mesh and 80 mesh sieve respectively. Mean phosphate content of soil particles that passed through 20 mesh 80 mesh sieve was 14.89 and 14.76 respectively. It showed 45.58, 37.50, 8.08 and 8.82% of total samples the sieve sizes showed differences of 0.01 – 0.05, 0.06 – 0.10, 0.11 – 0.15 and 0.16 – 0.20 units respectively. Results showed that for a given soil sample the available phosphate values of two sieve sizes (i.e. 20 mesh and 80 mesh) did not differ largely. The maximum difference was 0.2 kg P₂O₅ ha⁻¹ for some soils there was no difference. The difference mean of phosphate values of two particle sizes was 0.134 only. This difference can be neglected. The above finding is well supported by Li et al. [9]. Thus, for available phosphate determination of the soil sample may be screened through either 20 mesh or 80 mesh sieve. The box plot (Fig. 3) gave a variability of analyze data of available phosphate through two mesh size soil particle.

4. CONCLUSION

The effect of soil particle sizes i.e. 20 mesh and 80 mesh under study were few for determination of oxidizable organic carbon and available phosphate and almost negligible for determination of soil pH. Therefore, it can be concluded that soil particle sieved through 20 mesh (2 mm) and 80 (0.2 mm) mesh can be used for determination of soil pH, oxidizable organic carbon and available phosphate, since such particle sizes have almost negligible effect.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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