NOTE: PROCTOR DENSITY OF UMINGAN CLAY LOAM, MAASIN CLAY AND MALITBOG CLAY

Tomas D. Cardona and Alan L. Presbitero

Science Research Specialist, Regional Coconut Research Center; and Instructor, Department of Agricultural Engineering and Applied Mathematics (DAEAM), Visayas State College of Agriculture (ViSCA), Baybay, Leyte, Philippines.

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ABSTRACT

The proctor densities of Umingan clay loam, Maasin clay and Malitbog clay were 1,489.48, 1,444.61 and 1,527.49 kg/m^3, respectively at the optimum soil moisture content of 25%, dry basis. These values are statistically different at 1% level based on Scheffe's test.

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KEY WORDS: Proctor density. Optimum moisture content. Dry density. Umingan clay loam. Maasin clay. Malitbog clay.

Proctor density is the maximum dry density of the soil which occurs at a particular level of moisture known as the optimum moisture content (Schwab et al., 1966; Terzaghi and Peck, 1967; Sowers, 1979). This soil property indicates the minimum void ratio or porosity at a particular moisture content and maximum shearing strength (Hough, 1969).

The soil compaction process, which brings the soil to a dense state by such activities as blows, passages of a roller or some other types of loading, is responsible for attaining the Proctor density of any given soil type (Taylor, 1959). This process is very important in the construction of earthdams, embankments and fills involving transported and placed soils (Scott, 1963). Soil compaction increases the in-place density of a loosely dumped fill or a soft or weak natural soil formation to some specified value with minimum time and effort, reduces soil compressibility, increases shearing strength of the soil, and prevents excessive soil settlement in the future (Taylor, 1959; Hough, 1969; Das, 1979). Proper soil compaction during filling activity greatly affects the strength, compressibility and ability of the soil to absorb water (Sowers and Sowers, 1970). The effectiveness of soil compaction is measured by the resulting weight of the soil solids per unit volume of soil, i.e. dry density of the soil. For a given soil type and compaction effort, the dry density is a function of its soil moisture content.

Information on the Proctor density of soil to be used for construction enables the user to obtain the desired soil density with minimum time and compaction effort. Based on the soil map of Leyte province, three soil types, namely: Umingan clay loam, Maasin clay and Malitbog clay occupy a vast area of the province (Barrera et al., 1954). At present, the Proctor densities of each of these soil types are not yet known, hence this study was conducted.

Soil samples were collected from the experimental area of the Department of Horticulture, ViSCA, Baybay, Leyte and from barangays Buenavista and Bitanhu-an, Baybay, Leyte, as initially identified using the soil survey map prepared by the Bureau of Soil Conservation for the province of Leyte. Standard sampling technique was followed in gathering soil samples. Using the hydrometer method, the texture of soil samples was analyzed at the laboratories of the Philippine Root Crop Research and Training Center (PRCRTC) and Department of Agronomy and Soil Science, ViSCA, Baybay, Leyte.

The modified American Association of State Highway Officials (AASHO) test was used in determining the Proctor densities of each of the soil type (Means and Parcher, 1963; Hough, 1969). For each soil type, the treatments were the different levels of soil moisture (dry basis) namely: 5%, 10%, 15%, 20%, 25% and 30%. Each treatment was replicated five times and laid out in a completely randomized design. The conservative Scheffe's test was used to test the differences among treatments.

For each soil type, the dry density was determined using the gathered data on weight and volume of the compacted soil samples at each desired soil moisture level.

As determined from the textural classification chart, results of the soil textural analysis of the samples revealed the following soil types: Umingan clay loam at the experimental area of the Department of Horticulture, ViSCA, Baybay, Leyte; and Maasin and Malitbog clays at barangays Buenavista and Bitanhu-an, Baybay, Leyte, respectively (Table 1).

Table 1. Percentages of sand, silt and clay in the soil types used in the study.

Sampling Site	Sand (%) (0.05-2.0 mm)	Silt (%) (0.002-0.05 mm)	Clay (%) (0.002 mm)	Soil Type
ViSCA	39.08	25.28	35.64	Umingan clay loam
Brgy. Buenavista	34.16	9.84	56.00	Maasin clay
Brgy. Bitanhu-an	31.09	16.72	52.19	Malitbog clay

The mean dry density at different moisture levels for each soil type is shown in Table 2. The highest mean dry density was observed at 25% soil moisture content (dry basis) for all the soil types.

The graph of the soil moisture content (dry basis) against the dry density of each soil type is composed primarily of three parts, namely: the positive, and the negative relationships between the soil moisture content (dry basis) and the dry density, and the transition part (Schwab et al., 1966; Terzaghi and Peck, 1967; Sowers and Sowers, 1970; Das, 1979). The transition part is the peak where the dry density is maximum and is known as the Proctor density while the corresponding soil moisture content is the optimum moisture level (Schwab et al., 1966; Terzaghi and Peck, 1967). Hence, the Proctor densities of Umingan clay loam, and Maasin and Malitbog clays were 1,489.48, 1,444.61 and 1,527.49 kg/m^3, respectively at optimum soil moisture content of 25%, dry basis (Fig. 1).

Analysis of variance of the Proctor density values showed significant differences at 1% level among the three soil types used in the study (Table 3). Malitbog clay had the highest Proctor density while Maasin clay obtained the lowest value.

Particle size and gradation, and probably particle shape are the soil characteristics that significantly affect every attempt to obtain a specified density (Terzaghi and Peck, 1967; Hough, 1969; Sowers, 1979). Hence, the significant differences in Proctor densities of the three soil types could be explained by the result of laboratory analysis of soil separates (Table 1).

The high Proctor density for Malitbog clay could be due to a high percentage of fine separates (68.91%) while the low value for Maasin clay could have been caused by the very low percentage of silt (9.84%) but very high percentage of clay (56.00%). Umingan clay loam which has an intermediate Proctor density value had the highest sand percentage (39.08%) but the lowest clay percentage of 35.64%. The results of this study conform with the findings of McCarthy (1982).

Table 2. Mean dry density of the three soil types at different soil moisture levels, dry basis.[1]

Percent Moisture Content	Mean Dry Density (kg/m³)		
	Umingan clay loam	Maasin clay	Malitbog clay
5	1,371.55a	1,354.92a	1,399.70a
10	1,386.20b	1,381.55b	1,419.50b
15	1,422.62c	1,393.47c	1,452.67c
20	1,459.88d	1,423.96d	1,497.58d
25	1,489.48e	1,444.61e	1,527.49e
30	1,465.77f	1,427.69f	1,481.46f
S value	17.97	22.56	22.51
C.V. (%)	0.55	0.70	0.67

[1]Means within a column with different letters are significantly different at 5% level, Scheffe's test.

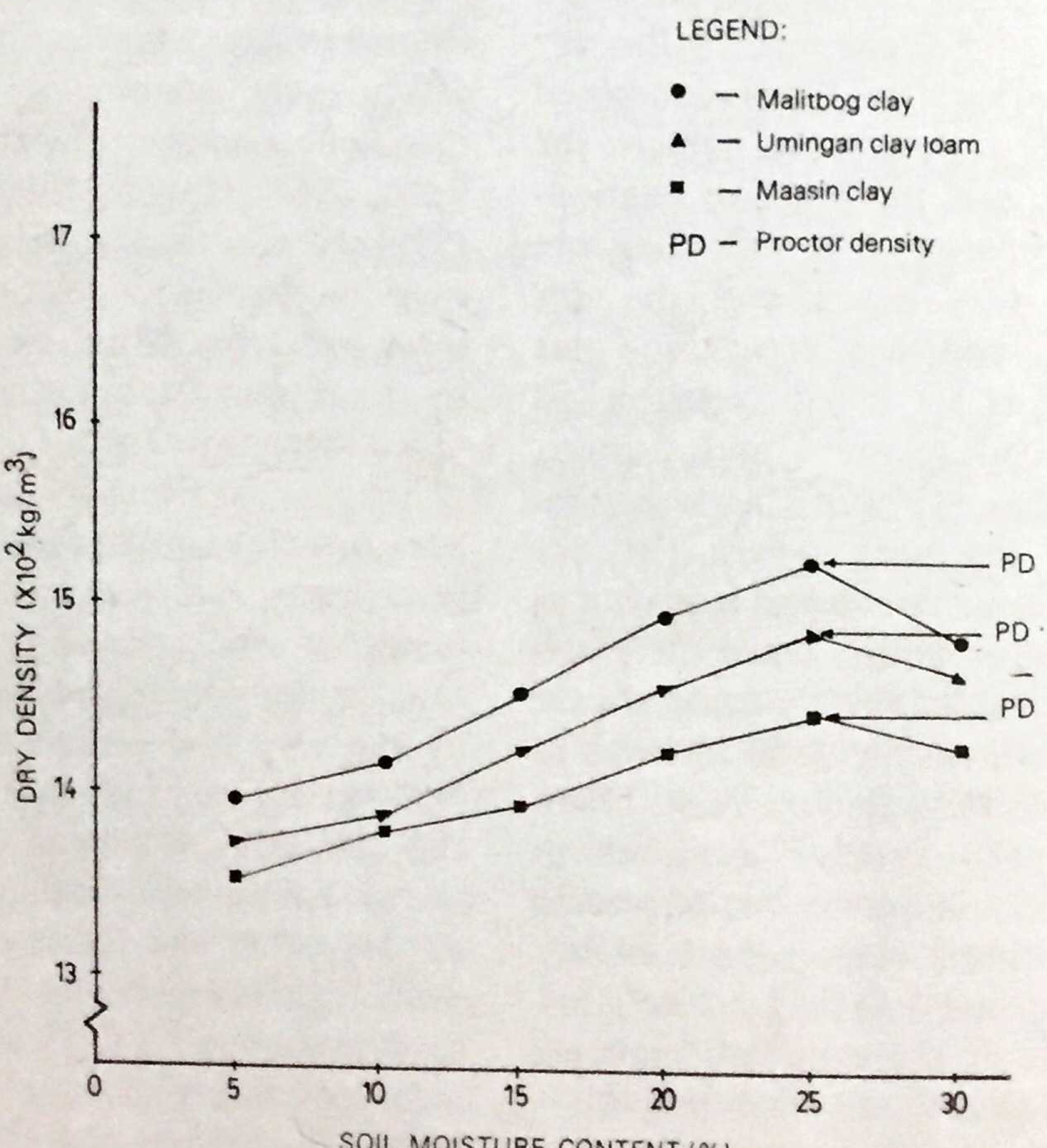

Figure 1. Relationship between dry density and soil moisture content of the three soil types.

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