

# PHOSPHORIC ACID AND SILICA OF PUERTO RICO SOILS

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One hundred and nine soil samples from three areas in the humid region of Puerto Rico are grouped into five textural soil classes according to their mechanical composition, irrespective of their altitudes, and data are reported for pH, total and available phosphoric acid and silica, supplemented also with some figures for volume weight and altitude (tables 1-6).

**Location and sampling of soils.** The following three areas of the humid region of Puerto Rico were chosen for this work:

1. Between the Arecibo and Manatí rivers including Utuado, Jayuya, Cialitos, Ciales, Florida, Arecibo and Barceloneta.
2. Between the Fajardo and Patillas rivers including Ceiba, Naguabo, Humacao, Las Piedras, Yabucoa, Maunabo and Patillas.
3. Around Caguas including Aguas Buenas, Gurabo, San Lorenzo and Las Cruces.

Soil survey maps were used for the location of the soil types. Samples to a depth of ten inches were taken with an auger in different places of the undisturbed field until a two-pound burlap bag was filled. The elevation of the field was read in a calibrated aneroid barometer.

**Analytical methods.** The analytical methods used were as follows:

| DETERMINATION  | METHOD                         |
|--|--------------------------------|
| pH   | Electrometric with quinhydrone |
| Volume weight  | Cylinder (3)                   |
| Mechanical analysis  | Bouyoucos hydrometer (2)       |
| Total P <sub>2</sub> O <sub>5</sub>                          | Magnesium nitrate              |
| Available P <sub>2</sub> O <sub>5</sub> and SiO <sub>2</sub> | 1% Citric acid (1)             |
| Total SiO <sub>2</sub>                                       | Sodium carbonate fusion        |

Available phosphoric acid and silica were determined in the same aliquot.

**Textural grades.** The 109 soil types were classified according to their mechanical composition (4) using as a basis the Bouyoucos system of soil separates: sands (1.00-0.05 mm.), silt (0.05-0.005 mm.), clay (<0.005 mm.). The soil types were grouped into five soil classes as follows: 3 sands (table 1), 19 sandy loams (table 2), 20 sandy clay loams (table 3), 14 clay loams (table 4) and 53 clays—1 sandy clay inclusive (table 5). The average values for volume weight, mechani-

TABLE 1. ACIDITY, MECHANICAL ANALYSIS, TOTAL AND AVAILABLE PHOSPHORIC ACID AND SILICA OF THREE SANDS IN THE HUMID REGION OF PUERTO RICO

| Soil Type      | Location                          | Elevation<br>(feet) | pH  | Percentage on Dry Basis |      |      |                               |                  |                               |                  |  |
|----------------|-----------------------------------|---------------------|-----|-------------------------|------|------|-------------------------------|------------------|-------------------------------|------------------|--|
|                |                                   |                     |     | Mechanical Analysis     |      |      | Total                         |                  | Available                     |                  |  |
|                |                                   |                     |     | Sand                    | Silt | Clay | P <sub>2</sub> O <sub>5</sub> | SiO <sub>2</sub> | P <sub>2</sub> O <sub>5</sub> | SiO <sub>2</sub> |  |
| Aguadilla sand | Km. 72.0 Naguabo-Humacao road     | ....                | 6.5 | 89.0                    | 3.2  | 7.8  | .051                          | 74.61            | .003                          | .028             |  |
| Bayamón sand   | Km. 73.5 Arecibo-Barceloneta road | 173                 | 8.1 | 85.6                    | 2.8  | 11.6 | .038                          | 93.79            | .002                          | .014             |  |
| Bayamón sand   | Km. 67.5 Arecibo-Barceloneta road | ....                | 6.1 | 73.6                    | 2.6  | 23.8 | .065                          | 80.48            | .002                          | .022             |  |

cal analysis, total and available phosphoric acid and silica are given in table 6. The weight of the soil calculated from the volume weight, and the ratio of total to available phosphoric acid are also reported in that table.

TABLE 2. ACIDITY, VOLUME WEIGHT, MECHANICAL ANALYSIS, TOTAL AND AVAILABLE PHOSPHORIC ACID AND SILICA OF NINETEEN SANDY LOAMS IN THE HUMID REGION OF PUERTO RICO

| Soil Type                          | Location  | Elevation<br>(feet) | pH  | Volume<br>weight | Percentage on Dry Basis |      |      |                               |                  |                               |                  |  |
|------------------------------------|---|---------------------|-----|------------------|-------------------------|------|------|-------------------------------|------------------|-------------------------------|------------------|--|
|                                    |   |                     |     |                  | Mechanical Analysis     |      |      | Total                         |                  | Available                     |                  |  |
|                                    |   |                     |     |                  | Sand                    | Silt | Clay | P <sub>2</sub> O <sub>5</sub> | SiO <sub>2</sub> | P <sub>2</sub> O <sub>5</sub> | SiO <sub>2</sub> |  |
| Caguas sandy loam                  | Km. 58.2 Ceiba-Naguabo road just outside of Ceiba             | 30                  | 7.9 | 1.70             | 68.0                    | 22.6 | 9.4  | .038                          | 86.06            | .003                          | .027             |  |
| Candelero sandy loam               | Yabucoa playa road about 1.5 km. from main road               | 53                  | 5.5 | 1.58             | 72.4                    | 14.0 | 13.6 | .057                          | 70.01            | .003                          | .034             |  |
| Candelero sandy loam shallow phase | Yabucoa playa road about 1 km. from main road                 | 35                  | 6.1 | 1.43             | 69.4                    | 13.8 | 16.8 | .071                          | 66.97            | .011                          | .043             |  |
| Cayaguá sandy loam                 | Km. 1.8 San Lorenzo-Patillas road                             | 480                 | 5.3 | 1.48             | 58.8                    | 24.4 | 16.8 | .117                          | 62.05            | .041                          | .153             |  |
| Ciales sandy loam                  | Colonia Ingenio, Yabucoa, at Cerro Santo Domingo              | ....                | 5.7 | 1.30             | 74.8                    | 12.0 | 13.2 | .107                          | 59.33            | .027                          | .051             |  |
| Daguao sandy loam                  | Km. 108.5 Yabucoa-Maunabo road                                | 117                 | 6.4 | 1.47             | 70.2                    | 12.4 | 17.4 | .124                          | 49.18            | .012                          | .146             |  |
| Maunabo sandy loam                 | Colonia Unión, Yabucoa, 1.5 km. from Yabucoa road at Don Paco | ....                | 5.6 | 1.43             | 70.6                    | 11.8 | 17.6 | .083                          | 61.78            | .002                          | .171             |  |
| Pandura sandy loam                 | Km. 103.6 Yabucoa-Maunabo road                                | 572                 | 5.4 | 1.48             | 66.2                    | 17.8 | 16.0 | .076                          | 58.67            | .003                          | .167             |  |
| Pandura sandy loam                 | Km. 102.3 Yabucoa-Maunabo road                                | 368                 | 5.6 | 1.30             | 78.4                    | 11.6 | 10.0 | .147                          | 62.31            | .027                          | .098             |  |
| Pandura sandy loam                 | Km. 107.3 Yabucoa-Maunabo road at Barrio Talante              | 358                 | 6.0 | 1.29             | 70.4                    | 15.8 | 13.8 | .158                          | 53.89            | .031                          | .130             |  |
| Pandura sandy loam                 | Km. 101.0 Yabucoa-Maunabo road                                | 162                 | 5.7 | 1.46             | 66.0                    | 15.6 | 18.4 | .062                          | 63.07            | .002                          | .088             |  |
| Teja sandy loam                    | Yabucoa playa road about 1 km. from main road                 | ....                | 5.6 | 1.40             | 68.0                    | 19.6 | 12.4 | .088                          | 58.61            | .002                          | .054             |  |
| Toa sandy loam                     | Km. 10.0 San Lorenzo-Patillas road                            | 600                 | 5.3 | 1.39             | 62.8                    | 22.4 | 14.8 | .085                          | 55.30            | .006                          | .108             |  |

TABLE 2. *Continued*

| Soil Type            | Location  | Elevation<br>(feet) | pH  | Volume<br>weight | Percentage on Dry Basis |      |      |                               |                  |                               |                  |
|----------------------|---|---------------------|-----|------------------|-------------------------|------|------|-------------------------------|------------------|-------------------------------|------------------|
|                      |   |                     |     |                  | Mechanical Analysis     |      |      | Total                         |                  | Available                     |                  |
|                      |   |                     |     |                  | Sand                    | Silt | Clay | P <sub>2</sub> O <sub>5</sub> | SiO <sub>2</sub> | P <sub>2</sub> O <sub>5</sub> | SiO <sub>2</sub> |
| Utuaado sandy loam   | About ¼ km. N. W. Central Santa Bárbara, Jayuya | 1302                | 6.7 | ....             | 68.0                    | 20.4 | 11.6 | .120                          | 59.11            | .036                          | .233             |
| Vega Alta sandy loam | ¼ Km. W. Florida                                | 473                 | 5.1 | ....             | 77.8                    | 7.8  | 14.4 | .120                          | 84.24            | .006                          | .020             |
| Vivi sandy loam      | About ½ km. W. Central Santa Bárbara, Jayuya    | 1202                | 5.6 | ....             | 56.0                    | 28.8 | 15.2 | .179                          | 54.54            | .038                          | .300             |
| Vivi sandy loam      | About ½ km. N. W. Central Colombia, Maunabo     | 39                  | 5.5 | 1.35             | 58.4                    | 21.8 | 19.8 | .155                          | 58.10            | .019                          | .200             |
| Vivi sandy loam      | Ingenio road about .2 km. from Yabucoa road     | ....                | 6.9 | 1.52             | 74.8                    | 12.0 | 13.2 | .085                          | 63.96            | .012                          | .089             |
| Yabucoa sandy loam   | Colonia Ingenio, Yabucoa                        | ....                | 5.0 | 1.53             | 74.4                    | 10.4 | 15.2 | .140                          | 67.04            | .037                          | .049             |

TABLE 3. ACIDITY, VOLUME WEIGHT, MECHANICAL ANALYSIS, TOTAL AND AVAILABLE PHOSPHORIC ACID AND SILICA OF TWENTY SANDY CLAY LOAMS IN THE HUMID REGION OF PUERTO RICO

| Soil Type                   | Location   | Elevation<br>(feet) | pH  | Volume<br>weight | Percentage on Dry Basis |      |      |                               |                  |                               |                  |
|-----------------------------|--|---------------------|-----|------------------|-------------------------|------|------|-------------------------------|------------------|-------------------------------|------------------|
|                             |  |                     |     |                  | Mechanical Analysis     |      |      | Total                         |                  | Available                     |                  |
|                             |  |                     |     |                  | Sand                    | Silt | Clay | P <sub>2</sub> O <sub>5</sub> | SiO <sub>2</sub> | P <sub>2</sub> O <sub>5</sub> | SiO <sub>2</sub> |
| Alonso sandy clay loam      | About ¼ km. S. W. Central Pasto Viejo, Humacao                     | 154                 | 6.1 | 1.43             | 50.8                    | 25.6 | 23.6 | .150                          | 63.70            | .006                          | .033             |
| Almirante sandy clay loam   | ½ km. S. Florida   | 484                 | 5.0 | ....             | 53.2                    | 18.0 | 28.8 | .289                          | 59.89            | .012                          | .022             |
| Caguas sandy clay loam      | Km. 1.0 Tomás de Castro road, Caguas                               | 210                 | 5.1 | 1.27             | 51.2                    | 20.0 | 28.8 | .065                          | 76.64            | .003                          | .064             |
| Caguas sandy clay loam      | Km. 2.9 Caguas-San Lorenzo road                                    | 90                  | 4.3 | 1.40             | 55.2                    | 20.0 | 24.8 | .064                          | 78.00            | .007                          | .063             |
| Cayaguá sandy clay loam     | Km. 1.8 San Lorenzo-Patillas road                                  | 480                 | 5.3 | 1.48             | 58.8                    | 24.4 | 16.8 | .117                          | 62.05            | .041                          | .153             |
| Cayaguá sandy clay loam     | Km. 9.0 Caguas-San Lorenzo road                                    | 310                 | 4.6 | 1.46             | 57.2                    | 14.4 | 28.4 | .060                          | 78.39            | .003                          | .073             |
| Cayaguá sandy clay loam     | Km. 25.2 Las Piedras-Humacao road                                  | 210                 | 4.9 | 1.59             | 51.2                    | 28.0 | 20.8 | .067                          | 62.61            | .003                          | .082             |
| Daguao sandy clay loam      | Km. 109.0 Yabucoa-Maunabo road, near Maunabo                       | 39                  | 6.7 | 1.42             | 58.0                    | 15.8 | 26.2 | .135                          | 53.42            | .007                          | .218             |
| Humacao sandy clay loam     | Km. 86.0 Humacao-Yabucoa road opposite entrance to Central Ejemplo | 117                 | 6.1 | 1.16             | 50.4                    | 26.0 | 23.6 | .135                          | 65.14            | .015                          | .083             |
| Las Piedras sandy clay loam | Km. 24.1 Las Piedras-Humacao road                                  | 348                 | 4.8 | 1.34             | 56.4                    | 22.4 | 21.2 | .122                          | 70.47            | .003                          | .056             |
| Mariana sandy clay loam     | Humacao-Antón Ruiz road at Barrio Mambiche Blanco                  | 128                 | 4.9 | 1.31             | 50.8                    | 22.0 | 27.2 | .154                          | 55.57            | .009                          | .045             |
| Maunabo sandy clay loam     | Km. 94.6 Yabucoa road  | ....                | 5.0 | 1.23             | 51.0                    | 25.8 | 23.2 | .160                          | 54.41            | .017                          | .079             |
| Naranjito sandy clay loam   | Km. 113.5 Maunabo-Patillas road at Cape Malapascua                 | 200                 | 7.4 | 1.14             | 64.4                    | 21.6 | 14.0 | .078                          | 64.25            | .002                          | .067             |

TABLE 3. *Continued*

| Soil Type                         | Location  | Elevation<br>(feet) | pH  | Volume<br>weight | Percentage on Dry Basis |      |      |                               |                  |                               |                  |
|-----------------------------------|---|---------------------|-----|------------------|-------------------------|------|------|-------------------------------|------------------|-------------------------------|------------------|
|                                   |   |                     |     |                  | Mechanical Analysis     |      |      | Total                         |                  | Available                     |                  |
|                                   |   |                     |     |                  | Sand                    | Silt | Clay | P <sub>2</sub> O <sub>5</sub> | SiO <sub>2</sub> | P <sub>2</sub> O <sub>5</sub> | SiO <sub>2</sub> |
| Pandura sandy<br>clay loam        | Km. 104.8 Yabucoa-<br>Maunabo road border<br>line between<br>Barrio Pica, Ya-<br>bucoo and Barrio<br>Talante, Maunabo | 761                 | 6.3 | 1.20             | 64.2                    | 14.0 | 21.8 | .130                          | 62.65            | .008                          | .081             |
| Pandura sandy<br>clay loam        | Km. 105.8 Yabucoa-<br>Maunabo road at<br>Barrio Talante   | 591                 | 6.4 | 1.37             | 54.8                    | 24.0 | 21.2 | .108                          | 60.32            | .002                          | .089             |
| Pandura sandy<br>clay loam        | Km. 7.0 San Lorenzo-<br>Patillas road   | 500                 | 5.3 | 1.40             | 58.8                    | 14.4 | 26.8 | .116                          | 62.43            | .005                          | .117             |
| Riverwash<br>sandy clay<br>loam   | Km. 2.0 Borinquen<br>road, Caguas   | 440                 | 5.3 | 1.39             | 54.0                    | 22.4 | 23.6 | .194                          | 63.68            | .016                          | .139             |
| Sabana Seca<br>sandy clay<br>loam | Between km. 79.3 and<br>79.4 Arecibo-Barce-<br>loneta road  | 17                  | 8.2 | ....             | 60.2                    | 11.8 | 28.0 | .133                          | 73.62            | .004                          | .055             |
| Talante sandy<br>clay loam        | About $\frac{3}{4}$ km. Ya-<br>bucoo-Calabazas road   | ....                | 5.2 | .98              | 53.0                    | 20.2 | 26.8 | .141                          | 53.81            | .004                          | .162             |
| Teja sandy<br>clay loam           | Km. 88.2 Humacao-<br>Yabucoa road   | ....                | 5.1 | 1.40             | 52.8                    | 26.4 | 20.8 | .079                          | 64.78            | .004                          | .050             |

TABLE 4. ACIDITY, VOLUME WEIGHT, MECHANICAL ANALYSIS, TOTAL AND AVAILABLE PHOSPHORIC ACID AND SILICA IN FOURTEEN CLAY LOAMS IN THE HUMID REGION OF PUERTO RICO

| Soil Type               | Location   | Elevation<br>(feet) | pH  | Volume<br>weight | Percentage on Dry Basis |      |      |                               |                  |                               |                  |
|-------------------------|--|---------------------|-----|------------------|-------------------------|------|------|-------------------------------|------------------|-------------------------------|------------------|
|                         |  |                     |     |                  | Mechanical Analysis     |      |      | Total                         |                  | Available                     |                  |
|                         |  |                     |     |                  | Sand                    | Silt | Clay | P <sub>2</sub> O <sub>5</sub> | SiO <sub>2</sub> | P <sub>2</sub> O <sub>5</sub> | SiO <sub>2</sub> |
| Candelerio clay<br>loam | Km. 89.3 Humacao-<br>Yabucoa road  | 117                 | 4.8 | 1.22             | 48.6                    | 30.2 | 21.2 | .089                          | 60.28            | .014                          | .067             |
| Coloso clay loam        | Km. 65.4 Ceiba-<br>Naguabo road at<br>Quebrada Palma                       | ....                | 6.1 | 1.32             | 48.8                    | 23.6 | 27.6 | .115                          | 65.01            | .005                          | .151             |
| Coloso clay loam        | Km. 0.8 Naguabo<br>Playa to Naguabo<br>road at Central<br>Triunfo          | ....                | 5.4 | 1.34             | 26.6                    | 44.2 | 29.2 | .138                          | 60.22            | .007                          | .239             |
| Daguao clay<br>loam     | Entrance of road to<br>Central Ejemplo,<br>Humacao                         | 167                 | 5.5 | 1.30             | 49.0                    | 30.2 | 20.8 | .133                          | 40.27            | .004                          | .096             |
| Estación clay<br>loam   | Km. 11.9 Manati-<br>Ciales road  | 367                 | 7.4 | ....             | 48.0                    | 26.4 | 25.6 | .224                          | 53.61            | .029                          | .656             |
| Humacao clay<br>loam    | Entrance of road to<br>Central Ejemplo,<br>Humacao                         | 117                 | 5.4 | 1.29             | 45.2                    | 30.0 | 24.8 | .090                          | 58.34            | .002                          | .083             |
| Juncos clay loam        | Km. 4.7 Caguas-San<br>Lorenzo road   | 270                 | 5.7 | 1.35             | 34.8                    | 36.0 | 29.2 | .087                          | 72.75            | .005                          | .096             |
| Mariana clay<br>loam    | Km. 60.9 Ceiba-<br>Naguabo road back<br>of Carlos Carlo<br>Figueroa School | 118                 | 5.3 | 1.62             | 36.8                    | 38.0 | 25.2 | .018                          | 74.93            | .002                          | .277             |
| Río Arriba clay<br>loam | Humacao-Antón Ruiz<br>road at Barrio<br>Mambiche Blanco                    | 136                 | 6.1 | 1.41             | 41.6                    | 30.4 | 28.0 | .167                          | 63.84            | .003                          | .045             |

TABLE 4. *Continued*

| Soil Type        | Location  | Elevation<br>(feet) | pH  | Volume<br>weight | Percentage on Dry Basis |      |      |                               |                  |                               |                  |
|------------------|---|---------------------|-----|------------------|-------------------------|------|------|-------------------------------|------------------|-------------------------------|------------------|
|                  |   |                     |     |                  | Mechanical Analysis     |      |      | Total                         |                  | Available                     |                  |
|                  |   |                     |     |                  | Sand                    | Silt | Clay | P <sub>2</sub> O <sub>5</sub> | SiO <sub>2</sub> | P <sub>2</sub> O <sub>5</sub> | SiO <sub>2</sub> |
| Sabana clay loam | Km. 112.8 Maunabo-Patillas road                       | 130                 | 7.1 | 1.10             | 48.4                    | 24.2 | 27.4 | .078                          | 56.15            | .003                          | .101             |
| Toa clay loam    | Km. 0.1 Tomás de Castro road, Caguas                  | 180                 | 5.9 | 1.18             | 48.0                    | 24.0 | 28.0 | .137                          | 62.50            | .011                          | .174             |
| Toa clay loam    | Km. 1.5 Caguas-San Lorenzo road                       | 80                  | 5.8 | 1.40             | 50.8                    | 24.0 | 25.2 | .119                          | 63.70            | .007                          | .176             |
| Via clay loam    | Humacao-Antón Ruiz road at Barrio Mambiche Blanco     | 109                 | 6.4 | 1.38             | 42.6                    | 29.4 | 28.0 | .135                          | 68.14            | .003                          | .076             |
| Via clay loam    | Km. 0.7 Humacao-Antón Ruiz road at Perseverancia farm | 107                 | 6.4 | 1.09             | 41.2                    | 24.8 | 34.0 | .100                          | 54.01            | .002                          | .093             |

TABLE 5. ACIDITY, VOLUME WEIGHT, MECHANICAL ANALYSIS, TOTAL AND AVAILABLE PHOSPHORIC ACID AND SILICA, OF FIFTY-THREE CLAYS IN THE HUMID REGION OF PUERTO RICO

| Soil Type                 | Location   | Elevation<br>(feet) | pH  | Volume<br>weight | Percentage on Dry Basis |      |      |                               |                  |                               |                  |
|---------------------------|--|---------------------|-----|------------------|-------------------------|------|------|-------------------------------|------------------|-------------------------------|------------------|
|                           |  |                     |     |                  | Mechanical Analysis     |      |      | Total                         |                  | Available                     |                  |
|                           |  |                     |     |                  | Sand                    | Silt | Clay | P <sub>2</sub> O <sub>5</sub> | SiO <sub>2</sub> | P <sub>2</sub> O <sub>5</sub> | SiO <sub>2</sub> |
| Alonso clay               | About km. 19.5 Ciales-Jayuya road                                | 1034                | 5.4 | ....             | 28.2                    | 33.0 | 38.8 | .068                          | 48.63            | .002                          | .080             |
| Alonso clay smooth phase  | About km. 21.2 Florida-Jayuya road at Barrio Piedra Gorda School | 759                 | 4.7 | ....             | 26.6                    | 28.0 | 45.4 | .065                          | 66.35            | .001                          | .044             |
| Caguas clay               | Km. 37.7 Caguas-Cayey road                                       | 280                 | 6.5 | ....             | 31.2                    | 32.8 | 36.0 | .113                          | 76.49            | .003                          | .074             |
| Caguas clay               | Km. 9.0 San Lorenzo-Patillas road                                | 620                 | 5.2 | 1.46             | 42.8                    | 20.4 | 36.8 | .089                          | 67.44            | .001                          | .065             |
| Cayaguá clay              | Km. 5.7 San Lorenzo-Patillas road at entrance of Jaguar road     | 600                 | 5.7 | 1.25             | 24.8                    | 34.4 | 40.8 | .106                          | 72.38            | .006                          | .202             |
| Catalina clay             | About km. 18.5 Ciales-Jayuya road                                | 940                 | 5.1 | ....             | 32.0                    | 24.0 | 44.0 | .073                          | 56.09            | .004                          | .036             |
| Catalina clay steep phase | 0.5 km. E. Hacienda Piedra Gorda, Florida-Jayuya road            | 685                 | 5.1 | ....             | 35.6                    | 22.4 | 42.0 | .139                          | 45.71            | .012                          | .077             |
| Ciales clay               | Km. 15.0 Ciales-Jayuya road                                      | 639                 | 4.6 | ....             | 25.2                    | 28.4 | 46.4 | .132                          | 48.71            | .008                          | .068             |
| Ciales clay               | Km. 12.5 Manati-Ciales road                                      | 367                 | 7.6 | ....             | 35.6                    | 26.4 | 38.0 | .153                          | 61.35            | .012                          | .131             |
| Cialitos clay             | Km. 47.9 Caguas-Cayey road                                       | 1525                | 4.5 | 1.24             | 23.6                    | 34.0 | 42.4 | .184                          | 70.60            | .002                          | .025             |
| Cialitos clay             | Km. 45.5 Caguas-Cayey road                                       | 1200                | 4.2 | 1.42             | 35.6                    | 24.0 | 40.4 | .169                          | 69.88            | .002                          | .026             |
| Cialitos clay             | About 1 km. S. E. Hacienda Piedra Gorda, Florida-Jayuya road     | 892                 | 4.9 | ...              | 29.8                    | 32.8 | 37.4 | .084                          | 57.50            | .005                          | .410             |
| Cialitos clay             | Between km. 20.2-20.3 Florida-Jayuya road                        | 685                 | 5.8 | ....             | 35.6                    | 30.4 | 34.0 | .056                          | 61.68            | .014                          | .219             |
| Cialitos clay steep phase | Camino Borinquen at km. 5.3 Naranjito road                       | 700                 | 5.2 | 1.47             | 40.0                    | 28.4 | 31.6 | .152                          | 62.16            | .006                          | .157             |

TABLE 5. *Continued*

| Soil Type        | Location   | Elevation<br>(feet) | pH  | Volume<br>weight | Percentage on Dry Basis |      |      |                               |                  |                               |                  |
|------------------|--|---------------------|-----|------------------|-------------------------|------|------|-------------------------------|------------------|-------------------------------|------------------|
|                  |  |                     |     |                  | Mechanical Analysis     |      |      | Total                         |                  | Available                     |                  |
|                  |  |                     |     |                  | Sand                    | Silt | Clay | P <sub>2</sub> O <sub>5</sub> | SiO <sub>2</sub> | P <sub>2</sub> O <sub>5</sub> | SiO <sub>2</sub> |
| Coloso clay      | Km. 0.5 Humacao-Antón Ruiz road at Perseverancia farm          | 107                 | 7.4 | 1.24             | 34.4                    | 10.0 | 55.6 | .121                          | 51.71            | .006                          | .124             |
| Coloso clay      | Km. 112.2 Maunabo-Patillas road                                | 39                  | 8.1 | 1.20             | 38.8                    | 28.0 | 33.2 | .088                          | 59.63            | .011                          | .173             |
| Coloso clay      | About ¼ km. S. W. Central Plazuela, Barceloneta                | 23                  | 7.0 | ....             | 24.0                    | 32.8 | 43.2 | .216                          | 53.05            | .014                          | .484             |
| Coloso clay      | About ¼ km. E. Central Pasto Viejo, Humacao                    | 16                  | 4.9 | 1.15             | 38.6                    | 27.8 | 33.6 | .244                          | 62.25            | .018                          | .048             |
| Coto clay        | Km. 14.6 Florida-Jayuya road                                   | 723                 | 8.2 | ....             | 42.8                    | 24.0 | 33.2 | .460                          | 26.83            | .017                          | .051             |
| Coto clay        | Km. 12.1 Florida-Jayuya road                                   | 555                 | 8.1 | ....             | 21.0                    | 20.8 | 58.2 | .525                          | 39.36            | .017                          | .044             |
| Daguao clay      | Km. 65.0 Ceiba-Naguabo road at Colonia Esperanza Barrio Daguao | 116                 | 6.3 | 1.40             | 24.4                    | 30.4 | 45.2 | .056                          | 49.26            | .003                          | .060             |
| Espinosa clay    | Km. 78.1 Arcibo-Barceloneta road                               | 90                  | 7.4 | ....             | 50.0                    | 10.8 | 39.2 | .119                          | 64.16            | .002                          | .064             |
| Espinosa clay    | Km. 74.8 Arcibo-Barceloneta road                               | ....                | 6.1 | ....             | 51.4                    | 11.4 | 37.2 | .086                          | 67.27            | .002                          | .035             |
| Irurena clay     | Colonia Unión about 2 km. from Yabucoa road at Moquilla        | ....                | 6.1 | 1.15             | 44.2                    | 23.8 | 32.0 | .162                          | 53.88            | .009                          | .235             |
| Juncos clay      | About 1 km. S. E. Hacienda Piedra Gorda, Florida-Jayuya road   | 891                 | 5.9 | ....             | 47.0                    | 24.2 | 28.8 | .057                          | 52.95            | .004                          | .886             |
| Juncos clay      | Borinquen road, Caguas, about 0.6 km. Naranjito road           | 525                 | 5.6 | 1.28             | 26.0                    | 32.4 | 41.6 | .113                          | 69.02            | .003                          | .072             |
| Juncos clay      | Km. 40.3 Caguas-Cayey road                                     | 390                 | 6.5 | 1.34             | 27.2                    | 28.8 | 44.0 | .106                          | 56.49            | .002                          | .174             |
| Juncos clay      | Km. 1.6 Caguas-Tomás de Castro road                            | 280                 | 6.0 | 1.36             | 26.8                    | 34.0 | 39.2 | .073                          | 58.51            | .004                          | .166             |
| Juncos clay      | Km. 8.0 Caguas-San Lorenzo road                                | 280                 | 6.3 | 1.24             | 28.8                    | 30.8 | 40.4 | .118                          | 66.43            | .006                          | .175             |
| Las Piedras clay | Km. 2.0 Jaguar road, San Lorenzo                               | 700                 | 6.2 | 1.05             | 38.8                    | 30.4 | 30.8 | .155                          | 66.93            | .004                          | .099             |
| Las Piedras clay | Km. 6.0 Caguas-San Lorenzo road                                | 275                 | 6.7 | 1.07             | 30.4                    | 28.8 | 40.8 | .142                          | 62.25            | .007                          | .169             |
| Los Guineos clay | Km. 27.8 Casa Blanca-Jayuya road                               | 2134                | 5.0 | ....             | 31.8                    | 37.4 | 30.8 | .187                          | 34.77            | .005                          | .065             |
| Los Guineos clay | Km. 30.9 Ciales-Jayuya road                                    | 1679                | 4.5 | ....             | 29.2                    | 24.0 | 46.8 | .141                          | 35.29            | .001                          | .061             |
| Múcara clay      | Km. 5.7 Caguas-Tomás de Castro road                            | 870                 | 5.5 | 1.29             | 28.8                    | 28.4 | 42.8 | .095                          | 57.07            | .003                          | .154             |
| Múcara clay      | Km. 43.1 Caguas-Cayey road                                     | 770                 | 5.1 | 1.35             | 43.6                    | 26.8 | 29.6 | .097                          | 53.09            | .003                          | .094             |
| Múcara clay      | Borinquen road, Caguas, at km. 3.8 camino Naranjito            | 680                 | 5.7 | 1.07             | 31.6                    | 30.4 | 38.0 | .148                          | 61.61            | .001                          | .173             |
| Múcara clay      | Km. 3.0 Caguas-Tomás de Castro road                            | 600                 | 5.7 | 1.27             | 30.8                    | 32.0 | 37.2 | .091                          | 52.90            | .004                          | .181             |

TABLE 5. *Continued*

| Soil Type               | Location   | Elevation<br>(feet) | pH  | Volume<br>weight | Percentage on Dry Basis |      |      |                               |                  |                               |                  |
|-------------------------|--|---------------------|-----|------------------|-------------------------|------|------|-------------------------------|------------------|-------------------------------|------------------|
|                         |  |                     |     |                  | Mechanical Analysis     |      |      | Total                         |                  | Available                     |                  |
|                         |  |                     |     |                  | Sand                    | Silt | Clay | P <sub>2</sub> O <sub>5</sub> | SiO <sub>2</sub> | P <sub>2</sub> O <sub>5</sub> | SiO <sub>2</sub> |
| Múcara clay             | Km. 42.0 Caguas-Cayey road at entrance of Camino Borinquen   | 510                 | 5.2 | 1.48             | 35.6                    | 26.8 | 37.6 | .201                          | 54.18            | .003                          | .155             |
| Múcara clay             | Km. 7.0 Caguas-Tomás de Castro road                          | 280                 | 5.2 | 1.07             | 34.8                    | 26.4 | 38.8 | .144                          | 56.79            | .005                          | .107             |
| Múcara clay steep phase | Km. 68.0 Ceiba-Naguabo road                                  | 80                  | 6.1 | 1.15             | 36.4                    | 4.8  | 58.8 | .053                          | 53.11            | .002                          | .123             |
| Múcara sandy clay       | Km. 1.2 Humacao-Antón Ruiz road, at Barrio Pitijalla         | 173                 | 6.3 | 1.17             | 53.2                    | 12.8 | 34.0 | .071                          | 49.94            | .002                          | .091             |
| Naranjito clay          | Borinquen road, Caguas, at km. 5.1 Naranjito road            | 620                 | 5.1 | 1.14             | 29.6                    | 26.4 | 44.0 | .087                          | 60.70            | .001                          | .086             |
| Reparada clay           | Km. 78.7 Naguabo road at Colonia Santa Teresa                | ....                | 4.7 | .43              | 48.8                    | 20.4 | 30.8 | .233                          | 41.34            | .034                          | .086             |
| Río Piedras clay        | About 21.2 Florida-Jayuya road at Barrio Piedra Gorda School | 762                 | 6.3 | ....             | 33.6                    | 27.6 | 38.8 | .068                          | 53.71            | .002                          | .057             |
| Sabana clay             | Km. 71.4 Naguabo-Humacao road                                | 70                  | 4.6 | 1.33             | 46.4                    | 22.0 | 31.6 | .128                          | 64.64            | .004                          | .032             |
| Sabana Seca clay        | Km. 1.6 Borinquen road, Caguas                               | 480                 | 6.2 | 1.32             | 27.2                    | 30.8 | 42.0 | .112                          | 58.97            | .003                          | .140             |
| Toa clay                | Km. 1.3 Jaguar road, San Lorenzo                             | 590                 | 5.7 | 1.08             | 24.8                    | 38.4 | 36.8 | .106                          | 57.35            | .005                          | .421             |
| Toa clay                | Km. 41.75 Caguas-Cayey road                                  | 420                 | 5.3 | 1.36             | 45.2                    | 21.2 | 33.6 | .164                          | 58.92            | .005                          | .200             |
| Toa clay                | Km. 1.0 Borinquen road, Caguas                               | 420                 | 5.8 | 1.24             | 31.6                    | 28.4 | 40.0 | .099                          | 63.16            | .008                          | .109             |
| Toa clay                | About ½ km. E. junction road No. 2 to Barceloneta            | 23                  | 6.0 | ....             | 27.2                    | 36.4 | 36.4 | .222                          | 52.72            | .024                          | .474             |
| Toa clay                | Km. 82.3 Cambalache-Arecibo road                             | 17                  | 7.9 | ....             | 36.4                    | 30.8 | 32.8 | .208                          | 55.30            | .037                          | .321             |
| Torres clay             | Km. 0.4 Borinquen road, Caguas                               | 500                 | 7.5 | 1.39             | 19.2                    | 28.8 | 52.0 | .154                          | 55.73            | .008                          | .204             |
| Yabucoa clay            | About ¼ km. Yabucoa-Calabazas road on Luis Toro's farm       | ....                | 5.2 | 1.17             | 41.6                    | 24.4 | 34.0 | .167                          | 51.35            | .006                          | .163             |

TABLE 6. AVERAGE VALUES FOR VOLUME WEIGHT, WEIGHT OF ACRE PLOW DEPTH, MECHANICAL ANALYSIS, TOTAL AND AVAILABLE PHOSPHORIC ACID AND SILICA AND RATIO OF TOTAL TO AVAILABLE PHOSPHORIC ACID OF ONE HUNDRED NINE SOILS IN THE HUMID REGION OF PUERTO RICO CLASSIFIED INTO FIVE TEXTURAL SOIL CLASSES

| Number of Samples | Textural Soil Class | Volume Weight | Weight of acre plow depth 6¾ inches, lbs. | Percentage on Dry Basis |       |       |                               |                  |                               | Total to Available P <sub>2</sub> O <sub>5</sub> ratio |                  |
|-------------------|---------------------|---------------|---|-------------------------|-------|-------|-------------------------------|------------------|-------------------------------|--|------------------|
|                   |                     |               |   | Mechanical Analysis     |       |       | Total                         |                  | Available                     |  |                  |
|                   |                     |               |   | Sand                    | Silt  | Clay  | P <sub>2</sub> O <sub>5</sub> | SiO <sub>2</sub> | P <sub>2</sub> O <sub>5</sub> |  | SiO <sub>2</sub> |
| 3                 | Sands               | ....*         | .....*                                    | 82.73                   | 2.87  | 14.40 | .051                          | 82.96            | .002                          | .021   | 22.2             |
| 19                | Sandy loams         | 1.43          | 2,159,414                                 | 68.71                   | 16.57 | 14.72 | .106                          | 62.85            | .017                          | .114   | 6.3              |
| 20                | Sandy clay loams    | 1.33          | 2,008,406                                 | 55.32                   | 20.86 | 23.82 | .125                          | 64.29            | .009                          | .087   | 13.9             |
| 14                | Clay loams          | 1.31          | 1,978,205                                 | 43.60                   | 29.67 | 26.73 | .116                          | 60.98            | .007                          | .166   | 16.6             |
| 53                | Clays               | 1.23          | 1,857,398                                 | 34.12                   | 26.68 | 39.20 | .140                          | 56.75            | .007                          | .154   | 20.0             |

\* Not determined.

## SUMMARY

One hundred and nine soil types from the humid region of Puerto Rico were classified on the basis of their mechanical analysis into five soil classes—sands, sandy loams, sandy clay loams, clay loams, clays—and were analyzed for pH, volume weight, total and available phosphoric acid and silica. The clay loams weigh about two million pounds per acre plow depth of  $6\frac{2}{3}$  inches, the sandy loams weigh about 5% more and the clays weigh about 10% less. The total phosphoric acid varies from .051% in the sands to .140% in the clays. The available phosphoric acid varies from .007% in the clays to .017% in the sandy loams. The total to available  $P_2O_5$  ratio varies from 6.3 in the sandy loams to 20.0 in the clays. The total silica varies from 56.75% in the clays to 82.96% in the sands. The available silica varies from .021% in the sands to .166% in the clay loams.

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## SUMARIO

Ciento nueve tipos de suelos en la zona húmeda de Puerto Rico se clasificaron a base del análisis mecánico en cinco clases de suelos: arenas, arenosolómicas, arenoarcillosolómicas, arcillosolómicas, arcillas, y se les hicieron determinaciones de pH, peso por volumen, ácido fosfórico y sílica total y asimilable. El promedio de los valores indica que las clases arcillosolómicas pesan cerca de dos millones de libras por acre arable ( $6\frac{2}{3}$  pulgadas de espesor), las arenosolómicas pesan como 5% más y las arcillas pesan como 10% menos; el ácido fosfórico total varía desde .051% en las arenas a .140% en las arcillas; el ácido fosfórico asimilable varía desde .007% en las arcillas a .017% en las clases arenosolómicas; la proporción de ácido fosfórico total a asimilable varía desde 6.3 en las clases arenosolómicas a 20.0 en las arcillas; la sílica total varía desde 56.75% en las arcillas a 82.96% en las arenas; la sílica asimilable varía desde .021% en las arenas a .166% en las clases arcillosolómicas.