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ARTICLE

A Computer Program to Determine the Soil Texture Class for any Classification Scheme

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INTRODUCTION

Soil textural class gives the relative proportion of the three primary soil particles: sand, silt and clay. The point of intersection of any two primary particles in the soil texture chart will locate the textural class. Using computers to automate this task is justified when one is handling a large number of soil samples, or in routine particle size analyses.

There are an increasing number of modern computer programs (*e.g.*, Christopher and Mokhtaruddin, 1996; Budihal, 1997; Gerakis and Baer, 1999; Liebiens, 2001) to automate this lookup task. The use of these programs, however, is limited only to the USDA (United States Department of Agriculture) soil classification scheme, neglecting other important schemes like those of the United Kingdom and International ones. Therefore, a computer program that is generic enough to handle most, if not all, of these varied is urgently needed.

Thus, this paper is to introduce *Texture AutoLookup for Windows* (TAL), which is a computer program that is able to lookup soil texture class based on any soil classification scheme.

PROGRAM DESCRIPTION

How it works

TAL is able to lookup the texture class based on any soil classification scheme because it describes each soil texture class in a given scheme as a two-dimensional polygon. In *Figure 1*, for example, a hypothetical soil classification scheme consists of five texture classes, each of which is described as a polygon located in a (*x*, *y*) or (%sand, %clay) coordinate system (*Table 1*).

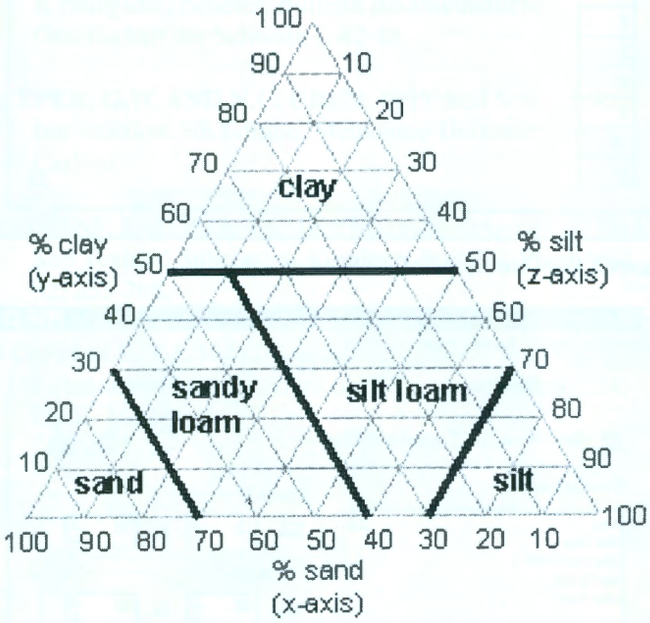

Figure 1. Texture chart for a hypothetical soil classification scheme

Table 1. Texture class polygons for the hypothetical soil scheme

Texture class	Polygon vertices (*x*, *y*) or (%sand, %clay)
silt	(30, 0), (0, 0), (0, 30)
silt loam	(40, 0), (30, 0), (0, 30), (0, 50), (40, 50)
clay	(50, 50), (0, 50), (0, 100)
sandy loam	(70, 0), (40, 0), (40, 50), (50, 50), (70, 30)
sand	(100, 0), (70, 0), (70, 30)

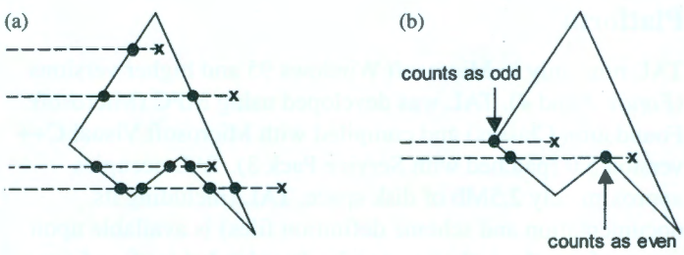

Figure 2. (a) The inside test method, and (b) the intersection with a polygon vertex

The principle to lookup a soil texture class is to determine if a given particle size distribution lies within the boundaries of a particular texture class. In other words, it is to determine if a given point lies inside a polygon. For this task, the *inside test* method, whereby a line segment is constructed between the point in question and a point outside the polygon is used (*Figure 2a*). A point outside the polygon is simply any point with an *x*-coordinate smaller than the smallest *x*-coordinate of the polygon's vertices (corners). Once the line segment is constructed, TAL counts the number of intersections of the line segment with the polygon boundaries. Odd number of intersections means the point in question is inside the polygon; otherwise, an even number of intersections indicate a point outside the polygon. The exception is when the intersection happens at a polygon vertex. For this situation, TAL looks at the other endpoints of the two segments, which meet at this vertex (*Figure 2b*). If these points lie on the same side of the constructed line, then the point in question counts as an even number of intersections. But if they lie on opposite sides of the constructed line, then the point is counted as a single intersection. Note that if a point lies exactly on a polygon boundary, TAL considers this point as being inside the polygon.

For each texture class of a given soil scheme, the (*x*, *y*) coordinates of its polygon vertices (*e.g.*, *Table 1*) are stored in a pre-defined format in a text file called the scheme definition file. Currently, thirteen scheme definition files have been prepared. These files are for the soil schemes: 1) USDA (Soil Survey Division Staff, 1993), 2) UK (Avery, 1980), 3) Canada (Canada Department of Agriculture, 1974), 4) International (Marshall, 1947; Leeper and Uren, 1993), 5) India (All India Soil and Land Use Survey Organization, 1971), 6) International Society of Soil Science (Verheye and Ameryckx, 1984), 7) Switzerland (Jeggli, and Frei, 1977), 8) Belgium (Sys, 1961), 9) New Zealand (Gibbs, 1980), 10) FAO (Verheye and

Ameryckx, 1984), 11) AISNE, France (Baize, 1993), 12) Germany (Boden, 1994), and 13) the Shepard's proposed scheme for sedimentologists (Shepard, 1954).

TAL also supports user-defined classification schemes. This means users can prepare their own scheme definition file for a scheme they regularly use, or for a totally new scheme. And most importantly, the inside test method to lookup soil texture classes, as described previously, is still applicable and unaffected by the type of soil classification scheme.

The lookup of texture classes from a given point in the texture chart is known as *Point Lookup* (*Figure 3*). TAL also supports *Range Lookup* which is the lookup of texture classes from a given range of particle size distribution (*Figure 4*). Range Lookup is particularly useful when only rough estimates are available on a soil's particle size distribution; for example, to determine the USDA texture classes of a soil having between 30 to 50% clay and between 20 to 40% sand. As stated earlier, the inside test method is used for Point Lookup, but for Range Lookup the polygon clipping method adapted from Vatti's algorithm called *Generic Polygon Clipper* (GPC) is used. The GPC algorithm, developed by Alan Murta (Advanced Interfaces Group, University of Manchester, UK), can handle clippings of concave and convex polygons.

In the Range Lookup, the range of texture classes is determined by testing if the source polygon enclosing the given range of particle size distribution can clip (intersect) the target polygon of a particular texture class. A successful clipping between these two polygons indicate that the target texture class belongs to the given range of particle size distribution.

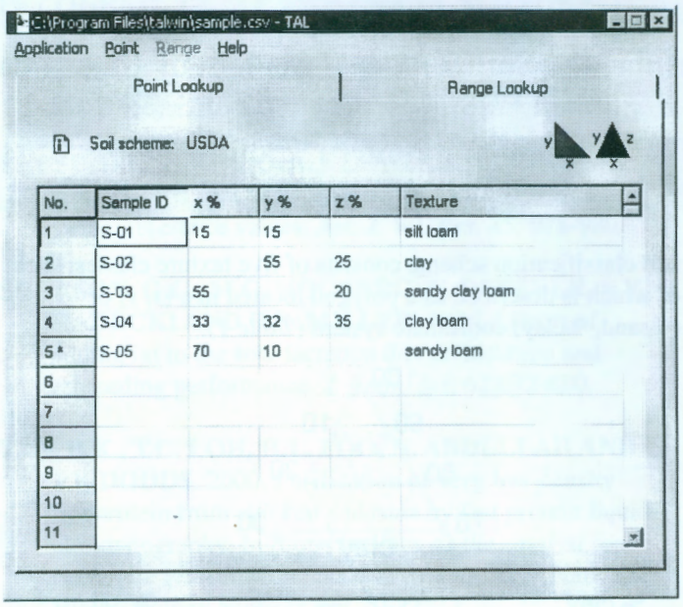

Figure 3. Point Lookup in TAL for Windows

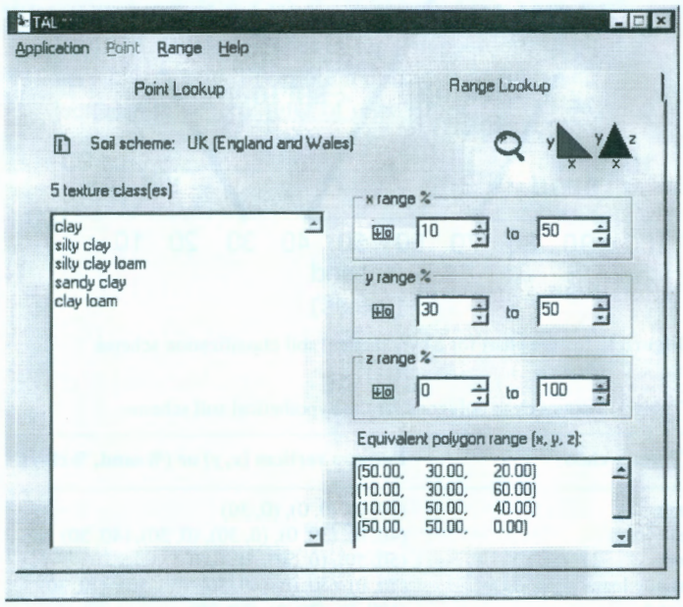

Figure 4. Range Lookup in TAL for Windows

Platform

TAL runs only in Microsoft Windows 95 and higher versions (*Figure 3* and *4*). TAL was developed using MFC (Microsoft Foundation Classes) and compiled with Microsoft Visual C++ version 5.0 (patched with Service Pack 3). TAL occupies approximately 2.5Mb of disk space. TAL (including its documentation and scheme definition files) is available upon request from the author, or can be downloaded for free from http://www.agri.upm.edu.my/~chris/tal.

To use TAL, users will first need to load the appropriate scheme definition file for a particular soil classification scheme. At least two primary particles are needed for a valid soil texture class lookup. Data entry is intuitive because the particle size distribution is entered in a similar way as in spreadsheet programs (*Figure 3*). The lookup results of soil texture classes as well as the soil data can be printed or saved to a comma-delimited text file. This means these text files can be imported from or exported to a text editor or spreadsheet. TAL has charting capabilities (*Figure 5* and *6*), where the charts can be saved as a picture file, copied to the clipboard, or be printed.

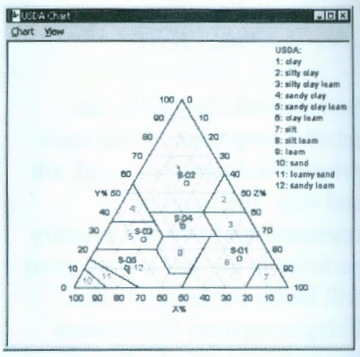

Figure 5. Point Lookup chart in TAL for Windows

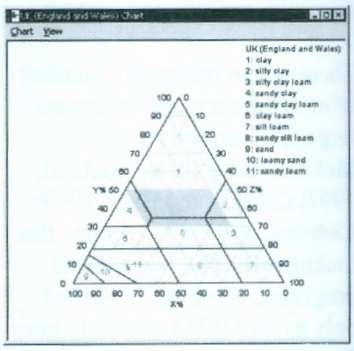

Figure 6. Range Lookup chart in TAL for Windowsfor Windows

REFERENCES

ALL INDIA SOIL AND LAND USE SURVEY ORGANIZATION. 1971. Soil Survey Manual. Revised Edition. New Dehli.

AVERY, B.W. 1980. Soil classification for England and Wales [Higher Categories]. Soil Survey Tech. Monograph, Rothamsted Experimental Station, Harpenden, UK.

BAIZE, D. 1993. Soil Science Analyses: A Guide to Current Use. Wiley, Chichester.

BODEN, A.G. 1994. Bodenkundliche Kartieranleitung. 4th Edition. E. Schweizerbart, Stuttgart.

BUDIHAL, S.L. 1997. A FORTRAN Program to Classify the Textural Class of a Soil According to the USDA Triangular Textural Diagram. J. Ind. Soc. Soil Sci. 45: 382-383.

CANADA DEPARTMENT OF AGRICULTURE. 1974. A System of Soil Classification for Canada. Revised Edition. Publication 1455. Information Canada, Ottawa.

CHRISTOPHER, T.B.S. AND A.M. MOKHTARUDDIN. 1996. A Computer Program to Determine Soil Textural Class in 1-2-3 for Windows and Excel. Commun. Soil Sci. Plant Anal. 27: 2315-2319.

GERAKIS, A. AND B. BAER. 1999. A Computer Program for Soil Textural Classification. Soil Sci. Soc. Am. J. 63: 807-808.

GIBBS, H.S. 1980. New Zealand Soils. An Introduction. Oxford University Press, Wellington.

JEGGLI, F. AND E. FREI. 1977. Vorschlag eines neuen K rnungsdiagrammes. Bulletin Bodenkundliche Gesellschaft der Schweiz 1: 42-48.

LEEPER, G.W. AND N.C. UREN. 1993. Soil Science: An Introduction. 5th Edition. Melbourne University Press, Carlton.

LIEBIENS, J. 2001. Spreadsheet Macro to Determine USDA Soil Textural Subclasses. Commun. Soil Sci. Plant Anal. 32: 255-265.

MARSHALL, T.J. 1947. Mechanical Composition of Soil in Relation to Field Descriptions of Texture. Bulletin 224. CSIR, Melbourne.

SHEPARD, F.P. 1954. Nomenclature Based on Sand-silt-clay Ratios. Journal of Sedimentary Petrology 24: 151-158.

SOIL SURVEY DIVISION STAFF. 1993. Soil survey manual. USDA Handbook 18. U.S. Government Print Office, Washington.

SYS, C. 1961. La Cartographie des Sols au Congo ses Principes et ses Methodes. Serie Technique No. 66. Publications de l'Institut National pour l'Etude Agronomique du Congo, Congo.

VERHEYE, W. AND J. AMERYCKX. 1984. Mineral Fractions and Classification of Soil Texture. Pedologie 2: 215-225.