Protecting Our Water Environment

Metropolitan Water Reclamation District of Greater Chicago

RESEARCH AND DEVELOPMENT DEPARTMENT

REPORT NO. 03-19

A SURVEY OF CHARACTERISTICS OF TOPSOILS MARKETED IN THE CHICAGO METROPOLITAN AREA

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A SURVEY OF CHARACTERISTICS OF TOPSOILS MARKETED IN THE CHICAGO METROPOLITAN AREA

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DISCLAIMER

Mention of topsoil vendor names in this report does not constitute endorsement by the Metropolitan Water Reclamation District of Greater Chicago.

INTRODUCTION

The beneficial reuse of the Metropolitan Water Reclamation District of Greater Chicago's (District) biosolids in the local market as a soil amendment or topsoil substitute is a cost-effective management option. In the Chicago metropolitan area and other urban areas, the topsoil market is quite diverse and includes residential and commercial landscaping, establishment of parks and recreational areas, home gardening, reclamation of severely disturbed land, and vegetative cover for landfills. There are no standards or regulatory guidelines for materials marketed as topsoil. Therefore, in urban areas the characteristics of materials marketed as topsoil are generally quite variable.

The Research and Development Department has recently begun an initiative to produce synthetic topsoil from the District's biosolids. The District recognizes the certain limitations that exist in using the biosolids currently produced by its standard processing trains as a general use topsoil. As a first step in the process of producing a better quality synthetic topsoil from biosolids, the District sought to characterize the topsoils currently marketed in the Chicago metropolitan area. The information obtained from the survey on the range of characteristics in the topsoils found in the local market can be used by the District to establish a range of properties for producing topsoil from its biosolids.

The types of topsoil marketed locally can be placed into two large groups:

- Bagged soil used for home gardens, greenhouse, and potted plants
- Bulk topsoil used in landscaping, gardening, restoration projects, and for landfill vegetative cover

The two groups of topsoil are somewhat different with respect to general characteristics and use.

Bagged soil usually has more desirable and well-defined characteristics for use as a plant growth medium. It usually consists of a blend of mineral soil and organic matter such as compost or peat. Bagged soil is distributed in relatively small quantities by garden shops. Bulk topsoil is mostly a by-product of the construction industry derived from the excavation for new building construction or the demolition of some structures.

Bulk topsoil is usually sold wholesale for the manufacture of bagged soil or it is used directly, although some is retailed to home gardeners and landscapers through home garden centers. The characteristics of bulk topsoil depend largely on its source because they are not usually modified before distribution, except for some bulk topsoils that are pulverized before sale.

There is very little information available and there are no standards on the acceptable range of properties for topsoil used in the Chicago metropolitan area or in the United States. Therefore, the objective of this survey was to determine the range in properties of bagged and bulk topsoil marketed in the Chicago metropolitan area.

MATERIALS AND METHODS

Sample Collection

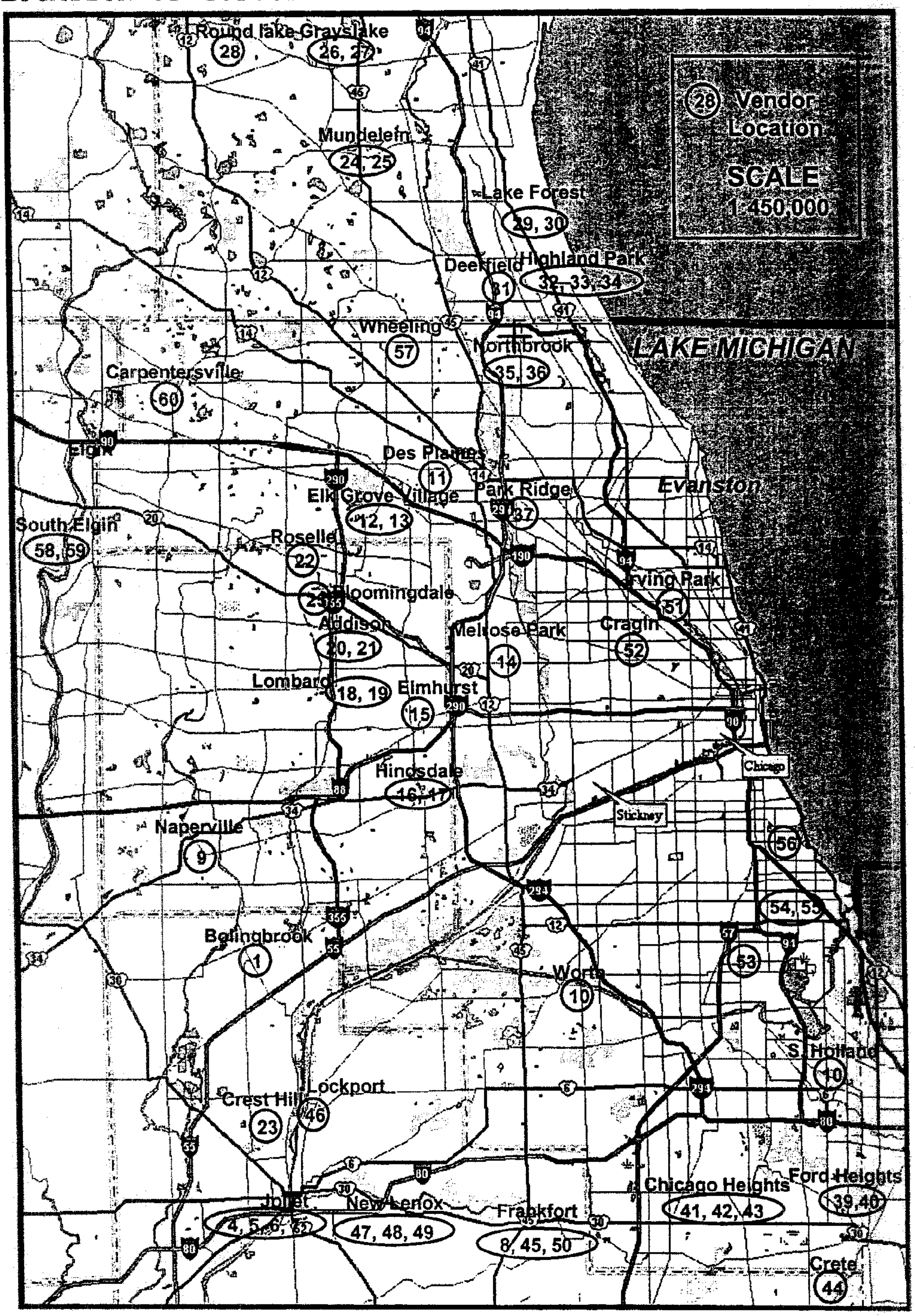
We compiled a list of 110 topsoil suppliers (vendors) in the Chicago metropolitan area that were within a 75-mile radius of the District's Lue-Hing R&D Complex, located in Stickney, Illinois (Figure 1). The vendors were identified in the U.S. Phone Disc or in the local telephone directories. We attempted to contact each vendor by telephone to obtain information on the type of topsoil the vendor supplied (bagged or bulk topsoil) and to schedule sample collection. In our telephone contacts, we found that many of the vendors listed as topsoil suppliers were companies that haul topsoil, but they do not actually supply it. We eventually narrowed the list to 47 vendors.

During September to November 2002, we collected a total of 60 topsoil samples (13 bagged and 47 bulk). The list of topsoil samples and vendors are presented in Table 1, and the locations of the vendors are mapped in Figure 1. We bought bagged products from the suppliers and collected approximately 1-kg samples from stockpiles of the bulk topsoil. More than one sample was collected from some vendors. While sampling the stockpiles of topsoil, the amount (percentage of bulk volume)

METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO

FIGURE 1

LOCATION OF TOPSOIL VENDORS WHERE SAMPLES WERE COLLECTED



METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO

TABLE 1

SOURCE INFORMATION OF BAGGED AND BULK TOPSOIL COLLECTED IN THE SURVEY

Sample Identification	Vendor	Map Location No.	City	Product Name or Source
		Bagged		
Ace	Mutual Cellular	32	Highland Park	Ace
All American 1	Schwarz Nursery & Garden Center	21	Addison	All American
All American 2	Red's Garden Center	35	Northbrook	All American
Earth Gro	Frank's Nursery & Crafts	23	Bloomingdale	Earth Gro
Garden Magic	Pasquesi Home & Gardens	30	Lake Forest	Garden Magic
Gardener Pride 1	Beeson's Nursery	31	Deerfield	Gardener's Pride
Gardener Pride 2	Clarke's Garden Center	40	Ford Heights	Gardener's Pride
Green Gro	Fiore, John & Sons	29	Lake Forest	Green Gro

METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO

TABLE 1 (Continued)

SOURCE INFORMATION OF BAGGED AND BULK TOPSOIL COLLECTED IN THE SURVEY

Sample Identification	Vendor	Map Location No.	City	Product Name or Source
		Bagged		
Green Thumb	Amlings Garden Center	16	Hinsdale	Green Thumb Organic Topsoil
Jeffrey 1	Landscape Depot	19	Lombard	Jeffrey's
Jeffrey 2	Smith Brothers Garden Center Inc	47	New Lenox	Jeffrey's
Natural Earth	Country Green House	38	South Holland	Natural Earth
New Plant Life	Allied Nursery Inc.	5	Joliet	New Plant Life
		Bulk		
AC	A C Topsoil	49	New Lenox	Local fields
Ace 1	Ace Landscaping & Garden Center	54	Chicago	Indiana
Ace 2	Ace Landscaping & Garden Center	55	Chicago	Indiana

METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO

TABLE 1 (Continued)

SOURCE INFORMATION OF BAGGED AND BULK TOPSOIL COLLECTED IN THE SURVEY

Sample Identification	Vendor	Map Location No.	City	Product Name or Source
		Bulk		
Anderson Excav.	Carl A. Anderson & Sons Excavating	15	Elmhurst	Local construction
Advance	Advance Garden Center	52	Chicago	Other suppliers
AG	A G Landscape Materials	22	Roselle	Dupage Topsoil West Chicago
Allied 1	Allied Nursery Inc.	4	Joliet	Local construction
Allied 2	Allied Nursery Inc.	6	Joliet	Local construction
Allied 3	Allied Nursery Inc.	7	Joliet	Local construction
Anderson	Anderson Landscape Supply	9	Naperville	No Information
Berthold	Berthold Nursery & Garden Center	13	Elk Grove Village	Earth Inc.

METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO

TABLE 1 (Continued)

SOURCE INFORMATION OF BAGGED AND BULK TOPSOIL COLLECTED IN THE SURVEY

Sample Identification	Vendor	Map Location No.	City	Product Name or Source
		Bulk		
Clarks	Clarke's Garden Center	39	Ford Heights	No Information
Country Bumpkin	Country Bumpkin Garden Center	24	Mundelein	Local fields
Dundee	Dundee Landscape	60	Carpentersville	Other suppliers
EZ Tree	E Z Tree Recycling	56	Chicago	Other suppliers
Fairfield	Fairfield Material & Supply	28	Round Lake	Local fields
Fortini	Fortini & Son Landscaping	51	Chicago	Other suppliers
Fowler	Fowler Materials	59	South Elgin	No Information
Golden Gate	Golden Gate Nursery Inc.	50	Frankfort	Local fields

METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO

TABLE 1 (Continued)

SOURCE INFORMATION OF BAGGED AND BULK TOPSOIL COLLECTED IN THE SURVEY

Sample Identification	Vendor	Map Location No.	City	Product Name or Source
		Bulk		
Highland Green	Highland Green Nursery Inc.	27	Grayslake	Potsy's or local field
JKS	JKS Ventures Inc.	14	Melrose Park	No Information
Jones	R. Jones Trucking & Grading	12	Elk Grove Village	No Information
Landscape Depot	Landscape Depot	18	Lombard	No Information
Lester's		26	Grayslake	No Information
Long's	Long's Garden Center	53	Chicago	No Information
Luvey's	Lurvey's American Green Garden	11	Des Plaines	No Information
Menoni	Menoni & Mocogni Inc.	34	Highland Park	Various

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TABLE 1 (Continued)

SOURCE INFORMATION OF BAGGED AND BULK TOPSOIL COLLECTED IN THE SURVEY

Sample Identification	Vendor	Map Location No.	City	Product Name or Source
		Bulk		
Mr. K	Mr. K Garden & Material Center	37	Park Ridge	Construction Union, IL
Mutual	Mutual Cellular	33	Highland Park	Local fields
Prime	Prime Soil	8	Frankfort	No Information
RC	RC Topsoil	57	Wheeling	No Information
Red's	Red's Garden Center	36	Northbrook	No Information
Reliable	Reliable Nurseries	46	Lockport	No Information
Saunoris	Saunoris Brothers Inc.	45	Frankfort	Local fields
Schoeder	Schroeder Material Inc.	10	Worth	No Information
Schwarz	Schwarz Nursery & Garden Center	20	Addison	Dupage Topsoil West Chicago
Scotty's 1	Scotty's Excavating & Topsoil	2	Crest Hill	Local construction

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TABLE 1 (Continued)

SOURCE INFORMATION OF BAGGED AND BULK TOPSOIL COLLECTED IN THE SURVEY

Sample Identification	Vendor	Map Location No.	City	Product Name or Source
		Bulk		
Scotty's 2	Scotty's Excavating & Topsoil	3	Crest Hill	Local construction
Smith Brothers	Smith Brothers Garden Center Inc.	48	New Lenox	No Information
Soderberg 1	Soderborg Tree & Landscaping Co.	41	Chicago Heights	Indiana
Soderberg 2	Soderborg Tree & Landscaping Co.	42	Chicago Heights	Indiana
Soderberg 3	Soderborg Tree & Landscaping Co.	43	Chicago Heights	Indiana
Tameling	Tameling Industries	17	Hinsdale	Local construction
Teczra	Teczra Rainbow Gardens	58	South Elgin	No Information
Terra Tech	Terra Tech Excavating Inc.	44	Crete	No Information

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TABLE 1 (Continued)

SOURCE INFORMATION OF BAGGED AND BULK TOPSOIL COLLECTED IN THE SURVEY

Sample Identification	Vendor	Map Location No.	City	Product Name or Source
		-Bulk-		
Topsoil Supply	Topsoil Supply Inc.	25	Mundelein	No Information
Wallace	Tim Wallace Land-scape Supply	1	Bolingbrook	Local Construction

of any debris (large pieces of non-soil-like material such as rocks and wood) in the pile was estimated visually. When possible, the vendors were interviewed briefly to obtain information regarding the source, availability, and customers of their topsoil.

Sample Analysis

The soil samples were screened through a 2-mm sieve, and then analyzed as follows:

- Soil textural class - The "Feel" method (Brady and Weil, 1999)
- pH and electrical conductivity (EC) - 1:2 soil:water ratio (volume basis) using the suspension and supernatant for pH and EC, respectively (Soil and Plant Analysis Council, 1999). We also did the pH and EC 1:2 soil:water ratio (weight basis) using the suspension and supernatant for pH and EC, respectively
- Organic carbon (OC) - Potassium dichromate wet oxidation method, followed by titrimetric determination (Nelson and Sommers, 1996)

- Extractable NH_3-N and NO_3-N - 1M KCl extraction (1:10 soil:solution ratio) followed by Lachat flow injection analysis (Mulvaney, 1996)
- Available P - Bray P1 extraction using a 1:7.5 soil:solution ratio followed by colorimetric determination of the extracted P (Soil and Plant Analysis Council, 1999)
- Total Kjeldahl nitrogen (TKN) and total P - determined by colorimetric analysis of the TKN digest (Bremner, 1996)

RESULTS AND DISCUSSION

Texture, pH, and Electrical Conductivity

The textural class and the pH and EC (measured using the 1:2 soil:solution ratio on a volume basis) of the 13 bagged and the 47 bulk soils are presented in Table 2 and the categorical summary of these data are presented in Table 3. The pH and EC of the soils measured using the weight basis, which is also a standard procedure, are presented in Table 4 for comparison.

SOIL TEXTURE

Soil texture is a fundamental property determined by the particle size distribution of the mineral fraction. The texture is determined by the relative proportion of sand (2 mm-0.05 mm), silt (0.05 mm-0.002 mm), and clay (<0.002 mm) sized particles. Ranges in the composition of these particles are grouped into textural classes that are represented in the United States Department of Agriculture's textural triangle (Figure 2). Soil texture is important because it has a significant influence on soil structure, moisture relations and drainage, tilth, and nutrient retention through its influence on the cation exchange capacity (CEC).

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TABLE 2

VISIBLE DEBRIS, TEXTURAL CLASS, pH, AND SALINITY (EC) OF BAGGED AND BULK TOPSOIL SURVEY SAMPLES

Sample Identification	Visible Debris[1]	Textural Class[2]	pH[4]	EC[4] (dS/m)
	------------------	Bagged	----------------	
Ace	None	1[3]	6.8	0.83
All American 1	None	1[3]	7.0	0.67
All American 2	None	1[3]	6.7	0.51
Earth Gro	None	1[3]	7.2	1.19
Garden Magic	None	1[3]	6.7	0.51
Gardener Pride 1	None	1[3]	6.3	1.00
Gardener Pride 2	None	1[3]	6.6	1.72
Green Gro	None	1[3]	6.6	1.44
Green Thumb	None	1[3]	6.7	1.37
Jeffrey 1	None	1[3]	7.4	3.61
Jeffrey 2	None	1[3]	6.9	3.05
Natural Earth	None	1[3]	6.3	4.15
New Plant Life	None	1[3]	6.4	2.25
Mean			6.7	1.71
Minimum			6.3	0.51
Maximum			7.4	4.15

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TABLE 2 (Continued)

VISIBLE DEBRIS, TEXTURAL CLASS, pH, AND SALINITY (EC) OF BAGGED AND BULK TOPSOIL SURVEY SAMPLES

Sample Identification	Visible Debris[1]	Textural Class[2]	pH[4]	EC[4] (dS/m)
	-----------------------	Bulk	-------------------	
AC	None	sicl	7.4	4.15
Ace 1	5-10%	Sl	7.5	0.88
Ace 2	1-5%	l[3]	7.2	0.33
Anderson Excav.	None	sicl	7.6	0.10
Advance	1-5%	sil	7.6	1.58
AG	None	cl	6.2	0.09
Allied 1	None	sicl	6.2	0.13
Allied 2	1-5%	sic	6.6	0.11
Allied 3	None	sicl	6.1	0.10
Anderson	None	sicl	6.9	0.13
Berthold	None	sil	5.4	0.10
Clarks	5-10%	l[3]	7.7	2.10
Country Bumpkin	None	Sic	7.2	0.25
Dundee	1-5%	sicl	6.4	0.34
EZ Tree	None	sl	7.5	0.29
Fairfield	None	sicl	6.9	0.19

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TABLE 2 (Continued)

VISIBLE DEBRIS, TEXTURAL CLASS, pH, AND SALINITY (EC) OF BAGGED AND BULK TOPSOIL SURVEY SAMPLES

Sample Identification	Visible Debris[1]	Textural Class[2]	pH[4]	EC[4] (dS/m)
	----------	----------	Bulk	----------
Fortini	None	sicl	6.8	0.08
Fowler	1-5%	sicl	6.6	0.36
Golden Gate	None	sic	7.1	0.17
Highland Green	None	cl	6.8	0.18
JKS	10-25%	s	11.3	1.99
Jones	None	sil	6.7	0.11
Landscape Depot	1-5%	sicl	7.1	0.36
Lester's	1-5%	cl	6.8	0.23
Long's	1-5%	cl	7.6	0.41
Luvey's	1-5%	cl	7.1	0.22
Menoni	1-5%	cl	7.1	0.14
Mr. K	1-5%	sicl	7.0	0.60
Mutual	1-5%	cl	7.6	0.21
Prime	None	sicl	7.2	0.02
RC	10-20%	sicl	7.2	0.18
Red's	1-5%	sic	6.9	0.32

METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO

TABLE 2 (Continued)

VISIBLE DEBRIS, TEXTURAL CLASS, pH, AND SALINITY (EC) OF BAGGED AND BULK TOPSOIL SURVEY SAMPLES

Sample Identification	Visible Debris[1]	Textural Class[2]	pH[4]	EC[4] (dS/m)
			Bulk	
Reliable	None	sicl	6.7	0.25
Saunoris	None	sic	6.6	0.23
Schoeder	None	cl	7.4	0.36
Schwarz	None	sicl	7.3	0.25
Scotty's 1	5-10%	cl	7.4	0.16
Scotty's 2	None	sicl	7.3	0.21
Smith Brothers	None	sic	7.4	0.26
Soderberg 1	None	cl	7.0	0.40
Soderberg 2	1-5%	sicl	7.4	0.26
Soderberg 3	None	l[3]	7.7	0.66
Tameling	None	Sicl	7.1	0.29
Teczra	1-5%	cl	6.8	0.27
Terra Tech	1-5%	cl	6.2	0.38
Topsoil Supply	None	sic	6.9	0.26
Wallace	1-5%	cl	6.9	0.32

TABLE 2 (Continued)

VISIBLE DEBRIS, TEXTURAL CLASS, pH, AND SALINITY (EC) OF BAGGED AND BULK TOPSOIL SURVEY SAMPLES

Sample Identification	Visible Debris[1]	Textural Class[2]	pH[4]	EC[4] (dS/m)
			Bulk	
Mean			7.1	0.36
Minimum			5.4	0.02
Maximum			11.3	2.10

[1]Debris is non-soil-like material. The percentage was estimated visually.
[2]s = sand, l = loam, c = clay, sl = sandy loam, sil = silt loam, sicl = silty clay loam, sic = silty clay, cl = clay loam. Relative amounts of sand, silt, and clay for each class is presented in Figure 2.
[3]These soils are highly organic. Therefore, they were assigned a default textural class of loam.
[4]EC = electrical conductivity. The pH and EC were done in the 1:2 soil:water (volume basis) suspension and extract, respectively.

METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO

TABLE 3

CATEGORICAL SUMMARY OF TEXTURAL CLASS, pH, AND SALINITY OBSERVED IN BAGGED AND BULK TOPSOIL SAMPLES

Category	Value Range	Bagged No. Samples	Bagged % of Total	Bulk No. Samples	Bulk % of Total
------------ Textural class ------------					
s	NA[1]	0	0.0	1	2.1
sl	NA[1]	0	0.0	2	4.3
l[2]	NA[1]	13	100.0	3	6.4
sil	NA[1]	0	0.0	3	6.4
sicl	NA[1]	0	0.0	18	38.3
sic	NA[1]	0	0.0	7	14.9
cl	NA[1]	0	0.0	13	27.7
------------ pH[2] ------------					
Very acid	<5.6	0	0.0	1	2.1
Acid	5.6-6.0	0	0.0	0	0.0
Slightly acid	6.1-6.8	9	69.2	14	29.8
Neutral	6.9-7.6	4	30.8	29	61.7
Alkaline	>7.6	0	0.0	3	6.4
------------ Salinity, EC[2] (dS/m) ------------					
Nonsaline	<0.4	0	0.0	39	83.0
Very slightly saline	0.40-0.80	3	23.1	4	8.5

TABLE 3 (Continued)

CATEGORICAL SUMMARY OF TEXTURAL CLASS, pH, AND SALINITY OBSERVED IN BAGGED AND BULK SOIL SAMPLES

Category	Value Range	Bagged No. Samples	Bagged % of Total	Bulk No. Samples	Bulk % of Total
Salinity, EC[2] (dS/m)					
Moderately saline	0.81-1.20	3	23.1	1	2.1
Saline	1.21-1.60	2	15.4	1	2.1
Strongly saline	1.61-3.20	3	23.1	2	4.3
Very strongly saline	>3.20	2	15.4	0	0.0

[1]NA = Not applicable.
[2]EC = electrical conductivity. The pH and EC were analyzed on the 1:2 soil:water (volume basis) suspension and extract, respectively.

TABLE 4

PH AND SALINITY (EC) IN THE 1:2 SOIL:WATER (WEIGHT BASIS) SUSPENSION AND EXTRACTS OF BAGGED AND BULK TOPSOIL SAMPLES

Sample Identification	pH[1]	EC[1] (dS/m)
	Bagged	
Ace	6.2	1.22
All American 1	6.4	1.28
All American 2	6.2	0.93
Earth Gro	6.6	1.45
Garden Magic	6.1	0.93
Gardener Pride 1	5.8	1.51
Gardener Pride 2	6.6	2.79
Green Gro	6.1	2.60
Green Thumb	6.3	2.02
Jeffrey 1	7.2	5.78
Jeffrey 2	6.5	7.75
Natural Earth	6.2	12.25
New Plant Life	6.0	2.96
Mean	6.3	3.34
Minimum	5.8	0.93
Maximum	7.2	12.25
	Bulk	
AC	7.0	0.26
Ace 1	6.7	1.02
Ace 2	6.7	0.48
Anderson Excav.	7.9	0.13
Advance	6.9	3.03
AG	6.7	0.13
Allied 1	6.0	0.15
Allied 2	6.3	0.12
Allied 3	5.9	0.12

TABLE 4 (Continued)

PH AND SALINITY (EC) IN THE 1:2 SOIL:WATER (WEIGHT BASIS) SUSPENSION AND EXTRACTS OF BAGGED AND BULK TOPSOIL SAMPLES

Sample Identification	pH[1]	EC[1] (dS/m)
	Bulk	
Anderson	6.5	0.17
Berthold	5.4	0.14
Clarks	7.0	4.36
Country Bumpkin	6.6	0.29
Dundee	7.2	0.49
EZ Tree	7.3	0.49
Fairfield	6.1	0.26
Fortini	6.0	0.12
Fowler	6.8	0.49
Golden Gate	6.8	0.19
Highland Green	6.4	0.26
JKS	11.1	2.04
Jones	6.2	0.14
Landscape Depot	6.6	0.45
Lester's	6.2	0.27
Long's	6.8	0.58
Luvey's	6.7	0.32
Menoni	6.6	0.16
Mr. K	6.3	0.78
Mutual	7.5	0.25
Prime	6.6	0.24
RC	7.2	0.27
Red's	6.2	0.15
Reliable	6.4	0.31

TABLE 4 (Continued)

PH AND SALINITY (EC) IN THE 1:2 SOIL:WATER (WEIGHT BASIS) SUSPENSION AND EXTRACTS OF BAGGED AND BULK TOPSOIL SAMPLES

Sample Identification	pH[1]	EC[1] (dS/m)
	Bulk	
Saunoris	6.4	0.27
Schoeder	7.0	0.56
Schwarz	6.7	0.34
Scotty's 1	7.0	0.21
Scotty's 2	7.1	0.25
Smith Brothers	7.2	0.33
Soderberg 1	6.5	0.62
Soderberg 2	7.2	0.35
Soderberg 3	5.0	1.83
Tameling	6.9	0.36
Teczra	7.3	0.32
Terra Tech	6.1	0.51
Topsoil Supply	6.4	0.31
Wallace	7.0	0.37
Mean	6.7	0.54
Minimum	5.0	0.12
Maximum	11.1	4.36

[1]EC = electrical conductivity. The pH and EC were done in the 1:2 soil:water (weight basis) suspension and extract, respectively.

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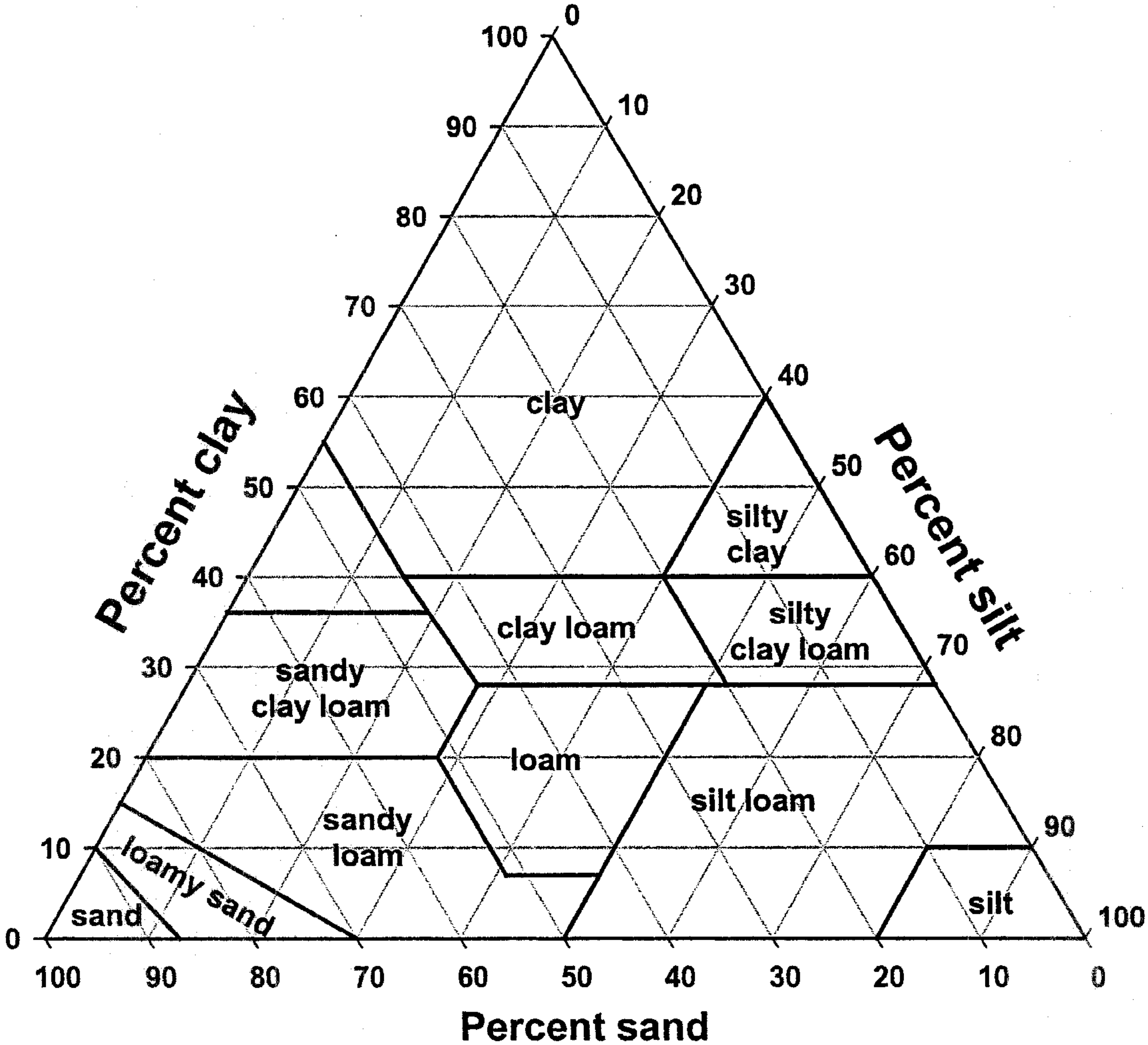
FIGURE 2

UNITED STATES DEPARTMENT OF AGRICULTURE'S

SOIL TEXTURAL TRIANGLE



We determined texture in the 60 soil samples collected in the survey by a rapid method referred to as determination of texture by "feel". This method allows for a rapid, semi-qualitative estimation of the textural classification of a soil. The interpretation of the textural classification with respect to the relative amounts of sand, silt, and clay is presented in Figure 2.

The results of the survey indicate that the textures of all 13 bagged soils were in the loam textural class (Table 2). This textural class is generally considered to have the greatest soil tilth and contains almost equal amounts of sand, silt, and clay particles. None of these particle sizes dominates the attributes of a soil with a loam texture.

The bulk soils tended to be heavier textured than the bagged soils; i.e. they contained a higher clay content. Approximately 38 percent of the bulk soils had textures in the silty clay loam class, approximately 15 percent had textures in the silty clay class, and 28 percent had textures in the clay loam class (Table 3). Less than 20 percent of the bulk soils sampled in the survey had lighter textures such as loam, silt loam, sandy loam, or sand.

Soils with textures in the silty clay and silty clay loam classes are usually harder to work and cultivate because they tend to be hard when dry and sticky and prone to compaction when wet. These textural classes also tend to have a lower hydraulic conductivity, and hence, they are more difficult to drain. The heavy textured soils are less desirable for most landscaping purposes than the lighter textured soils.

SOIL pH

Soil pH is a very important property because it controls the other soil chemical properties such as CEC and the availability of plant nutrients, and it affects the suitability of the environment for soil microorganisms. The pH in the 1:2 soil:water (volume basis) suspension of all 60 samples collected in the survey is reported in Table 2. The range of values for the categories of soil pH assigned in Table 3 are according to the Soil and Plant Analysis Council (1999).

The mean pH of the bagged soils was 6.7, and the mean pH of the bulk soils was 7.1. The pH range in the bagged soils was narrower than in the bulk soil. The pH for bagged soils ranged from 6.3 to 7.4, and they were all in the slightly acid to neutral range (pH 6.1 to 7.6; Table 3). This narrow pH range is most likely due to the fact that bagged soils are manufactured to have a defined range of characteristics to make them suitable as a plant growth medium. The pH of bulk soils ranged from 5.4 to 11.3, and most of them (about 92 percent) were in the slightly acid to neutral range (pH 6.1 to 7.6; Table 3). A pH of 11.3 was observed in the JKS bulk soil, which is a poor quality soil comprised of mostly sand, cobbles, and rocks (Tables 1 and 2). The optimum pH range for topsoil is generally considered to be 6.0 to 7.0 (Brady and Weil, 1999), and about 50 percent of the soils surveyed were within this range.

Soil pH is also commonly determined on 1:2 soil:water extracts conducted on a weight basis, especially on mineral soils. For comparison, we also measured soil pH by this method in addition to the volume basis method. The pH in the 1:2 soil:water (weight basis) suspension of all 60 samples collected in the survey is reported in Table 4. The data show that the pH determined by using the 1:2 soil:water ratio on a weight basis tended to be lower than the pH determined by using the 1:2 soil:water ratio on a volume basis. In nearly all cases, the results were within one pH unit for data generated by the two methods (weight basis and volume basis).

SOIL ELECTRICAL CONDUCTIVITY

The EC of a soil extract provides an index of the soluble salt content. This is an important soil property because a high soluble salt content can limit plant growth and the activity of soil microorganisms. Soils having a high soluble salt content (saline soil) tend to support the growth of mostly salt tolerant species of plants. These soils must be leached with water to reduce the salt content before they can be effectively used as a growth medium for other plant species. These soils may also be incapable of supporting healthy populations of beneficial soil microorganisms.

The ECs in the 1:2 soil:water (volume basis) extracts for the 60 soil samples collected in the survey are reported in Table 2. The range of values for the categories of soil EC assigned in Table 3 and the interpretation of plant effects associated with those categories (Table 5) are according to the Soil and Plant Analysis Council (1999).

The results of our survey indicate that the bagged soils tended to have a higher soluble salt content than bulk soils (Table 2). The mean soil extract ECs of the bagged and bulk soils were 1.71 and 0.36 dS/m, respectively.

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TABLE 5

INTERPRETATION OF SALINITY EFFECTS ON PLANT GROWTH[1]

Category	EC[2] Range (ds/m)	Effects
Nonsaline	<0.4	Salinity effects mostly negligible
Very slightly saline	0.4-0.8	Yield of salt sensitive species may be reduced by 25 to 50%
Moderately saline	0.8-1.2	Yield of salt sensitive species restricted. Seedlings may be injure
Saline	1.2-1.6	Salinity higher than desirable for greenhouse soils.
Strongly saline	1.6-3.2	Only salt tolerant species yield satisfactorily
Very strongly saline	>3.2	Only salt tolerant grasses, herbaceous plants, certain shrubs and trees will grow

[1]Soil and Plant Analysis Council (1999).
[2]EC is measured on 1:2 soil:water (volume basis) extract.

The soil extract EC range in the bagged soils was wider than in the bulk soil. The EC's of the bagged soils ranged from 0.51 to 4.15 dS/m, and the values were well distributed throughout the salinity categories of very slightly saline to very strongly saline, which has an EC greater than 3.2 (Table 3). About 53 percent of the bagged soils surveyed were in the saline to very strongly saline range (EC greater than 1.2 dS/m). This limits their use primarily to growing salt tolerant species (Tables 3 and 5) unless they are leached to remove the excess salts. The EC of the bulk soils ranged from 0.36 to 2.10 dS/m, and most of them (about 92 percent) were non-saline to slightly saline (EC less than 0.81), which is considered to be non-limiting to nearly all plant species (Tables 3 and 5).

Soil EC is also commonly determined on 1:2 soil:water extracts conducted on a weight basis, especially in mineral soils. For comparison, we also measured the soil EC by this method in addition to the volume basis method. The ECs in the 1:2 soil:water (weight basis) extracts of all 60 samples collected in the survey are reported in Table 4. The data show that the EC's determined on a weight basis tended to be higher than EC's using the volume basis, especially for the bagged soils.

The reason for this relationship is that in cases where the bulk density of the soil is less than 1, which is the case with all the bagged soils and some of the bulk soils, a larger volume of soil is used to measure the EC on a weight basis as compared to measurement on a volume basis. The difference observed is greater for the bagged soil because these soils are less dense than most of the bulk soils.

Soil Organic Carbon and Nutrients

The OC content and concentrations of major plant nutrients in the 13 bagged and the 47 bulk topsoils are presented in Table 6, and a categorical summary of these data are presented in Table 7.

SOIL ORGANIC CARBON

The soil OC or organic matter content is a very important soil property because it greatly influences the physical and chemical properties of soils. Organic matter affects the soil physical properties by improving the soil structure, moisture retention, and the flow of water through soil. Chemically, organic matter contains essential micro and macronutrients (especially N) that are released slowly over time as the organic matter decomposes. Soil organic matter also has a

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TABLE 6

NITROGEN SPECIES, ORGANIC CARBON (OC), C:N RATIO, TOTAL P, AND BRAY P1 AVAILABLE P IN BAGGED AND BULK TOPSOIL SAMPLES

Sample Identification	NH_3-N[1] (mg/kg)	NO_3-N[1] (mg/kg)	OC (%)	TKN (mg/kg)	C:N Ratio	AV-P[2] (mg/kg)	Total P (mg/kg)
				Bagged			
Ace	1.4	172	10.9	7,927	13.5	10	772
All American 1	1.7	198	10.6	6,062	16.9	7.5	847
All American 2	1.5	109	10.3	6,289	16.1	7.7	775
Earth Gro	1.1	11	5.0	2,382	20.9	66	788
Garden Magic	1.4	146	19.9	6,327	30.8	4.1	273
Gardener Pride 1	4.9	290	15.3	9,969	15.0	5.8	767
Gardener Pride 2	1.3	545	22.7	13,951	15.6	2.7	1,010
Green Gro	1.9	371	9.5	5,659	15.8	52	919
Green Thumb	1.8	401	24.0	17,014	13.8	4.7	874
Jeffrey 1	3.0	484	15.1	14,947	9.8	133	2,495
Jeffrey 2	7.8	1,030	12.5	15,627	7.5	188	2,468
Natural Earth	4.1	1,897	15.4	19,761	7.1	229	3,482
New Plant Life	1.9	372	20.6	11,771	16.9	0.2	535
Mean	2.6	464	14.8	10,591	15.4	54.6	1,231
Minimum	1.1	10.5	5.0	2,382	7.1	0.2	274
Maximum	7.8	1,897	24.0	19,760	30.8	228.6	3,482

METROPOLITAN WATER RECLAMATION DISTRICT OF GREATER CHICAGO

TABLE 6 (Continued)

NITROGEN SPECIES, ORGANIC CARBON (OC), C:N RATIO, TOTAL P, AND BRAY P1 AVAILABLE P IN BAGGED AND BULK TOPSOIL SAMPLES

Sample Identification	NH_3-N[1] (mg/kg)	NO_3-N[1] (mg/kg)	OC (%)	TKN (mg/kg)	C:N Ratio	AV-P[2] (mg/kg)	Total P (mg/kg)
	----------	----------	----------	Bulk	----------	----------	----------
AC	<0.5	40	2.2	1,614	13.2	6.8	479
Ace 1	1.3	108	4.0	2,660	14.4	33	580
Ace 2	0.5	61	5.2	3,441	15.0	12	431
Anderson Excav.	1.3	15	1.9	1,664	11.4	10	452
Advance	4.9	24	11.5	10,422	11.0	84	1,399
AG	1.1	18	2.4	1,185	19.9	5.9	612
Allied 1	<0.5	18	3.4	2,786	12.1	12	759
Allied 2	3.6	8.5	3.2	1,614	19.5	20	735
Allied 3	2.4	13	2.2	2,471	8.9	14	666
Anderson	3.3	23	2.8	1,765	15.4	12	500
Berthold	1.5	25	3.1	2,168	14.0	23	746
Clarks	13	224	36.5	20,492	17.6	326	3,002
Country Bumpkin	6.9	39	2.9	2,136	13.2	4.5	492
Dundee	<0.5	24	1.3	1,488	8.9	6.2	476
EZ Tree	1.5	0.37	8.5	4,046	21.0	18	650
Fairfield	<0.5	28	3.6	656	52.4	2.6	599

TABLE 6 (Continued)

NITROGEN SPECIES, ORGANIC CARBON (OC), C:N RATIO, TOTAL P, AND BRAY P1 AVAILABLE P IN BAGGED AND BULK TOPSOIL SAMPLES

Sample Identification	NH_3-N[1] (mg/kg)	NO_3-N[1] (mg/kg)	OC (%)	TKN (mg/kg)	C:N Ratio	AV-P[2] (mg/kg)	Total P (mg/kg)
	----------	----------	----------	Bulk	----------	----------	----------
Fortini	1.2	16	2.8	1,337	20.8	7.0	511
Fowler	6.7	98	2.7	2,521	10.3	7.3	572
Golden Gate	1.5	19	3.2	1,337	23.6	9.4	484
Highland Green	<0.5	29	3.1	1,097	27.9	3.8	516
JKS	<0.5	5.0	1.7	455	35.9	<0.2	199
Jones	2.4	16	2.3	1,727	13.4	30	612
Landscape Depot	<0.5	70	2.3	2,042	10.9	4.6	543
Lester's	<0.5	31	4.2	1,941	21.0	3.4	514
Long's	1.0	25	3.4	1,891	17.7	8.3	540
Luvey's	1.3	18	3.8	3,013	12.7	20	900
Menoni	<0.5	23	3.4	1,689	20.0	11	607
Mr. K	<0.5	58	3.7	2,256	16.1	17	596
Mutual Cellular	3.7	16	2.5	706	33.9	4.9	447
Prime	1.9	13	2.1	1,286	16.1	4.4	402
RC	1.0	28	3.6	3,517	10.2	6.7	716
Red's	<2.5	20	2.8	2,017	13.5	14	706
Reliable	<2.5	39	2.6	996	25.0	5.3	423
Saunoris	2.9	29	3.4	1,211	27.3	6.8	538

TABLE 6 (Continued)

NITROGEN SPECIES, ORGANIC CARBON (OC), C:N RATIO, TOTAL P, AND BRAY P1 AVAILABLE P IN BAGGED AND BULK TOPSOIL SAMPLES

Sample Identification	NH_3-N[1] (mg/kg)	NO_3-N[1] (mg/kg)	OC (%)	TKN (mg/kg)	C:N Ratio	AV-P[2] (mg/kg)	Total P (mg/kg)
				Bulk			
Schoeder	4.9	4.6	4.3	3,088	13.8	11	575
Schwarz	0.6	44	2.1	1,803	11.3	5.9	434
Scotty's 1	2.2	18	1.9	1,929	9.8	19	634
Scotty's 2	0.5	32	2.8	2,521	11.1	24	820
Smith Brothers	<0.5	30	2.2	1,047	20.0	5.6	423
Soderberg 1	1.7	71	5.4	5,041	10.6	4.1	506
Soderberg 2	2.2	36	2.0	1,778	10.9	3.5	452
Soderberg 3	3.3	216	33.0	22,180	14.7	14	740
Tameling	2.7	42	2.4	1,992	11.9	5.1	474
Teczra	<0.5	37	1.9	1,614	11.2	2.6	370
Terra Tech	2.1	76	2.7	2,269	11.5	7.2	532
Topsoil Supply	0.9	52	2.9	2,282	12.6	3.4	492
Wallace	6.6	53	3.2	2,735	11.6	8.2	679
Mean	2.8	41	4.6	3,020	16.7	18.8	628
Minimum	<0.5	0.37	1.3	455	8.9	2.6	199
Maximum	12.7	224	36.5	22,180	52.4	326	3,002

[1]1M KCl extractable NO_3-N and NH_3-N.
[2]Bray P1 available P.

TABLE 7

RATING SUMMARY OF NITROGEN SPECIES, ORGANIC CARBON, C:N RATIO, BRAY P1 AVAILABLE P, AND TOTAL P IN BAGGED AND BULK TOPSOIL SAMPLES

		Bagged		Bulk	
Category	Value Range	No. Samples	% of Total	No. Samples	% of Total
		Organic carbon (%)			
Low	<2	0	0.0	5	10.6
Medium	2-4	0	0.0	34	72.3
High	4.1-6.7	1	7.7	4	8.5
Very high	>6.7	12	92.3	4	8.5
		NH_3+NO_3-N (mg/kg)			
Low	<50	1	7.7	36	76.6
Medium	50-150	2	15.4	9	19.1
High	>150	10	76.9	2	4.3
		TKN (mg/kg)			
Low	<1,500	0	0.0	12	25.5
Medium	1,500-4,000	12	92.3	31	66.0
High	>4,000	1	7.7	4	8.5
		Bray P1 Available P (mg/kg)			
Low	<15	0	0.0	36	76.6

TABLE 7 (Continued)

RATING SUMMARY OF NITROGEN SPECIES, ORGANIC CARBON, C:N RATIO, BRAY P1 AVAILABLE P, AND TOTAL P IN BAGGED AND BULK TOPSOIL SURVEY SAMPLES

Category	Value Range	Bagged No. Samples	Bagged % of Total	Bulk No. Samples	Bulk % of Total
		Bray P1 Available P (mg/kg)			
Medium	15-30	1	7.7	8	17.0
High	>30	12	92.3	3	6.4
		Total P (mg/kg)			
Low	<1,500	8	61.5	45	95.7
Medium	1,500-4,000	4	30.8	1	2.1
High	>4,000	1	7.7	1	2.1
		C:N Ratio			
Low	<20	11	84.6	36	76.6
Medium	20-30	1	7.7	7	14.9
High	>30	1	7.7	4	8.5

high CEC, which increases the nutrient holding capacity of soils. Soils with a high organic matter content are usually very fertile.

Soil OC values for the 60 soil samples collected in the survey are reported in Table 6. We developed a series of categories for illustrating the distribution of the soil OC values in the topsoils sampled. Except for the lower limit assigned to the "Very High" category, the range of values for the other categories of soil OC in Table 7 were assigned based on the potential of the soil to mineralize organic N for plant needs (University of Illinois, 2000). Soil with an OC content rated as "High" can supply adequate N to most plants without additional fertilizer N inputs. The lower limit of 6.7 percent for the "Very High" category was assigned based on the fact that mineral soils having more than 6.7 percent OC are classified as organic soils or Histosols (Brady and Weil, 1999).

Soil OC in most of the bagged soils was higher than in the bulk soil. Mean soil OC was 14.8 percent and 4.6 percent for the bagged and bulk soils, respectively. In the bagged soils, the OC content ranged from 5 to 24 percent and almost all (92 percent) were in the "Very High" range. The OC content of the bulk soils ranged from 1.3 to 36.5 percent and most of them (72 percent) were rated as Medium (2 to 4 percent). The bulk soils with the highest OC content were obtained from Clarks and Soderberg (36.5 and 33 percent, respectively) and appear very humic (Table 1). Soderberg uses this humus to blend with other mineral soils to produce topsoil for the greenhouse and potted plants market (Table 1). Soils containing "Very High" OC have good characteristics as a plant growth medium and will be easy to work.

SOIL NITROGEN

Plants utilize soil N in the inorganic forms, mostly as NH_3-N and NO_3-N. However, very high levels of NH_3-N may be toxic to plants and some microorganisms. Potassium chloride extractable NH_3-N and NO_3-N is usually used as an index of inorganic N availability. Total N, measured as TKN, includes inorganic N as well as organic N which is converted slowly to inorganic N over time as organic matter decomposes.

The concentration of NO_3-N and NH_3-N in the 60 soil samples collected in the survey are reported in Table 6. The values for the categories of inorganic N assigned in Table 7 were based on the plant nutritional needs. Plants grown in soils having a "High" N rating would not usually respond to additional fertilizer N. Whereas, soils with an inorganic N rated as "Medium" or "Low" will require fertilizer N for optimum performance. The values for the TKN categories were assigned based on the relationship between soil OC and TKN in the survey samples [TKN (mg/kg) = 530 + 600 x OC (%), r^2 = 0.80]. Using this relationship, a soil having 2% OC ("Low") will have approximately 1,500 mg/kg TKN ("Low"). This interpretation is based on the assumption that NH_3-N represents an insignificant fraction of TKN, which is the case in the survey samples (Table 6).

The NH_3-N concentrations were very low in both the bagged and bulk soils, with a mean value of 2.7 mg/kg (Table 6). Most of the inorganic N (NH_3-N + NO_3-N) in both the bagged and bulk soils was in the NO_3-N form. Nitrate N ranged from 10.5 to 1,897 mg/kg in the bagged soils and from 0.37 to 224 mg/kg in the bulk soils. The higher concentrations of inorganic N in the bagged soils can be attributable to the N release from the high organic matter in these soils and/or the addition of a commercial N fertilizer by the bagged topsoil manufacturers or vendors. Although a relatively high inorganic N content is favorable for plant nutrition, leaching of excessive levels of NO_3-N to groundwater can be an environmental concern when these soils are used on land that is environmentally sensitive.

The TKN levels in the soils were also quite variable, ranging from 2,382 to 19,760 mg/kg in the bagged soils and from 455 to 22,180 mg/kg in the bulk soils.

SOIL PHOSPHORUS

Similar to N, P is an important macronutrient, but excessive levels in soils can result in runoff losses, which can contaminate surface waters. Total P levels in soils are usually not indicative of P availability to plants, but it is normally used to determine the potential for soil to have accumulated excess levels of P. Plant available P in soils is usually measured by various methods, which extracts only the portion of soil P that tends to correlate with P uptake by plants. In the midwest, plant available P is usually measured using the Bray P1 method. The range of values for the categories of Bray P1 available P assigned in Table 7 are according to the Soil and Plant Analysis Council (1999).

Generally, Bray P1 available P levels in the bagged soils were higher than in the bulk soils (Table 6). Mean Bray P1 concentrations were 54.6 and 18.8 mg/kg for the bagged and bulk soils, respectively. In the bagged soils, Bray P1 P ranged from 0.2 to 229 mg/kg. Eight of the bagged soils (about 63 percent) were rated as "Low" (less than 15 mg/kg) and the remainder were rated as "High"(more than 30 mg/kg). In the bulk soils, Bray P1 P ranged from 2.6 to 326 mg/kg, and most of them (about 77 percent) were rated as "Low" (less than 15 mg/kg). The 3 bulk soils in which Bray P1 was rated as "High" were highly organic (Tables 1 and 6).

Total P in the bagged soils was generally higher than in the bulk soils (Table 6). Mean total P levels were 1,231 and 628 mg/kg for the bagged and bulk soils, respectively. In the bagged soils, total P ranged from 274 to 3,482 mg/kg and only the Natural Earth sample (3,482 mg/kg) was rated as "High". In the bulk soils, total P ranged from 199 to 3,002 mg/kg, and most of them (about 96 percent) were rated as "Low" (less than 1,500 mg/kg). The 2 bulk soils in which total P was rated as "Medium" or "High" were the highly organic Advance and Clarks soils (Tables 1 and 6).

STABILITY OF SOIL ORGANIC MATTER

The stability of soils with respect to their potential to immobilize (tie-up) or mineralize (release) N is usually evaluated using the carbon to nitrogen ratio of the soil (C:N ratio). As the C:N ratio increases, microorganisms in soils tend to utilize inorganic forms of N as an energy source to decompose OC, making the N unavailable for plant use and reducing the potential for excess N to leach from the soil. With time, the N that is tied up in soil microorganisms is mineralized or released. Therefore, a soil with a high C:N ratio tends to be more unstable (i.e. ties up nutrients and has organic carbon which is subject to net mineralization in the long run) as compared to a low C:N ratio soil in which the inorganic N is readily available for plant use and leaching loses.

Soils with C:N ratio rated as "High" (greater than 30) tend to immobilize or tie-up any added inorganic N. In soils rated as "Low" (less than 20), most of the added inorganic N would be available for plant use (Brady and Weil, 1999). This relationship was used to assign the range of values for the C:N ratio in Table 7.

Mean C:N ratios were similar for bagged and bulk soils (15.4 and 16.7, respectively). The C:N ratios ranged from 7.1 to 30.8 in the bagged soils and from 8.9 to 52.4 in the bulk soil (Table 6). The C:N ratio for most of the soils (about 85 and 79 percent, for the bagged and bulk soils, respectively) was rated as "Low". The highest C:N ratio of 52.4 was observed in the Fairfield soil, which was relatively low in TKN (Table 6).

SUMMARY

We conducted a survey of the topsoil marketed in the Chicago metropolitan area to determine the range in soil properties which are critical to the suitability of the topsoil for the local market. The information obtained from the survey will be used by the District to determine the range in those soil properties that can be considered adequate for the local topsoil market and to establish target specifications for manufacturing synthetic topsoil from its biosolids.

We collected 13 bagged and 47 bulk topsoils from companies listed as topsoil vendors in the local telephone directory. Most of the bagged soils are marketed by garden centers, and they are used locally for potted plants and in home gardens. The bulk topsoil vendors surveyed indicated that the bulk topsoils are used mostly for residential and commercial landscaping.

The samples were evaluated for some of the properties that are considered critical to topsoil suitability for plant growth. These properties included texture, pH, EC, organic matter, and the major plant nutrients N and P. A summary of the range and typical values for these properties is presented in Table 8. The survey showed that most of the 13 bagged soil

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TABLE 8

SUMMARY OF RESULTS FROM THE TOPSOIL SURVEY FOR THE CHICAGO METROPOLITAN AREA

Property		Bagged Soils				Bulk Soils			
	Units	Min.	Max.	Mean	Typical Range	Min.	Max.	Mean	Typical Range
Textural Class[1]		l	l	l	l	s	sic	NA[2]	sic,sicl,cl
pH		6.3	7.4	6.7	6.1-7.6	5.4	11.3	6.7	6.1-7.6
EC	dS/m	0.51	4.15	1.71	0.40-3.20	0.02	2.10	0.36	<0.40
OC	%	5.0	24.0	14.8	>6.7 (9.5-16)	1.3	36.5	4.6	2.0-4.0
TKN	mg/kg	2,382	19,760	10,591	1,500-4,000	455	22,180	3,020	1,500-4,000
TP	mg/kg	274	3,482	1,231	<1,500 (500-950)	199	3,002	628	<1,500 (300-800)
C:N Ratio		7.1	30.8	15.4	<20 (9-16)	8.9	52.4	16.7	<20 (10-17)
AV-P[3]	mg/kg	0.2	228.6	54.6	<15 (2-8)	2.6	326	18.8	<15 (3-12)
NO_3-N	mg/kg	10.5	1,897	464	100-500	0.37	224	41	15-50
NH_3-N	mg/kg	1.1	7.8	2.6	1.0-2.0	<0.5	12.7	2.8	0.5-4

[1] The ranges for texture is based on the range of clay content in the textural classes.
[2] NA = not applicable.
[3] Bray P1 available P.

were highly organic with a loamy texture and had an adequate pH range, and they were relatively high in plant available N and P. The salinities of those soils were evenly distributed throughout the salinity ratings of slightly saline to very strongly saline. This indicates that some of these soils would tend to retard the growth of young seedlings and salt sensitive plants, except when the soils are sufficiently leached with water to remove the excess salts. Leaching of salts in the bagged soil will be fairly easy because the high organic matter content and loamy texture facilitate good soil structure and water transmission characteristics.

Generally, the characteristics of the bulk soils were much more variable than the bagged soils. The survey showed that most of the bulk soils were heavy textured in the silty clay loam, silty clay, and clay loam textural classes (containing more than 28 percent clay). These soils were also low in plant available N and P, but the salinity was quite desirable with most of them being nonsaline. There were a few of the bulk soils which were similar to the bagged soils with respect to texture, organic matter, and nutrient content. These types of bulk soils are usually used to blend with other mineral soils to produce bulk topsoils that are similar to the bagged soils.

FUTURE WORK

The next step the District intends to undertake in the initiative to produce a synthetic topsoil is to utilize the results of this survey and the literature review conducted earlier (Cox et al., 2002) to establish ranges of chemical and physical properties that will serve as targets for our synthetic topsoil products. We will also begin to outline operational procedures that will be tested for producing synthetic topsoils that have properties within the target chemical and physical property ranges using biosolids as the major feedstock.

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