Soil Sample Survey

Ulster County
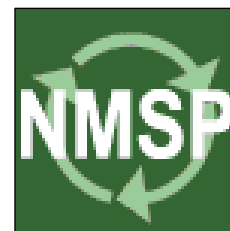
Samples analyzed by CNAL (2002-2006)

Ulster County (photo credit: Michael Fargione, CCE of Ulster County).

Summary compiled by

Renuka Rao, Michael J. Fargione, Quirine M. Ketterings, Hettie Krol

Cornell Nutrient Analysis Laboratory
http://www.css.cornell.edu/soiltest/newindex.asp
&
Nutrient Management Spear Program
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Ulster County (photo credit: Michael Fargione, CCE of Ulster County).

1. County Introduction

Ulster County is located in Southeastern New York, 70 miles north of NY City and 45 miles south of Albany. It covers 721,024 acres (1,126 square miles). The county includes parts of two main physiographic units: to the northwest is the Catskill Mountain area of the Appalachian Plateaus province. To the southeast is the Hudson Lowland area of the Valley and Ridge province. The Hudson Lowland area includes several distinct regions including the Rondout Esopus Valley region, the Shawangunk Mountain region, the Wallkill Valley region, and the Marlboro Mountain region.
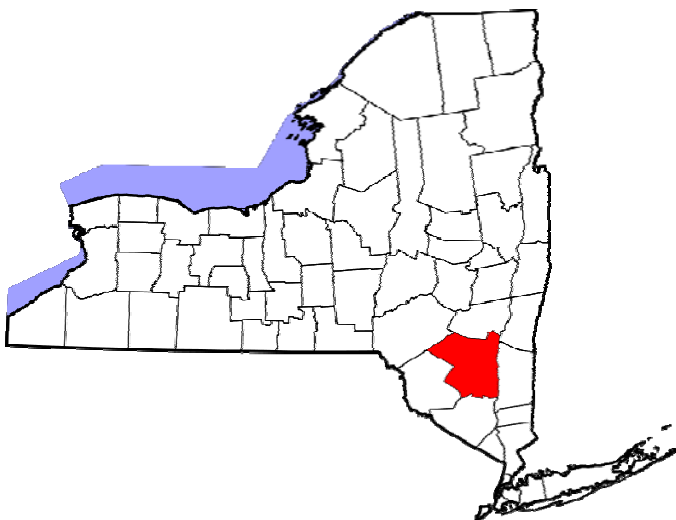
Major water bodies associated with Ulster County include the Hudson River on the eastern border, and the Ashokan and part of the Roundout Reservoirs in the west that contribute to NY City's drinking water. Land elevations range from sea level at the Hudson River to 4,204 feet atop Slide Mountain in the Catskills. Ulster soils have been divided into 6 main units: Bath-Nassau (19%), Stockbridge-Farmington-Bath (3.5%), Wellsboro-Wurtsboro-Swartswood (6%), Arnot-Oquaga-Lacawanna (39%), Lordstown-Arnot-Mardin (19%), Churchville-Rhinebeck-Madalin (4.5%), Hoosic-Schoharie-Chenango (9%).

Differences in physiography, soil and bedrock geology, and climate throughout the area have influenced the history of land use in Ulster County. Eighty-one percent of the County's 582,800 acres are covered with forest, including 160,000 acres of NY State Forest Preserve lands. In 2006, farms covered 11 percent of the land surface. Important farm commodities include fruit, grass/hay, corn, vegetables, nursery/greenhouse and equine. Although it is only 41st in farm acreage among NY counties, Ulster ranks in the top 6 in the production of apples, pears, peaches and sweet corn. Orchards and vineyards are located primarily on the higher elevations in the southern and eastern portions of the county. Here the Hudson River has a moderating effect on local microclimates, and

topographic relief provides air drainage to reduce the danger of spring frost damage. Sweet corn production is concentrated in the fertile, deep-soil river valleys, while grass/hay production is scattered across upland sites. Agriculture is limited in the Catskill Mountain section of the County. Normal precipitation is adequate for all crops, except on sites with shallow soils and in droughty years. Many fruit and vegetable farms have installed supplemental irrigation systems.

International competition, stagnant prices to farmers, increased taxation and regulation, and a rapidly increasing market for building lots resulted in significant amounts of Ulster farmland being converted to residential housing sites during the last 20 years. Apple acreage dropped by 43% between 1996 and 2006, yet production has been more stable due to adoption of high-density, higher-yielding orchard planting systems. The year 2000 population of Ulster County was estimated at 177,749 and is predicted to exceed 203,000 by the year 2020. Demand for house sites is expected to continue if favorable economic factors prevail. Yet, agriculture remains an integral part of Ulster County's economic base, supporting local communities and regional tourism. Ulster residents and government officials are increasingly concerned about retaining viable agricultural businesses and the working landscapes they help to preserve.

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References:

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2. General Survey Summary

This survey summarizes the soil test results from grower (identified as "commercial samples") and homeowner samples from Ulster County submitted to the Cornell Nutrient Analysis Laboratory (CNAL) from 2002 to 2006. The total number of samples analyzed in these years amounted to 914. Of these, 707 samples (77%) were submitted by commercial growers while 207 samples (23%) were submitted by homeowners.
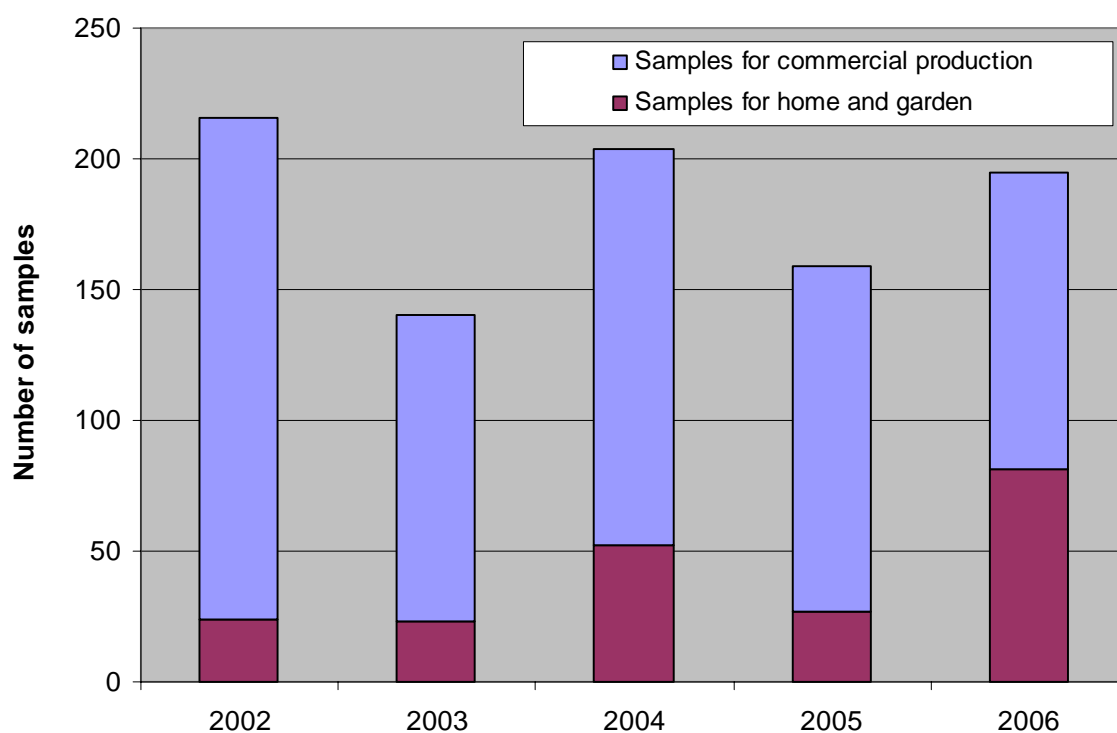
Homeowners		Commercial		Total
2002	24	2002	192	216
2003	23	2003	117	140
2004	52	2004	152	204
2005	27	2005	132	159
2006	81	2006	114	195
Total	207	Total	707	914

Homeowners submitted soil samples to the Cornell Nutrient Analysis Laboratory during 2002-2006 primarily to request fertilizer recommendations for home garden vegetable production (38%) and lawns (24%). Commercial growers submitted samples primarily to grow apples (41%), grass hay production (13%), alfalfa or alfalfa/grass mixes (6%), and mixed vegetables (6%).

Soils tested for home and garden in Ulster County were classified as belonging to soil management group 2 (19%), group 3 (29%), group 4 (35%), or group 5 (16%). A description of the different management groups is given below.

Soil Management Groups for New York

1	Fine-textured soils developed from clayey lake sediments and medium- to fine-textured soils developed from lake sediments.
2	Medium- to fine-textured soils developed from calcareous glacial till and medium-textured to moderately fine-textured soils developed from slightly calcareous glacial till mixed with shale and medium-textured soils developed in recent alluvium.
3	Moderately coarse textured soil developed from glacial outwash and recent alluvium and medium-textured acid soil developed on glacial till.
4	Coarse- to medium-textured soils formed from glacial till or glacial outwash.
5	Coarse- to very coarse-textured soils formed from gravelly or sandy glacial outwash or glacial lake beach ridges or deltas.
6	Organic or muck soils with more than 80% organic matter.

Of the samples submitted by commercial growers, the majority (74%) belonged to soil management group 3. One percent belonged to group 1, 7% to group 2, 13% to group 4 while the remainder belonged to group 5 (less than 1%) or were of unknown origin. Mardin and Bath were the most common soil series (18% of all samples each), followed by Wellsboro (17%, Hoosic (7%) and Chenango (5%).

Organic matter levels, as measured by loss-on-ignition, ranged from less than 1% to 30%. For homeowners most samples had between 2 and 5% organic matter (51% of all samples), 14% testing between 5 and 6% organic matter and 18% were classified as soils

with more than 6.9% organic matter. Of the samples submitted by commercial growers, 41% contained between 3 and 6% organic matter while 36% had 2-3% organic matter.

Soil pH in water (1:1 soil:water extraction ratio) varied from 4.6 to 8.0 for home and garden samples while 58% tested between 6.0 and 7.4 for pH. For the commercial samples, the highest pH was 8.0 and 60% tested between 6.0 and 7.4.

Extractable nutrients such as phosphorus (P), potassium (K), magnesium (Mg), calcium (Ca), iron (Fe), manganese (Mn), and zinc (Zn) were measured using the Morgan method (Morgan, 1941). This solution contains sodium acetate buffered at pH of 4.8.

Soil test P levels of <1 lb P/acre are classified as very low. Between 1-3 lbs P/acre is low. Medium is between 4-8 lbs P/acre. High testing soils have P levels between 9 and 39 lbs P/acre and anything higher is classified as very high. For homeowners, 14% of the soils tested low for P, 14% tested medium, 35% tested high and 38% tested very high. This meant that 73% tested high or very high in P. For commercial growers, 9% tested very high. In total 32% were low in P, 26% tested medium for P while 32% of the submitted samples were classified as high in soil test P. This means that 41% tested high or very high in P.

Classifications for K depend on soil management group. The fine textured soils (soil management group 1) have a greater K supplying capacity than the coarse textured sandy soils (soil management group 5). Classification for each of the management groups in the above table represent very low, low, medium, high and very high. So for example for soil management group 5 and 6, <60 lbs K/acre means the soil is very low in K, between 60 and 114 lbs K/acre is medium, 115-164 lbs K/acre is medium, 165-269 lbs K/acre is high and >269 lbs K/acre is classified as very high (see Table on page 6).

Potassium classifications for Ulster County soils varied from very low (3% of the homeowner soils and 2% of the commercial growers' soils) to very high (48% of the homeowner soils and 43% of the commercial growers' soils). For homeowners, 13% tested low in K, 12% tested medium, and 24% tested high for potassium. For commercial growers' soils, 7% tested low, 14% tested medium and 29% tested high in K.

Soil Management Group	Potassium Soil Test Value (Morgan extraction in lbs K/acre)				
	Very low	Low	Medium	High	Very High
1	<35	35-64	65-94	95-149	>149
2	<40	40-69	70-99	100-164	>164
3	<45	45-79	80-119	120-199	>199
4	<55	55-99	100-149	150-239	>239
5 and 6	<60	60-114	115-164	165-269	>269

Soils test very low for Mg if Morgan extractable Mg is less than 20 lbs Mg/acre. Low testing soils have 20-65 lbs Morgan Mg per acre. Soils with 66-100 lbs Mg/acre test medium for Mg. High testing soils have 101-199 lbs Mg/acre while soils with more than 200 lbs Mg/acre in the Morgan extraction are classified as very high in Mg. Magnesium levels ranged from 3 to more than 4000 lbs Mg/acre. There were only two soils that tested very low for Mg (commercial grower samples). Most soils tested high or very high for Mg (87% of the homeowner soils and 88% of the soils of the commercial growers). In total 13% of the homeowner soils and 12% of the commercial growers' soil samples were deficient in Mg.

Soils with more than 50 lbs Morgan extractable Fe per acre test excessive for Fe. Anything lower than 50 lbs Fe/acre is considered normal. Ninety-six percent of all samples (homeowner or commercial grower samples) tested normal for Fe. Similarly, most soils (92-97%) tested normal for manganese. Soils with more than 100 lbs Morgan extractable Mn per acre are classified as excessive in Mn. Anything less than 100 lbs Mn per acre is classified as normal. Soils with less than 0.5 lb Zn per acre in the Morgan extraction are classified as low in Zn. Medium testing soils have between 0.5 and 1 lb of Morgan extractable Zn per acre. If more than 1 lb of Zn/acre is extracted with the Morgan solution, the soil tests high in Zn. For the homeowner soils, 85% tested high for Zn while 10% tested medium and 5% were low in Zn. Of the commercial growers' samples, 6% tested low, 17% tested medium while 78% were high in Zn.

In the following sections, the summary tables for each of the soil fertility indicators described above are given. The appendix contains the crop codes used in section 3.

3. Cropping Systems

3.1 Homeowner Samples

Crops for which recommendations were requested by homeowners:

	2002	2003	2004	2005	2006	Total	%
ALG	0	0	2	1	0	3	1
ATF	0	2	1	1	0	4	2
BET	0	0	1	0	0	1	0
BLB	2	0	0	0	0	2	1
BLU	0	0	0	0	2	2	1
CEM	0	0	0	1	0	1	0
FAR	0	0	0	1	0	1	0
FLA	0	0	1	1	2	4	2
GEN	0	1	0	0	0	1	0
GOO	0	0	0	0	1	1	0
HRB	0	0	0	1	1	2	1
LAW	9	5	13	8	15	50	24
MVG	2	6	20	8	42	78	38
OTH	3	3	2	1	2	11	5
PER	0	3	8	4	7	22	11
PTO	0	0	1	0	1	2	1
ROS	1	1	0	0	2	4	2
RSP	0	0	0	0	2	2	1
SAG	5	2	1	0	3	11	5
TOM	0	0	2	0	0	2	1
TRF	1	0	0	0	1	2	1
Unknown	1	0	0	0	0	1	0
Total	24	23	52	27	81	207	100

Note: See Appendix for Cornell crop codes.

3.2 Commercial Samples

Crops for which recommendations were requested in commercial samples:

Current year crop	2002	2003	2004	2005	2006	Total	%
ABE/ABT	0	0	0	3	0	3	0
AGE/AGT	41	0	1	3	0	45	6
ALE/ALT	0	0	0	1	0	1	0
APP	19	70	86	72	46	293	41
BCE/BCT	1	1	0	1	0	3	0
BGE/BGT	13	0	0	0	1	14	2
BLB	2	2	0	0	0	4	1
BRS	0	0	1	0	0	1	0
CBP	0	0	0	1	0	1	0
CBS	0	0	0	1	0	1	0
CGE/CGT	1	2	8	3	2	16	2
CLE	0	0	0	0	1	1	0
COG/COS	11	0	0	0	7	18	3
GIE	2	0	0	0	0	2	0
GPF	2	0	0	4	3	9	1
GPV	2	3	0	2	5	12	2
GRE/GRT	65	3	5	12	10	95	13
HRB	0	1	0	0	0	1	0
IDL	1	0	0	2	0	3	0
LET	0	1	0	0	0	1	0
MIX	7	9	9	5	9	39	6
OAS	0	0	5	1	0	6	1
OAT	1	0	0	0	0	1	0
OTH	3	2	0	7	2	14	2
PAR	1	0	0	0	0	1	0
PCH	1	0	0	0	0	1	0
PEA	0	0	1	0	0	1	0
PEP	0	0	1	0	0	1	0
PGE/PGT	4	1	9	5	12	31	4
PIE/PIT	0	1	0	0	9	10	1
PLE	0	2	1	0	1	4	1
PNT	6	7	20	1	0	34	5
POT	1	2	0	1	0	4	1
PUM	1	1	1	2	0	5	1
RSF	0	1	0	0	0	1	0
RSS	0	1	0	0	0	1	0

Current year crop	2002	2003	2004	2005	2006	Total	%
RYC	0	0	0	1	0	1	0
RYS	0	0	0	0	1	1	0
SAG	1	0	0	0	0	1	0
SOY	0	0	0	0	1	1	0
SQS	0	1	1	0	0	2	0
SQW	0	0	1	0	1	2	0
SSH	0	0	1	0	0	1	0
SUN	0	0	0	0	1	1	0
SWC	3	2	1	1	0	7	1
TOM	0	1	0	3	0	4	1
TRT	0	0	0	0	1	1	0
TUR	0	0	0	0	1	1	0
Unknown	3	3	0	0	0	6	1
Total	192	117	152	132	114	707	100

Note: See Appendix for Cornell crop codes.

4. Soil Types

4.1 Homeowner Samples

Soil types (soil management groups) for homeowner samples:

	2002	2003	2004	2005	2006	Total	%
SMG 1 (clayey)	0	0	0	0	0	0	0
SMG 2 (silty)	5	7	9	9	10	40	19
SMG 3 (silt loam)	11	7	16	8	19	61	29
SMG 4 (sandy loam)	5	4	18	5	40	72	35
SMG 5 (sandy)	3	5	9	5	12	34	16
SMG 6 (mucky)	0	0	0	0	0	0	0
Total	24	23	52	27	81	207	100

photo by M. Fargione

4.2 Commercial Samples

Soil series for commercial samples:

Name	SMG	2002	2003	2004	2005	2006	Total	%
Allard	3	0	1	0	0	0	1	0
Arnot	3	2	0	1	0	0	3	0
Atherton	3	0	1	2	0	2	5	1
Basher	3	0	0	2	0	0	2	0
Bath	3	24	17	25	29	31	126	18
Bernardston	4	0	0	0	3	0	3	0
Cambridge	3	4	0	0	0	3	7	1
Canadaigua	3	0	3	0	0	3	6	1
Castile	4	0	0	0	0	1	1	0
Cayuga	2	1	1	2	0	1	5	1
Chenango	3	4	9	11	4	10	38	5
Chippewa	3	0	1	0	0	0	1	0
Churchville	2	4	1	2	0	8	15	2
Erie	3	0	1	1	1	0	3	0
Georgia	4	0	1	0	0	0	1	0
Hamlin	2	1	0	0	1	0	2	0
Haven	4	0	0	1	2	0	3	0
Hoosic	4	4	13	9	9	11	46	7
Hudson	2	0	6	0	4	0	10	1
Joliet	4	0	1	0	0	0	1	0
Kingsbury	1	0	0	0	4	0	4	1
Lackawanna	3	1	0	11	2	0	14	2
Lordstown	3	2	3	0	0	0	5	1
Lyons	2	0	0	3	2	1	6	1
Mardin	3	13	33	32	35	14	127	18
Massena	4	0	0	0	2	0	2	0
Middlebury	3	0	3	1	0	1	5	1
Morris	3	1	0	0	0	0	1	0
Nassau	4	0	5	0	0	1	6	1
Odessa	2	0	0	0	0	1	1	0
Oquaga	3	3	0	0	1	0	4	1
Pittsfield	4	0	3	0	0	0	3	0
Plainfield	5	2	0	1	0	0	3	0
Pompton	4	0	1	4	1	0	6	1
Raynham	3	1	0	1	0	0	2	0
Red Hook	4	2	0	0	0	2	4	1

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Name	SMG	2002	2003	2004	2005	2006	Total	%
Rhinebeck	2	0	0	8	0	0	8	1
Riverhead	4	4	1	2	2	0	9	1
Schoharie	1	1	0	2	0	0	3	0
Scio	3	0	1	0	1	0	2	0
Stockbridge	3	0	0	0	1	5	6	1
Teel	2	1	0	0	1	0	2	0
Tioga	3	1	0	0	0	0	1	0
Tunkhannock	3	0	2	4	0	0	6	1
Unadilla	3	2	0	1	1	0	4	1
Valois	3	0	0	6	0	0	6	1
Volusia	3	5	5	5	5	9	29	4
Wellsboro	3	107	0	9	2	2	120	17
Williamson	4	0	1	0	2	1	4	1
Unknown	-	2	3	6	17	7	35	5
Total	-	192	117	152	132	114	707	100

5. Organic Matter

5.1 Homeowner Samples

Organic matter (loss-on-ignition method) in homeowner samples (number):

	<1	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	>6.9	Total
2002	1	4	2	9	3	3	0	2	24
2003	1	3	4	8	3	2	0	2	23
2004	2	3	16	13	7	3	0	8	52
2005	2	5	7	3	4	3	1	2	27
2006	6	8	11	9	8	17	14	8	81
Total	12	23	40	42	25	28	15	22	207

	2002	2003	2004	2005	2006
Lowest:	0.5	0.9	0.1	0.5	0.2
Highest:	24.0	16.7	15.9	13.9	9.9
Mean:	4.4	4.1	4.3	3.7	4.4
Median:	3.3	3.6	3.3	2.9	4.6

Organic matter in homeowner samples (% of total number of samples):

	<1	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	>6.9	Total
2002	4	17	8	38	13	13	0	8	100
2003	4	13	17	35	13	9	0	9	100
2004	4	6	31	25	13	6	0	15	100
2005	7	19	26	11	15	11	4	7	100
2006	7	10	14	11	10	21	17	10	100
Total	6	11	19	20	12	14	7	11	100

5.2 Commercial Samples

Organic matter (loss-on-ignition method) in commercial samples (number):

	<1	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	>6.9	Total
2002	0	4	30	27	33	50	30	18	192
2003	0	16	60	17	13	5	2	4	117
2004	4	23	59	20	8	15	18	5	152
2005	0	10	59	46	11	4	2	0	132
2006	2	13	49	23	12	6	6	3	114
Total	6	66	257	133	77	80	58	30	707

	2002	2003	2004	2005	2006
Lowest:	1.1	1.1	0.5	1.0	0.7
Highest:	10.9	30.0	8.1	6.9	26.8
Mean:	4.9	3.6	3.4	3.1	3.4
Median:	5.0	2.6	2.8	2.9	2.8

Organic matter in commercial samples (% of total number of samples):

	<1	1.0-1.9	2.0-2.9	3.0-3.9	4.0-4.9	5.0-5.9	6.0-6.9	>6.9	Total
2002	0	2	16	14	17	26	16	9	100
2003	0	14	51	15	11	4	2	3	100
2004	3	15	39	13	5	10	12	3	100
2005	0	8	45	35	8	3	2	0	100
2006	2	11	43	20	11	5	5	3	100
Total	1	9	36	19	11	11	8	4	100

6. pH

6.1 Homeowner Samples

pH of homeowner samples (numbers):

	<4.5	4.5-4.9	5.0-5.4	5.5-5.9	6.0-6.4	6.5-6.9	7.0-7.4	7.5-7.9	8.0-8.4	>8.4	Total
2002	0	2	1	2	11	3	4	1	0	0	24
2003	0	1	4	2	4	4	7	1	0	0	23
2004	0	4	5	11	10	10	9	3	0	0	52
2005	0	0	0	4	4	9	8	2	0	0	27
2006	0	1	6	25	17	14	7	9	2	0	81
Total	0	8	16	44	46	40	35	16	2	0	207

	2002	2003	2004	2005	2006
Lowest:	4.8	4.8	4.6	5.6	4.6
Highest:	7.7	7.7	7.7	7.6	8.0
Mean:	-	-	-	-	-
Median:	6.2	6.5	6.2	6.7	6.1

pH of homeowner of samples (% of total number of samples):

	<4.5	4.5-4.9	5.0-5.4	5.5-5.9	6.0-6.4	6.5-6.9	7.0-7.4	7.5-7.9	8.0-8.4	>8.4	Total
2002	0	8	4	8	46	13	17	4	0	0	100
2003	0	4	17	9	17	17	30	4	0	0	100
2004	0	8	10	21	19	19	17	6	0	0	100
2005	0	0	0	15	15	33	30	7	0	0	100
2006	0	1	7	31	21	17	9	11	2	0	100
Total	0	4	8	21	22	19	17	8	1	0	100

6.2 Commercial Samples

pH of commercial samples (number):

	<4.5	4.5-4.9	5.0-5.4	5.5-5.9	6.0-6.4	6.5-6.9	7.0-7.4	7.5-7.9	8.0-8.4	>8.4	Total
2002	1	4	29	62	33	23	28	12	0	0	192
2003	0	0	6	26	36	32	14	2	1	0	117
2004	0	3	11	29	59	35	15	0	0	0	152
2005	1	4	11	24	34	31	21	6	0	0	132
2006	0	2	9	42	25	28	7	0	1	0	114
Total	2	13	66	183	187	149	85	20	2	0	707

	2002	2003	2004	2005	2006
Lowest:	4.2	5.0	4.5	4.3	4.7
Highest:	7.8	8.3	7.4	7.8	8.0
Mean:	-	-	-	-	-
Median:	5.9	6.4	6.2	6.4	6.0

pH of commercial samples (% of total number of samples):

	<4.5	4.5-4.9	5.0-5.4	5.5-5.9	6.0-6.4	6.5-6.9	7.0-7.4	7.5-7.9	8.0-8.4	>8.4	Total
2002	1	2	15	32	17	12	15	6	0	0	100
2003	0	0	5	22	31	27	12	2	1	0	100
2004	0	2	7	19	39	23	10	0	0	0	100
2005	1	3	8	18	26	23	16	5	0	0	100
2006	0	2	8	37	22	25	6	0	1	0	100
Total	0	2	9	26	26	21	12	3	0	0	100

7. Phosphorus

7.1 Homeowner Samples

Phosphorus (lbs/acre Morgan P) in homeowner samples (numbers):

	<1	1-3	4-8	9-39	40-60	61-80	81-100	101-150	151-200	>200	Total
	VL	L	M	H	VH	VH	VH	VH	VH	VH	
2002	0	4	7	7	1	1	0	0	2	2	24
2003	0	7	0	3	4	2	1	3	0	3	23
2004	0	6	8	12	6	3	4	3	1	9	52
2005	0	4	2	11	1	2	1	0	1	5	27
2006	0	7	11	39	4	5	4	4	3	4	81
Total	0	28	28	72	16	13	10	10	7	23	207

VL = very low, L = low, M = medium, H = high, VH = very high.

	2002	2003	2004	2005	2006
Lowest:	1	1	1	1	1
Highest:	821	461	745	541	516
Mean:	71	93	104	99	58
Median:	13	45	41	27	23

Phosphorus in homeowner samples (% of total number of samples):

	<1	1-3	4-8	9-39	40-60	61-80	81-100	101-150	151-200	>200	Total
	VL	L	M	H	VH	VH	VH	VH	VH	VH	
2002	0	17	29	29	4	4	0	0	8	8	100
2003	0	30	0	13	17	9	4	13	0	13	100
2004	0	12	15	23	12	6	8	6	2	17	100
2005	0	15	7	41	4	7	4	0	4	19	100
2006	0	9	14	48	5	6	5	5	4	5	100
Total	0	14	14	35	8	6	5	5	3	11	100

VL = very low, L = low, M = medium, H = high, VH = very high.

7.2 Commercial Samples

Phosphorus (lbs P/acre Morgan extraction) for commercial samples (number):

	<1	1-3	4-8	9-39	40-60	61-80	81-100	101-150	151-200	>200	Total
	VL	L	M	H	VH	VH	VH	VH	VH	VH	
2002	0	79	33	62	14	2	1	0	1	0	192
2003	0	43	41	20	5	2	0	1	1	4	117
2004	0	44	52	46	4	0	2	0	1	3	152
2005	0	39	31	46	6	2	1	4	1	2	132
2006	0	24	29	51	3	2	0	1	3	1	114
Total	0	229	186	225	32	8	4	6	7	10	707

VL = very low, L = low, M = medium, H = high, VH = very high.

	2002	2003	2004	2005	2006
Lowest:	1	1	1	1	1
Highest:	153	837	562	373	203
Mean:	14	34	22	22	18
Median:	6	5	7	7	9

Phosphorus in commercial samples (% of total number of samples):

	<1	1-3	4-8	9-39	40-60	61-80	81-100	101-150	151-200	>200	Total
	VL	L	M	H	VH	VH	VH	VH	VH	VH	
2002	0	41	17	32	7	1	1	0	1	0	100
2003	0	37	35	17	4	2	0	1	1	3	100
2004	0	29	34	30	3	0	1	0	1	2	100
2005	0	30	23	35	5	2	1	3	1	2	100
2006	0	21	25	45	3	2	0	1	3	1	100
Total	0	32	26	32	5	1	1	1	1	1	100

VL = very low, L = low, M = medium, H = high, VH = very high.

8. Potassium

8.1 Homeowner Samples

Potassium (lbs K/acre Morgan extraction) in homeowner samples (number):

Soil Management Group 2					
	Very Low	Low	Medium	High	Very High	
	<40	40-69	70-99	100-164	>164	Total
2002	0	1	0	3	1	5
2003	0	2	0	3	2	7
2004	0	0	1	2	6	9
2005	0	0	2	2	5	9
2006	0	0	3	5	2	10
Total (#)	0	3	6	15	16	40
Total (%)	0	8	15	38	40	100

Soil Management Group 3					
	<45	45-79	80-119	120-199	>199	Total
2002	0	4	3	2	2	11
2003	0	0	0	0	7	7
2004	0	2	3	2	9	16
2005	0	1	0	2	5	8
2006	0	1	1	6	11	19
Total (#)	0	8	7	12	34	61
Total (%)	0	13	11	20	56	100

Soil Management Group 4					
	<55	55-99	100-149	150-239	>239	Total
2002	0	0	1	0	4	5
2003	0	1	1	1	1	4
2004	0	4	3	6	5	18
2005	0	0	2	1	2	5
2006	1	3	2	2	32	40
Total (#)	1	8	9	10	44	72
Total (%)	1	11	13	14	61	100

Soil Management Group 5					
	<60	60-114	115-164	165-269	>269	Total
2002	0	1	1	1	0	3
2003	1	0	1	3	0	5
2004	1	1	0	4	3	9
2005	2	2	0	0	1	5
2006	1	4	1	5	1	12
Total (#)	5	8	3	13	5	34
Total (%)	15	24	9	38	15	100

Potassium classification summary for homeowners:

Summary (#)	Very Low	Low	Medium	High	Very High	Total
2002	0	6	5	6	7	24
2003	1	3	2	7	10	23
2004	1	7	7	14	23	52
2005	2	3	4	5	13	27
2006	2	8	7	18	46	81
Grand Total	6	27	25	50	99	207

Summary (%)	Very Low	Low	Medium	High	Very High	Total
2002	0	25	21	25	29	100
2003	4	13	9	30	43	100
2004	2	13	13	27	44	100
2005	7	11	15	19	48	100
2006	2	10	9	22	57	100
Grand Total	3	13	12	24	48	100

	2002	2003	2004	2005	2006
Lowest:	58	48	50	56	41
Highest:	483	2639	2291	1230	1137
Mean:	189	351	316	256	411
Median:	124	180	214	183	275

Rao, R., M. Fargione, Q.M. Ketterings, and H. Krol (2007). Ulster Soil Sample Survey (2002-2006). CSS Extension Bulletin E07-26. 34 pages.

8.2 Commercial Samples

Potassium (lbs K/acre Morgan extraction) in commercial samples (number):

Soil Management Group 1					
	<35	35-64	65-94	95-149	>149	Total
	Very Low	Low	Medium	High	Very High	
2002	0	0	0	1	0	1
2003	0	0	0	0	0	0
2004	0	0	0	0	2	2
2005	0	0	1	2	1	4
2006	0	0	0	0	0	0
Total (#)	0	0	1	3	3	7
Total (%)	0	0	14	43	43	100

Soil Management Group 2					
	<40	40-69	70-99	100-164	>164	Total
	Very Low	Low	Medium	High	Very High	
2002	0	0	3	2	2	7
2003	0	0	1	6	1	8
2004	0	6	1	0	8	15
2005	0	0	2	3	3	8
2006	0	2	2	4	3	11
Total (#)	0	8	9	15	17	49
Total (%)	0	16	18	31	35	100

Soil Management Group 3					
	<45	45-79	80-119	120-199	>199	Total
	Very Low	Low	Medium	High	Very High	
2002	1	12	41	57	59	170
2003	1	7	15	28	29	80
2004	4	4	14	30	60	112
2005	2	1	3	24	52	82
2006	3	6	5	21	45	80
Total (#)	11	30	78	160	245	524
Total (%)	2	6	15	31	47	100

Rao, R., M. Fargione, Q.M. Ketterings, and H. Krol (2007). Ulster Soil Sample Survey (2002-2006). CSS Extension Bulletin E07-26. 34 pages.

Soil Management Group 4					
	<55	55-99	100-149	150-239	>239	Total
	Very Low	Low	Medium	High	Very High	
2002	1	3	1	2	3	10
2003	0	2	4	9	11	26
2004	0	2	2	9	3	16
2005	0	6	1	2	12	21
2006	0	0	5	4	7	16
Total (#)	1	13	13	26	36	89
Total (%)	1	15	15	29	40	100

Soil Management Group 5					
	<60	60-114	115-164	165-269	>269	Total
	Very Low	Low	Medium	High	Very High	
2002	0	1	1	0	0	2
2003	0	0	0	0	0	0
2004	0	0	0	1	0	1
2005	0	0	0	0	0	0
2006	0	0	0	0	0	0
Total (#)	0	1	1	1	0	3
Total (%)	0	33	33	33	0	100

Soil Management Group 6					
	<60	60-114	115-164	165-269	>269	Total
	Very Low	Low	Medium	High	Very High	
2002	0	0	0	0	0	0
2003	0	0	0	0	0	0
2004	0	0	0	0	0	0
2005	0	0	0	0	0	0
2006	0	0	0	0	0	0
Total (#)	0	0	0	0	0	0
Total (%)	-	-	-	-	-	-

Potassium classification summary for commercial samples.

Summary (#)	Very Low	Low	Medium	High	Very High	Un-known	Total
2002	2	16	46	62	64	2	192
2003	1	9	20	43	41	3	117
2004	4	12	17	40	73	6	152
2005	2	7	7	31	68	17	132
2006	3	8	12	29	55	7	114
Grand Total	12	52	102	205	301	35	707

Summary (%)	Very Low	Low	Medium	High	Very High	Un-known	Total
2002	1	8	24	32	33	1	100
2003	1	8	17	37	35	3	100
2004	3	8	11	26	48	4	100
2005	2	5	5	23	52	13	100
2006	3	7	11	25	48	6	100
Grand Total	2	7	14	29	43	5	100

	2002	2003	2004	2005	2006
Lowest:	38	35	23	29	28
Highest:	916	13303	1750	890	888
Mean:	213	514	238	238	216
Median:	155	175	209	207	185

9. Magnesium

9.1 Homeowner Samples

Magnesium (lbs Mg/acre Morgan extraction) in homeowner samples (numbers):

	<20	20-65	66-100	101-199	>199	Total
	Very Low	Low	Medium	High	Very High	
2002	0	1	1	11	11	24
2003	0	1	2	7	13	23
2004	0	6	6	14	26	52
2005	0	1	2	8	16	27
2006	0	3	4	11	63	81
Total	0	12	15	51	129	207

	2002	2003	2004	2005	2006
Lowest:	48	47	38	40	24
Highest:	1557	2748	2155	920	746
Mean:	288	369	361	339	383
Median:	191	211	195	263	427

Magnesium in homeowner samples (% of total number of samples):

	<20	20-65	66-100	101-199	>199	Total
	Very Low	Low	Medium	High	Very High	
2002	0	4	4	46	46	100
2003	0	4	9	30	57	100
2004	0	12	12	27	50	100
2005	0	4	7	30	59	100
2006	0	4	5	14	78	100
Total	0	6	7	25	62	100

9.2 Commercial Samples

Magnesium (lbs Mg/acre Morgan extraction) in commercial samples (number):

	<20	20-65	66-100	101-199	>199	Total
	Very Low	Low	Medium	High	Very High	
2002	0	6	24	59	103	192
2003	0	1	12	35	69	117
2004	0	2	8	61	81	152
2005	0	4	6	35	87	132
2006	2	12	7	30	63	114
Total	2	25	57	220	403	707

	2002	2003	2004	2005	2006
Lowest:	35	44	53	22	3
Highest:	887	4322	1548	649	1020
Mean:	261	356	261	285	261
Median:	229	230	212	252	209

Magnesium in commercial samples (% of total number of samples):

	<20	20-65	66-100	101-199	>199	Total
	Very Low	Low	Medium	High	Very High	
2002	0	3	13	31	54	100
2003	0	1	10	30	59	100
2004	0	1	5	40	53	100
2005	0	3	5	27	66	100
2006	2	11	6	26	55	100
Total	0	4	8	31	57	100

10. Iron

10.1 Homeowner Samples

Iron (lbs Fe/acre Morgan extraction) in homeowner samples:

Total number of samples:

	0-49	>49	Total
	Normal	Excessive	
2002	23	1	24
2003	21	2	23
2004	49	3	52
2005	27	0	27
2006	78	3	81
Total	198	9	207

Percentages:

	0-49	>49	Total
	Normal	Excessive	
2002	96	4	100
2003	91	9	100
2004	94	6	100
2005	100	0	100
2006	96	4	100
Total	96	4	100

	2002	2003	2004	2005	2006
Lowest:	2	2	1	2	2
Highest:	112	82	81	37	122
Mean:	12	16	15	11	12
Median:	6	8	11	8	6

10.2 Commercial Samples

Iron (lbs Fe/acre Morgan extraction) in commercial samples:

Total number of samples:

	0-49	>49	Total
	Normal	Excessive	
2002	180	12	192
2003	115	2	117
2004	146	6	152
2005	125	7	132
2006	111	3	114
Total	667	30	707

Percentages:

	0-49	>49	Total
	Normal	Excessive	
94	6	100
98	2	100
96	4	100
95	5	100
97	3	100
96	4	100

	2002	2003	2004	2005	2006
Lowest:	1	1	1	1	1
Highest:	315	257	208	332	104
Mean:	18	12	14	16	12
Median:	11	8	7	7	8

11. Manganese

11.1 Homeowner Samples

Manganese (lbs Mn/acre Morgan extraction) in homeowner samples:

Total number of samples:

	0-99	>99	Total
	Normal	Excessive	
2002	23	1	24
2003	20	3	23
2004	46	6	52
2005	26	1	27
2006	76	5	81
Total	191	16	207

Percentages:

	0-99	>99	Total
	Normal	Excessive	
96	4	100
87	13	100
88	12	100
96	4	100
94	6	100
92	8	100

	2002	2003	2004	2005	2006
Lowest:	14	18	15	10	6
Highest:	140	135	175	460	226
Mean:	40	55	54	56	50
Median:	31	43	44	37	45

11.2 Commercial Samples

Manganese (lbs Mn/acre Morgan extraction) in commercial samples:

Total number of samples:

	0-99	>99	Total
	Normal	Excessive	
2002	182	10	192
2003	116	1	117
2004	147	5	152
2005	128	4	132
2006	114	0	114
Total	687	20	707

Percentages:

	0-99	>99	Total
	Normal	Excessive	
95	5	100
99	1	100
97	3	100
97	3	100
100	0	100
97	3	100

	2002	2003	2004	2005	2006
Lowest:	14	10	6	8	7
Highest:	154	287	451	1381	98
Mean:	44	35	39	49	41
Median:	37	29	29	32	37

12. Zinc

12.1 Homeowner Samples

Zinc (lbs Zn/acre Morgan extraction) in homeowner samples:

Total number of samples:

	<0.5	0.5-1.0	>1	Total
	Low	Medium	High	
2002	1	3	20	24
2003	0	3	20	23
2004	1	5	46	52
2005	2	3	22	27
2006	6	6	69	81
Total	10	20	177	207

Percentages:

	<0.5	0.5-1.0	>1	Total
	Low	Medium	High	
4	13	83	100
0	13	87	100
2	10	88	100
7	11	81	100
7	7	85	100
5	10	85	100

	2002	2003	2004	2005	2006
Lowest:	0.4	0.5	0.1	0.1	0.1
Highest:	18.3	74.9	69.3	105.7	168.5
Mean:	5.3	10.1	10.0	10.7	7.2
Median:	3.3	6.6	4.7	5.0	3.5

12.2 Commercial Samples

Zinc (lbs Zn/acre Morgan extraction) in commercial samples:

Total number of samples:

	<0.5	0.5-1.0	>1	Total
	Low	Medium	High	
2002	2	23	167	192
2003	7	35	75	117
2004	7	25	120	152
2005	6	16	110	132
2006	18	20	76	114
Total	40	119	548	707

Percentages:

	<0.5	0.5-1.0	>1	Total
	Low	Medium	High	
1	12	87	100	
6	30	64	100	
5	16	79	100	
5	12	83	100	
16	18	67	100	
6	17	78	100	

	2002	2003	2004	2005	2006
Lowest:	0.2	0.1	0.1	0.1	0.1
Highest:	13.3	69.5	31.9	161.6	20.3
Mean:	2.6	3.1	4.2	4.4	3.7
Median:	2.0	1.5	1.9	2.0	2.1

Rao, R., M. Fargione, Q.M. Ketterings, and H. Krol (2007). Ulster Soil Sample Survey (2002-2006). CSS Extension Bulletin E07-26. 34 pages.

Appendix: Cornell Crop Codes

Crop codes used in the Cornell Nutrient Analysis Laboratory.

Crop Code	Crop Description
	Alfalfa
ABE	Alfalfa trefoil grass, Establishment
ABT	Alfalfa trefoil grass, Established
AGE	Alfalfa grass, Establishment
AGT	Alfalfa grass, Established
ALE	Alfalfa, Establishment
ALT	Alfalfa, Established
	Birdsfoot
BCE	Birdsfoot trefoil clover, Establishment
BCT	Birdsfoot trefoil clover, Established
BGE	Birdsfoot trefoil grass, Establishment
BGT	Birdsfoot trefoil grass, Established
BSE	Birdsfoot trefoil seed, Establishment
BST	Birdsfoot trefoil seed, Established
BTE	Birdsfoot trefoil, Establishment
BTT	Birdsfoot trefoil, Established
	Barley
BSP	Spring barley
BSS	Spring barley with legumes
BUK	Buckwheat
BWI	Winter barley
BWS	Winter barley with legumes
	Clover
CGE	Clover grass, Establishment
CGT	Clover grass, Established
CLE	Clover, Establishment
CLT	Clover, Established
CSE	Clover seed production, Establishment
CST	Clover seed production, Established

Rao, R., M. Fargione, Q.M. Ketterings, and H. Krol (2007). Ulster Soil Sample Survey (2002-2006). CSS Extension Bulletin E07-26. 34 pages.

Crop Code	Crop Description
	Corn
COG	Corn grain
COS	Corn silage
	Grasses, pastures, covercrops
CVE	Crownvetch, Establishment
CVT	Crownvetch, Established
GIE	Grasses intensively managed, Establishment
GIT	Grasses intensively managed, Established
GRE	Grasses, Establishment
GRT	Grasses, Established
PGE	Pasture, Establishment
PGT	Pasture improved grasses, Established
PIE	Pasture intensively grazed, Establishment
PIT	Pasture intensively grazed, Established
PLE	Pasture with legumes, Establishment
PLT	Pasture with legumes, Established
PNT	Pasture native grasses
RYC	Rye cover crop
RYS	Rye seed production
TRP	Triticale peas
	Small grains
MIL	Millet
OAS	Oats seeded with legume
OAT	Oats
SOF	Sorghum forage
SOG	Sorghum grain
SOY	Soybeans
SSH	Sorghum sudan hybrid
SUD	Sudangrass
WHS	Wheat with legume
WHT	Wheat
	Others
ALG	Azalea
APP	Apples
ATF	Athletic field

Crop Code	Crop Description
BDR/DND	Beans-dry
BLU	Blueberries
CEM	Cemetery
FAR	Fairway
FLA	Flowering annuals
GRA	Grapes
GEN	Green
HRB	Herbs
IDL	Idle land
LAW	Lawn
MIX/MVG	Mixed vegetables
PER	Perennials
PRK	Park
POT/PTO	Potatoes
PUM	Pumpkins
ROD	Roadside
ROS	Roses
RSF	Raspberries, Fall
RSP	Raspberries (homeowners)
RSS	Raspberries, Summer
SAG	Ornamentals adapted to pH 6.0 to 7.5
SQW	Squash, Winter
STE	Strawberries, Ever
STR	Strawberries (homeowners)
STS	Strawberries, Spring
SUN	Sunflowers
SWC	Sweet corn
TOM	Tomatoes
TRE	Christmas trees, Establishment
TRF	Turf
TRT	Christmas trees, Topdressing