

Ketterings, Q.M., H. Krol, W.S. Reid and D. Dewing (2003). Delaware County Soil Sample Survey 1995-2001. CSS Extension Bulletin E03-10. 39 pages.

Soil Sample Survey

Delaware Co.

Samples analyzed by CNAL in 1995-2001



Farming in Delaware County, New York.

Summary compiled by

Quirine M. Ketterings, Hettie Krol, W. Shaw Reid and Dale Dewing



Nutrient Management Spear Program: <http://nmsp.css.cornell.edu/>

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1. General Survey Summary

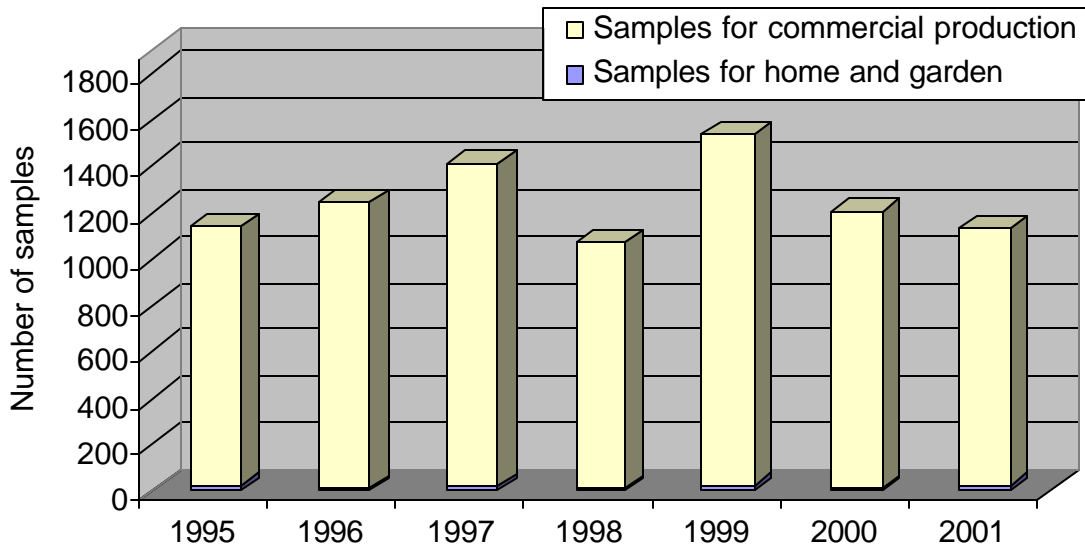
Delaware County is geographically one of the larger counties in New York State. Delaware County covers 939,900 acres, an area larger than that of Rhode Island. It ranges from valley bottoms of 1000 feet above sea level to peaks higher than 3000 feet above sea level. Both branches of the Delaware River rise in the northeast corner - the West Branch in Lake Utsayantha, Stamford, and the East Branch in Grand Gorge - and traverse the County before joining forces in Hancock. The Susquehanna River flows along the northwest edge of the county.

Farming in Delaware County is dominated by small and mid-sized dairy farms, intermixed with small livestock farms. The crops grown are used on the farm as livestock feed. Because of steep slopes and high elevation, many of the areas of the county are best suited for permanently vegetated forage crops like grass hay and pasture these crops occupy the majority of acreage. Corn – alfalfa rotations are grown on alluvial valley soils where the land has low soil erosion potential resulting in outstanding yield.

Much of Delaware County is located within the watershed of drinking water reservoirs supplying nine million consumers in and around New York City. The Watershed Agricultural Council (WAC) administers voluntary water quality protection programs in farming and forestry with a goal of balancing economic viability, pollution prevention, and public health concerns. WAC's programs focus on Whole Farm Planning, adoption of best management practices, the promotion of good forest stewardship by landowners and forestry professionals, and the purchase of development rights on farms through conservation easements. These programs are carried out through partnerships with the New York City Department of Environmental Protection, Cornell Cooperative Extension, USDA NRCS, Soil and Water Conservation Districts, USDA Forest Service and others.

Nutrient management planning is an essential Best Management Practice (BMP) in all Whole Farm Plans developed by WAC. A Nutrient Management Plan (NMP) is designed to manage the amount, source, placement, form and timing of the application of nutrients from fertilizer, manure, and other organic sources to assure optimum crop growth. A NMP minimizes the risk of pollution of surface water from excess nutrients while improving or maintaining the physical, chemical, and biological condition of the soil.

To support its nutrient management planning efforts WAC seeks to maintain up to date soil fertility information on all participating farms by soil sampling all fields every three years. This survey summarizes the soil test results from Delaware County soil samples submitted for analyses to the Cornell Nutrient Analysis Laboratory (CNAL) during 1995-2001. Many of the samples represented in this summary were collected as part of the WAC nutrient management planning efforts. The total number of samples analyzed in these years was 8735. Of these, 8611 samples (99%) were submitted to obtain fertilizer recommendations for commercial production while 124 samples (1%) were submitted as home and garden samples.



Homeowners		Commercial		Total
1995	24	1995	1114	1138
1996	12	1996	1231	1243
1997	21	1997	1392	1413
1998	9	1998	1057	1066
1999	23	1999	1517	1540
2000	11	2000	1194	1205
<u>2001</u>	<u>24</u>	<u>2001</u>	<u>1106</u>	<u>1130</u>
Total	124	Total	8611	8735

Most of the home and garden soil samples submitted during the period 1995-2001 were submitted to request fertilizer recommendations for home garden vegetable production (47%). People submitting samples for commercial production requested fertilizer recommendations for hay production (49%), alfalfa, alfalfa/grass or alfalfa/trefoil mixtures (18%), corn silage or grain (17%), or pasture (12%), while a few producers were planning on growing other crops including clover/grass mixtures, small grains and vegetables. Home and garden samples in Delaware County were mostly sandy loam soils belonging to soil management group 4 (64%). Fourteen percent belonged to soil management group 2. Group 3 was represented by 17% of all samples and 6% were classified as sandy (soil management group 5). The table below gives descriptions of each of the soil management groups.

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 for commercial production, 94% belonged to soil management group 3. One percent was from soil management group 4. None of the samples belonged to either group 1 or group 5 while 3% were classified group 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 from recent alluvium). The six most common soil series, all belonging to soil management group 3, were Willowemoc (21%), Lewbeach (13%), Tunkhannoc (10%), Barbour (8%), Lackawanna (8%) and Wellsboro (8%). These soils represent 11% (Willowemoc), 10% (Lewbeach), 2% (Tunkhannock), 1% (Barbour), 10% (Lackawanna) and 6% (Wellsboro) of the total 939,900 acres in the county.

Organic matter levels, as measured by loss on ignition, ranged from less than 1% to over 35% with median values ranging from 4.0 to 7.2% organic matter for home and garden samples and values ranging from 5.2 to 6.0% organic matter for samples submitted for commercial production. Thirty six percent of the home and garden samples had between 2 and 5% organic matter with 26% testing between 2 and 2.9% organic matter, 9% between 3.0 and 3.9% organic matter and 16% between 4.0 and 4.9% organic matter. Fifty six percent of the soils submitted for home and garden tested >4.9% in organic matter while 8% had less than 2% organic matter. Of the samples submitted for commercial production, 9% contained between 3 and 4% organic matter, 33% tested between 4.0 and 4.9% while 30% had 5.0-5.9% organic matter. In total, 72% of the samples tested between 4.0 and 6.9% organic matter.

Soil pH in water (1:1 extraction ratio) varied from pH 3.7 to 7.5 with the median for home and garden samples ranging from pH 5.7 to pH 6.8 and for samples submitted for commercial production ranging from pH 5.8 to pH 6.1. Of the home and garden samples, 64% tested between pH 6.0 and 7.4. For the samples submitted for commercial production, this was 46% while 32% tested between pH 5.0 and 5.9

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

Soil test P levels of <1 lbs 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 soils with >39 lbs P/acre are classified as very high. Of the home and garden samples, 10% tested low, 16% tested medium, 31% tested high and 44% tested very high. This meant that 75% tested high or very high in P.

Phosphorus levels for samples for commercial production in Delaware County were similar to the state average (50% tests high or very high in P). Ten percent of the samples tested very high in P. Twenty five percent were low in P, 26% tested medium for P while 38% of the submitted samples were classified as high in soil test P. This means that 48% tested high or very high in P. There were no clear trends in P levels over the 6 years.

Classifications for potassium depend on soil management group. The fine-textured soils of 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 table below 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 low, 115-164 lbs K/acre is medium, 165-269 lbs K/acre is high, while >269 lbs K/acre is classified as very high (see the table below).

Potassium classifications depend on soil test K levels and soil management group.

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

Of the home and garden samples, 11% were classified as very low or low in potassium. Eighteen percent tested medium, 23% high and 48% very high. For samples submitted for commercial production, 2% tested very low in K, 13% tested low, 21% medium, 25% high and 37% were very high in potassium. As with phosphorus, there were no trends over the 6 years of soil sampling.

Soils test very low for magnesium 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 magnesium. 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 30 to almost 4000 lbs Mg/acre (Morgan extraction). There were no samples that tested very low in Mg. Most soils tested high or very high for Mg (92% of the homeowner soils and 97% of the soils of the commercial growers). No more than 8% of the homeowner soils and 4% of the commercial growers' soils tested low or medium in Mg. Thus, magnesium deficiency is not likely to occur in Delaware County provided the soil pH is maintained in the desirable range.

Soils with more than 50 lbs Morgan extractable Fe per acre are considered excessive in Fe. Anything lower than 50 lbs Fe/acre is considered normal. Iron levels fell for 92-94% in the normal range with 6% of the home and garden samples and 8% of the samples for commercial production testing excessive for Fe. Similarly, most soils (88-97%) for both groups tested normal for manganese. Soils with more than 100 lbs Morgan extractable Mn per acre are classified excessive in Mn. Anything less than 100 lbs Mn per acre is considered normal. Soils with less than 0.5 lb Zinc 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 home and garden samples, 91% tested high for zinc while 6% tested medium. Of the samples for commercial production, 3% tested low, 19% medium, and 78% were high in zinc.

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 2.

Reference

- Morgan, M.F. 1941. Chemical soil diagnosis by the universal soil testing system. Connecticut Agricultural Experimental Station. Bulletin 450.

2. Cropping Systems

2.1 Samples for Home and Garden

Crops for which recommendations are requested by homeowners:

	1995	1996	1997	1998	1999	2000	2001	Total	%
ALG	1	0	0	0	0	0	0	1	1
ATF	0	0	1	1	0	2	0	4	3
BLU	0	0	0	0	0	0	1	1	1
FLA	2	1	1	0	1	0	0	5	4
GEN	9	0	0	0	0	0	0	9	7
HRB	0	1	0	0	0	0	0	1	1
LAW	0	0	1	0	4	0	4	9	7
MVG	4	9	14	5	11	7	8	58	47
OTH	1	0	1	0	0	0	3	5	4
PER	6	0	1	3	0	0	4	14	11
PTO	0	0	0	0	1	0	0	1	1
ROU	0	0	0	0	4	0	0	4	3
SAG	1	0	0	0	2	1	2	6	5
TRF	0	1	2	0	0	1	1	5	4
Unknown	0	0	0	0	0	0	1	1	1
Total	24	12	21	9	23	11	24	124	100

Notes:

See Appendix for Cornell crop codes.

2.2 Samples for Commercial Production

Crops for which recommendations are requested for commercial production:

Current year crop	1995	1996	1997	1998	1999	2000	2001	Total	%
ABE/ABT	24	11	1	12	2	0	0	50	1
AGE/AGT	139	185	219	152	227	196	99	1217	14
ALE/ALT	76	67	21	48	9	3	2	226	3
APP	0	0	1	0	1	4	0	6	0
ASP	0	0	0	0	1	0	0	1	0
BCE/BCT	16	0	0	1	0	2	3	22	0
BGE/BGT	4	2	1	4	3	0	0	14	0
BLB	0	0	5	2	2	1	0	10	0
BND	0	0	0	0	1	0	0	1	0
BSP	0	0	0	3	1	0	0	4	0
BUK	0	0	0	0	0	0	1	1	0
BWI	0	0	0	0	0	1	0	1	0
CGE/CGT	14	4	5	6	19	36	21	105	1
CLE/CLT	3	8	5	9	1	6	2	34	0
COG/COS	200	225	207	248	253	174	136	1443	17
CSE/CST	0	3	1	0	0	0	0	4	0
GIE/GIT	3	1	3	4	1	35	11	58	1
GRE/GRT	487	553	678	404	754	618	628	4122	48
IDL	1	7	20	5	16	1	3	53	1
LET	0	0	0	1	0	0	0	1	0
MIL	0	0	0	0	0	2	0	2	0
MIX	4	1	5	6	14	2	6	38	0
MML	0	0	1	0	1	0	0	2	0
OAS	0	0	0	0	2	0	0	2	0
OAT	1	0	0	0	0	0	1	2	0
ONS	0	0	0	0	1	0	0	1	0
OTH	10	1	4	9	4	2	1	31	0
PAR	0	0	0	0	0	3	0	3	0
PGE/PGT	2	2	2	3	4	4	1	18	0
PIE/PIT	18	9	18	8	24	21	0	98	1
PLE/PLT	6	1	1	1	3	2	0	14	0
PNE/PNT	88	142	168	119	142	72	176	907	11
POP	0	0	0	0	0	1	0	1	0
POT	1	0	2	2	9	1	1	16	0
PUM	0	1	2	1	0	1	1	6	0

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Current year crop	1995	1996	1997	1998	1999	2000	2001	Total	%
RSS	0	0	0	0	2	0	0	2	0
RYC	1	0	0	0	2	0	0	3	0
SOY	0	0	0	0	2	0	0	2	0
SQS	0	0	0	0	2	0	2	4	0
SQW	0	0	0	0	0	0	1	1	0
SSH	0	0	0	1	0	0	1	2	0
STE	0	0	3	1	0	0	0	4	0
STS	0	0	0	0	6	0	0	6	0
SUD	1	0	0	0	0	0	0	1	0
SUN	0	0	0	1	0	0	0	1	0
SWC	2	1	7	3	3	0	1	17	00
TOM	0	0	1	0	0	0	0	1	0
TRE/TRT	0	3	0	1	2	0	0	6	0
WHT	1	0	1	0	0	0	0	2	0
Unknown	12	4	10	2	3	6	8	45	1
Total	1114	1231	1392	1057	1517	1194	1106	8611	100

Notes:

See Appendix for Cornell crop codes.

3. Soil Types

3.1 Samples for Home and Garden

Soil types (soil management groups) for home and garden samples:

	1995	1996	1997	1998	1999	2000	2001	Total
SMG 1 (clayey)	0	0	0	0	0	0	0	0
SMG 2 (silty)	3	3	0	0	2	4	5	17
SMG 3 (silt loam)	4	2	6	0	1	0	8	21
SMG 4 (sandy loam)	17	7	14	9	16	6	10	79
SMG 5 (sandy)	0	0	1	0	4	1	1	7
SMG 6 (mucky)	0	0	0	0	0	0	0	0
Total	24	12	21	9	23	11	24	124

3.2 Samples for Commercial Production

Soil series for samples submitted for commercial production:

Name	SMG	1995	1996	1997	1998	1999	2000	2001	Total
Arnot	3	0	0	1	0	2	0	0	3
Barbour	3	112	87	86	57	186	88	88	704
Basher	3	33	52	41	23	47	36	24	256
Bath	3	13	5	8	14	5	0	3	48
Castile	4	0	4	0	0	0	3	1	8
Chenengo	3	12	3	3	12	3	2	11	46
Collamer	3	0	0	1	1	0	8	0	10
Deposit	3	0	0	2	6	1	4	2	15
Elka	4	0	20	16	6	11	10	15	78
Halcott	2	2	6	8	6	11	11	8	52
Lackawanna	3	151	96	60	137	90	64	79	677
Lewbath	3	1	11	7	26	19	17	21	102
Lewbeach	3	116	145	245	121	191	166	148	1132
Lordstown	3	30	2	3	3	6	0	3	47
Maplecrest	2	1	29	29	35	51	26	29	200
Mardin	3	49	22	8	48	17	5	11	160
Mongaup	3	4	19	7	5	13	11	5	64
Morris	3	15	24	14	13	24	24	36	150
Norchip	3	0	11	0	0	2	1	2	16
Onteora	3	43	30	36	31	44	32	34	250
Ontusia	3	1	19	3	3	3	3	1	33
Oquaga	3	47	74	23	4	7	7	1	163
Philo	3	0	0	0	4	0	0	1	5
Raypol	3	1	1	0	0	0	1	0	3
Red Hook	4	0	2	1	0	4	7	2	16
Riverhead	4	0	0	0	0	7	0	0	7
Tioga	3	0	0	0	2	1	0	0	3
Torull	3	0	0	1	0	1	0	0	2
Trestle	3	19	30	51	32	8	3	3	146
Tunkhannock	3	102	177	115	109	149	102	77	831
Udorthen	3	0	0	0	0	15	0	0	15
Unadilla	3	6	2	0	2	5	0	19	34
Valois	3	20	7	4	2	3	4	9	49
Vly	3	2	51	102	58	86	92	70	461
Volusia	3	4	2	1	2	2	0	1	12
Wayland	2	0	0	0	0	2	0	0	2

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Name	SMG	1995	1996	1997	1998	1999	2000	2001	Total
Wellsboro	3	112	92	98	79	101	123	65	670
Wenonah	4	0	0	0	3	0	0	1	4
Willdin	3	6	45	41	3	42	22	10	169
Willowemock	3	188	157	363	202	329	291	282	1812
Unknown	-	24	5	14	8	29	31	44	156
Total	-	1114	1231	1392	1057	1517	1194	1106	8611

4. Organic Matter

4.1 Samples for Home and Garden

Number of home and garden samples within each % organic matter range:

	<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
1995	1	1	4	1	4	4	2	7	24
1996	0	0	1	1	1	6	1	2	12
1997	1	0	3	2	3	5	2	5	21
1998	0	0	1	2	2	1	0	3	9
1999	1	4	3	3	5	4	2	1	23
2000	0	1	1	1	3	2	1	2	11
2001	0	1	1	1	2	2	4	13	24
Total	3	7	14	11	20	24	12	33	124

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	0.1	2.1	0.5	2.4	0.9	1.6	1.8	
Highest:	24.4	9.0	24.5	13.4	7.1	20.3	22.4	
Mean:	6.9	5.4	6.3	6.5	3.9	6.1	8.6	
Median:	5.3	5.5	5.5	4.9	4.0	4.6	7.2	

Percent of home and garden samples within each % organic matter range:

	<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
1995	4	4	17	4	17	17	8	29	100
1996	0	0	8	8	8	50	8	17	100
1997	5	0	14	10	14	24	10	24	100
1998	0	0	11	22	22	11	0	33	100
1999	4	17	13	13	22	17	9	4	100
2000	0	9	9	9	27	18	9	18	100
2001	0	4	4	4	8	8	17	54	100
Total	2	6	11	9	16	19	10	27	100

4.2 Samples for Commercial Production

Number of samples for commercial production within each % organic matter range:

	<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
1995	0	4	20	100	173	251	284	282	1114
1996	1	22	58	115	241	342	304	148	1231
1997	1	20	47	109	283	483	323	126	1392
1998	1	30	28	48	199	341	259	151	1057
1999	5	40	81	180	340	473	276	122	1517
2000	0	14	57	142	257	391	211	122	1194
2001	0	9	42	77	200	317	256	205	1106
Total	8	139	333	771	1693	2598	1913	1156	8611

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	1.2	0.6	0.1	0.9	0.1	1.2	1.3	
Highest:	18.5	10.8	12.2	14.8	13.7	37.7	23.3	
Mean:	6.0	5.4	5.4	5.6	5.1	5.3	5.7	
Median:	6.0	5.5	5.5	5.6	5.2	5.3	5.7	

Percent of samples for commercial production within each % organic matter range:

	<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
1995	0	0	2	9	16	23	25	25	100
1996	0	2	5	9	20	28	25	12	100
1997	0	1	3	8	20	35	23	9	100
1998	0	3	3	5	19	32	25	14	100
1999	0	3	5	12	22	31	18	8	100
2000	0	1	5	12	22	33	18	10	100
2001	0	1	4	7	18	29	23	19	100
Total	0	2	4	9	20	30	22	13	100

5. pH

5.1 Samples for Home and Garden

Number of home and garden samples within each pH range:

	<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
1995	1	1	3	2	2	6	9	0	0	0	24
1996	0	1	2	4	1	2	2	0	0	0	12
1997	0	1	1	5	6	6	1	1	0	0	21
1998	0	0	0	1	2	4	2	0	0	0	9
1999	0	0	2	5	6	2	7	1	0	0	23
2000	0	0	2	2	3	3	1	0	0	0	11
2001	2	3	1	4	7	5	1	1	0	0	24
Total	3	6	11	23	27	28	23	3	0	0	124

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	3.8	4.9	4.7	5.9	5.3	5.2	4.0	
Highest:	7.4	7.2	7.7	7.1	7.5	7.4	7.5	
Mean:	-	-	-	-	-	-	-	
Median:	6.8	5.7	6.4	6.7	6.2	6.4	6.1	

Percent of home and garden samples within each pH range:

	<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
1995	4	4	13	8	8	25	38	0	0	0	100
1996	0	8	17	33	8	17	17	0	0	0	100
1997	0	5	5	24	29	29	5	5	0	0	100
1998	0	0	0	11	22	44	22	0	0	0	100
1999	0	0	9	22	26	9	30	4	0	0	100
2000	0	0	18	18	27	27	9	0	0	0	100
2001	8	13	4	17	29	21	4	4	0	0	100
Total	2	5	9	19	22	23	19	2	0	0	100

5.2 Samples for Commercial Production

Number of samples for commercial production within each pH range:

	<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
1995	1	15	153	338	357	208	42	0	0	0	1114
1996	1	33	248	353	331	218	46	1	0	0	1231
1997*	6	70	331	466	367	136	8	1	0	1	1386
1998*	4	12	122	260	351	254	49	0	0	0	1052
1999	0	15	239	534	415	267	45	2	0	0	1517
2000	3	10	76	375	395	265	56	14	0	0	1194
2001	0	5	184	457	321	125	14	0	0	0	1106
Total	15	160	1353	2783	2537	1473	260	18	0	1	8600

* Six and five samples were not analyzed for pH in 1997 and in 1998, respectively.

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	4.3	4.3	4.2	4.2	4.5	3.7	4.7	
Highest:	7.4	7.5	9.5	7.4	7.5	7.9	7.2	
Mean:	-	-	-	-	-	-	-	
Median:	6.0	5.9	5.8	6.1	5.9	6.1	5.9	

Percent of samples for commercial production within each pH range:

	<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
1995	0	1	14	30	32	19	4	0	0	0	100
1996	0	3	20	29	27	18	4	0	0	0	100
1997	0	5	24	33	26	10	1	0	0	0	100
1998	0	1	12	25	33	24	5	0	0	0	100
1999	0	1	16	35	27	18	3	0	0	0	100
2000	0	1	6	31	33	22	5	1	0	0	100
2001	0	0	17	41	29	11	1	0	0	0	100
Total	0	2	16	32	29	17	3	0	0	0	100

6. Phosphorus

6.1 Samples for Home and Garden

Number of home and garden samples within each range Morgan extractable P range (lbs/acre Morgan P):

	<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	
1995	0	3	2	10	4	0	0	1	0	4	24
1996	0	3	1	1	1	3	1	0	0	2	12
1997	0	0	5	6	0	2	2	2	0	4	21
1998	0	2	0	2	0	1	0	1	0	3	9
1999	0	3	7	6	4	0	2	0	1	0	23
2000	0	0	2	4	2	0	0	0	0	3	11
2001	0	1	3	9	3	2	2	2	0	2	24
Total	0	12	20	38	14	8	7	6	1	18	124

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

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	1	1	4	2	2	4	2	
Highest:	1330	484	987	716	194	369	552	
Mean:	160	94	135	163	32	91	72	
Median:	33	63	34	61	10	28	37	

Percent of home and garden samples within each Morgan extractable phosphorus range:

	<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	
1995	0	13	8	42	17	0	0	4	0	17	100
1996	0	25	8	8	8	25	8	0	0	17	100
1997	0	0	24	29	0	10	10	10	0	19	100
1998	0	22	0	22	0	11	0	11	0	33	100
1999	0	13	30	26	17	0	9	0	4	0	100
2000	0	0	18	36	18	0	0	0	0	27	100
2001	0	4	13	38	13	8	8	8	0	8	100
Total	0	10	16	31	11	6	6	5	1	15	100

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

6.2 Samples for Commercial Production

Number of samples submitted for commercial production within each Morgan extractable phosphorus (lbs P/acre) range:

	<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	
1995	0	243	239	443	103	40	17	18	4	7	1114
1996	0	321	288	468	77	28	15	13	9	12	1231
1997	0	313	402	562	75	20	11	6	2	1	1392
1998	0	179	270	472	90	30	9	4	2	1	1057
1999	0	454	398	528	75	35	10	14	2	1	1517
2000	0	331	329	450	57	14	6	5	1	1	1194
2001	0	328	316	387	36	15	9	10	2	2	1106
Total	0	2169	2242	3310	513	182	77	70	22	26	8611

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

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	1	1	1	1	1	1	1	
Highest:	371	618	378	449	512	250	343	
Mean:	22	21	15	18	15	13	14	
Median:	11	9	8	11	7	7	7	

Percent of samples submitted for commercial production within each Morgan P range:

	<1	1-3	4-8	9-39	40-60	61-80	81-100	101-150	151-200	>200	Total
1995	0	22	21	40	9	4	2	2	0	1	100
1996	0	26	23	38	6	2	1	1	1	1	100
1997	0	22	29	40	5	1	1	0	0	0	100
1998	0	17	26	45	9	3	1	0	0	0	100
1999	0	30	26	35	5	2	1	1	0	0	100
2000	0	28	28	38	5	1	1	0	0	0	100
2001	0	30	29	35	3	1	1	1	0	0	100
Total	0	25	26	38	6	2	1	1	0	0	100

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

7. Potassium

7.1 Samples for Home and Garden

Number of home and garden samples within each K range (lbs K/acre Morgan extraction):

Soil Management Group 1						
	<35	35-64	65-94	95-149	>149	Total
	Very Low	Low	Medium	High	Very High	
1995	0	0	0	0	0	0
1996	0	0	0	0	0	0
1997	0	0	0	0	0	0
1998	0	0	0	0	0	0
1999	0	0	0	0	0	0
2000	0	0	0	0	0	0
2001	0	0	0	0	0	0
Total (#)	0	0	0	0	0	0
Total (%)	-	-	-	-	-	-
Soil Management Group 2						
	<40	40-69	70-99	100-164	>164	Total
	Very Low	Low	Medium	High	Very High	
1995	0	0	0	1	2	3
1996	0	0	2	0	1	3
1997	0	0	0	0	0	0
1998	0	0	0	0	0	0
1999	0	0	0	1	1	2
2000	0	0	0	2	2	4
2001	0	0	1	1	3	5
Total (#)	0	0	3	5	9	17
Total (%)	0	0	18	29	53	100
Soil Management Group 3						
	<45	45-79	80-119	120-199	>199	Total
	Very Low	Low	Medium	High	Very High	
1995	1	0	0	1	2	4
1996	0	0	0	0	2	2
1997	0	0	2	0	4	6
1998	0	0	0	0	0	0
1999	0	0	0	0	1	1
2000	0	0	0	0	0	0
2001	0	0	2	2	4	8
Total (#)	1	0	4	3	13	21
Total (%)	5	0	19	14	62	100

Soil Management Group 4						
	<55	55-99	100-149	150-239	>239	Total
	Very Low	Low	Medium	High	Very High	
1995	0	1	9	4	3	17
1996	0	1	0	1	5	7
1997	1	2	0	0	11	14
1998	0	2	0	3	4	9
1999	2	3	3	4	4	16
2000	0	0	0	2	4	6
2001	0	0	1	2	7	10
Total (#)	3	9	13	16	38	79
Total (%)	4	11	16	20	48	100
Soil Management Group 5						
	<60	60-114	115-164	165-269	>269	Total
	Very Low	Low	Medium	High	Very High	
1995	0	0	0	0	0	0
1996	0	0	0	0	0	0
1997	0	0	0	1	0	1
1998	0	0	0	0	0	0
1999	0	1	1	2	0	4
2000	0	0	0	1	0	1
2001	0	0	1	0	0	1
Total (#)	0	1	2	4	0	7
Total (%)	0	14	29	57	0	100
Soil Management Group 6						
	<60	60-114	115-164	165-269	>269	Total
	Very Low	Low	Medium	High	Very High	
1995	0	0	0	0	0	0
1996	0	0	0	0	0	0
1997	0	0	0	0	0	0
1998	0	0	0	0	0	0
1999	0	0	0	0	0	0
2000	0	0	0	0	0	0
2001	0	0	0	0	0	0
Total (#)	0	0	0	0	0	0
Total (%)	-	-	-	-	-	-

Number of home and garden samples within each potassium classification:

Summary (#)	Very Low	Low	Medium	High	Very High	Total
1995	1	1	9	6	7	24
1996	0	1	2	1	8	12
1997	1	2	2	1	15	21
1998	0	2	0	3	4	9
1999	2	4	4	7	6	23
2000	0	0	0	5	6	11
2001	0	0	5	5	14	24
Total #	4	10	22	28	60	124

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	44	73	45	60	47	149	92	
Highest:	4394	1872	3971	1283	466	1436	549	
Mean:	456	498	653	373	192	504	289	
Median:	159	386	320	235	169	267	285	

Percent of samples submitted for home and garden within each potassium classification.

Summary (%)	Very Low	Low	Medium	High	Very High	Total
1995	4	4	38	25	29	100
1996	0	8	17	8	67	100
1997	5	10	10	5	71	100
1998	0	22	0	33	44	100
1999	9	17	17	30	26	100
2000	0	0	0	45	55	100
2001	0	0	21	21	58	100
Grand Total	3	8	18	23	48	100

7.2 Samples for Commercial Production

Number of samples submitted for commercial production within each potassium (lbs K/acre Morgan extraction) range:

Soil Management Group 1						
	<35	35-64	65-94	95-149	>149	Total
	Very Low	Low	Medium	High	Very High	
1995	0	0	0	0	0	0
1996	0	0	0	0	0	0
1997	0	0	0	0	0	0
1998	0	0	0	0	0	0
1999	0	0	0	0	0	0
2000	0	0	0	0	0	0
2001	0	0	0	0	0	0
Total (#)	0	0	0	0	0	0
Total (%)	-	-	-	-	-	-
Soil Management Group 2						
	<40	40-69	70-99	100-164	>164	Total
	Very Low	Low	Medium	High	Very High	
1995	0	1	0	1	1	3
1996	1	4	5	8	17	35
1997	0	1	4	11	21	37
1998	1	3	6	8	23	41
1999	0	2	7	18	37	64
2000	0	2	6	10	19	37
2001	0	2	8	10	17	37
Total (#)	2	15	36	66	135	254
Total (%)	1	6	14	26	53	100
Soil Management Group 3						
	<45	45-79	80-119	120-199	>199	Total
	Very Low	Low	Medium	High	Very High	
1995	3	52	148	297	587	1087
1996	30	182	264	283	405	1164
1997	32	225	352	344	371	1324
1998	24	106	214	252	403	999
1999	40	173	338	358	493	1402
2000	38	182	225	265	396	1106
2001	21	133	188	263	401	1006
Total (#)	188	1053	1729	2062	3056	8088
Total (%)	2	13	21	25	38	100

Soil Management Group 4						
	<55	55-99	100-149	150-239	>239	Total
	Very Low	Low	Medium	High	Very High	
1995	0	0	0	0	0	0
1996	1	6	5	4	10	26
1997	0	3	2	6	6	17
1998	1	4	3	0	1	9
1999	0	4	8	3	7	22
2000	2	2	6	4	6	20
2001	1	3	7	7	1	19
Total (#)	5	22	31	24	31	113
Total (%)	4	19	27	21	27	100
Soil Management Group 5						
	<60	60-114	115-164	165-269	>269	Total
	Very Low	Low	Medium	High	Very High	
1995	0	0	0	0	0	0
1996	0	0	0	0	0	0
1997	0	0	0	0	0	0
1998	0	0	0	0	0	0
1999	0	0	0	0	0	0
2000	0	0	0	0	0	0
2001	0	0	0	0	0	0
Total (#)	0	0	0	0	0	0
Total (%)	-	-	-	-	-	-
Soil Management Group 6						
	<60	60-114	115-164	165-269	>269	Total
	Very Low	Low	Medium	High	Very High	
1995	0	0	0	0	0	0
1996	0	0	0	0	0	0
1997	0	0	0	0	0	0
1998	0	0	0	0	0	0
1999	0	0	0	0	0	0
2000	0	0	0	0	0	0
2001	0	0	0	0	0	0
Total (#)	0	0	0	0	0	0
Total (%)	-	-	-	-	-	-

Number of samples submitted for commercial production within each potassium classification.

Summary (#)	Very Low	Low	Medium	High	Very High	Un-known	Total
1995	3	53	148	298	588	24	1114
1996	32	192	274	295	432	6	1231
1997	32	229	358	361	398	14	1392
1998	26	113	223	260	427	8	1057
1999	40	179	353	379	537	29	1517
2000	40	186	237	279	421	31	1194
2001	22	138	203	280	419	44	1106
Grand Total	195	1090	1796	2152	3222	156	8611

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	31	24	19	19	12	21	28	
Highest:	1708	1289	1052	2439	1715	1351	2091	
Mean:	289	213	181	229	210	208	231	
Median:	214	144	130	163	145	146	165	

Percent of samples submitted for commercial production within each potassium classification.

% summary	Very Low	Low	Medium	High	Very High	Un-known	Total
1995	0	5	13	27	53	2	100
1996	3	16	22	24	35	0	100
1997	2	16	26	26	29	1	100
1998	2	11	21	25	40	1	100
1999	3	12	23	25	35	2	100
2000	3	16	20	23	35	3	100
2001	2	12	18	25	38	4	100
Grand Total	2	13	21	25	37	2	100

8. Magnesium

8.1 Samples for Home and Garden

Number of home and garden samples within each Mg range (lbs Morgan Mg/acre):

	<20	20-65	66-100	101-199	>199	Total
	Very Low	Low	Medium	High	Very High	
1995	0	2	0	11	11	24
1996	0	0	0	3	9	12
1997	0	1	3	0	17	21
1998	0	0	1	1	7	9
1999	0	1	1	8	13	23
2000	0	0	0	2	9	11
2001	0	0	1	3	20	24
Total	0	4	6	28	86	124

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	53	133	63	90	63	152	96	
Highest:	3932	1306	3252	1566	1038	1758	967	
Mean:	508	443	600	586	318	506	427	
Median:	195	319	367	493	235	322	396	

Percent of home and garden samples within each Mg range (lbs Morgan Mg/acre):

	<20	20-65	66-100	101-199	>199	Total
	Very Low	Low	Medium	High	Very High	
1995	0	8	0	46	46	100
1996	0	0	0	25	75	100
1997	0	5	14	0	81	100
1998	0	0	11	11	78	100
1999	0	4	4	35	57	100
2000	0	0	0	18	82	100
2001	0	0	4	13	83	100
Total	0	3	5	23	69	100

8.2 Samples for Commercial Production

Number of samples submitted for commercial production within each Mg range (lbs Mg/acre Morgan extraction):

	<20	20-65	66-100	101-199	>199	Total
	Very Low	Low	Medium	High	Very High	
1995	0	2	25	164	923	1114
1996	0	11	31	219	970	1231
1997	0	8	49	237	1098	1392
1998	0	7	32	179	839	1057
1999	0	7	51	315	1144	1517
2000	0	6	25	195	968	1194
2001	0	14	36	216	840	1106
Total	0	55	249	1525	6782	8611

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	55	30	38	42	52	36	43	
Highest:	1547	1203	1402	1279	1474	1394	1301	
Mean:	397	360	375	377	344	381	347	
Median:	354	313	352	336	305	340	314	

Percent of samples submitted for commercial production within each magnesium range (lbs Mg/acre Morgan extraction):

	<20	20-65	66-100	101-199	>199	Total
	Very Low	Low	Medium	High	Very High	
1995	0	0	2	15	83	100
1996	0	1	3	18	79	100
1997	0	1	4	17	79	100
1998	0	1	3	17	79	100
1999	0	0	3	21	75	100
2000	0	1	2	16	81	100
2001	0	1	3	20	76	100
Total	0	1	3	18	79	100

9. Iron

9.1 Samples for Home and Garden

Iron (lbs Fe/acre Morgan extraction) in samples for home and garden:

Total number of samples:

	0-49	>49	Total
	Normal	Excessive	
1995	23	1	24
1996	12	0	12
1997	21	0	21
1998	9	0	9
1999	22	1	23
2000	10	1	11
2001	20	4	24
Total	117	7	124

Percentages:

	0-49	>49	Total
	Normal	Excessive	
	96	4	100
	100	0	100
	100	0	100
	100	0	100
	96	4	100
	91	9	100
	83	17	100
	94	6	100

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	3	4	3	3	2	3	4	
Highest:	78	33	46	19	103	77	684	
Mean:	17	15	11	9	20	17	77	
Median:	10	12	10	8	11	8	10	

9.2 Samples for Commercial Production

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

Total number of samples:

	0-49	>49	Total
	Normal	Excessive	
1995	1002	112	1114
1996	1115	116	1231
1997	1278	114	1392
1998	993	64	1057
1999	1398	119	1517
2000	1117	77	1194
2001	1038	68	1106
Total	7941	670	8611

Percentages:

	0-49	>49	Total
	Normal	Excessive	
	90	10	100
	91	9	100
	92	8	100
	94	6	100
	92	8	100
	94	6	100
	94	6	100
	92	8	100

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	1	1	1	1	1	1	1	
Highest:	311	242	465	329	266	344	177	
Mean:	21	21	21	18	20	18	19	
Median:	11	11	12	11	12	9	13	

10. Manganese

10.1 Samples for Home and Garden

Manganese (lbs Mn/acre Morgan extraction) in samples for home and garden:

Total number of samples:

	0-99	>99	Total
	Normal	Excessive	
1995	21	3	24
1996	12	0	12
1997	16	5	21
1998	9	0	9
1999	21	2	23
2000	10	1	11
2001	20	4	24
Total	109	15	124

Percentages:

0-99	>99	Total
Normal	Excessive	
88	13	100
100	0	100
76	24	100
100	0	100
91	9	100
91	9	100
83	17	100
88	12	100

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	11	21	21	10	9	12	19	
Highest:	226	94	127	55	138	102	856	
Mean:	52	59	62	29	45	45	91	
Median:	30	59	48	28	38	44	48	

10.2 Samples for Commercial Production

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

Total number of samples:

	0-99	>99	Total
	Normal	Excessive	
1995	1064	50	1114
1996	1208	23	1231
1997	1307	85	1392
1998	1031	26	1057
1999	1482	35	1517
2000	1146	48	1194
2001	1076	30	1106
Total	8314	297	8611

Percentages:

	0-99	>99	Total
	Normal	Excessive	
	96	4	100
	98	2	100
	94	6	100
	98	2	100
	98	2	100
	96	4	100
	97	3	100
	97	3	100

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	7	5	4	6	5	4	7	
Highest:	346	943	390	768	439	648	354	
Mean:	41	33	44	35	37	38	39	
Median:	33	26	34	27	30	27	33	

11. Zinc

11.1 Samples for Home and Garden

Zinc (lbs Zn/acre Morgan extraction) in samples for home and garden:

Total number of samples:

	<0.5	0.5-1.0	>1	Total
	Low	Medium	High	
1995	0	2	22	24
1996	0	0	12	12
1997	0	2	19	21
1998	1	1	7	9
1999	2	3	18	23
2000	0	0	11	11
2001	0	0	24	24
Total	3	8	113	124

Percentages:

<0.5	0.5-1.0	>1	Total
Low	Medium	High	
0	8	92	100
0	0	100	100
0	10	90	100
11	11	78	100
9	13	78	100
0	0	100	100
0	0	100	100
2	6	91	100

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	0.5	1.2	0.1	0.4	0.1	2.0	1.4	
Highest:	237.7	20.1	31.4	63.6	36.2	18.5	61.3	
Mean:	20.1	6.4	9.7	13.9	5.6	7.6	10.7	
Median:	6.4	3.6	5.8	2.6	2.3	5.4	6.9	

11.2 Samples for Commercial Production

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

Total number of samples:

	<0.5	0.5-1.0	>1	Total
	Low	Medium	High	
1995	19	138	957	1114
1996	15	260	956	1231
1997	26	285	1081	1392
1998	36	234	787	1057
1999	85	313	1119	1517
2000	26	286	882	1194
2001	22	123	961	1106
Total	229	1639	6743	8611

Percentages:

<0.5	0.5-1.0	>1	Total
Low	Medium	High	
2	12	86	100
1	21	78	100
2	20	78	100
3	22	74	100
6	21	74	100
2	24	74	100
2	11	87	100
3	19	78	100

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	0.3	0.2	0.1	0.1	0.1	0.1	0.1	
Highest:	26.9	33.1	43.8	33.1	30.7	36.3	39.8	
Mean:	2.5	2.2	2.2	2.0	2.1	1.9	2.7	
Median:	1.9	1.8	1.7	1.5	1.6	1.5	2.1	

Appendix: Cornell Crop Codes

Crop codes are used in the Cornell Nutrient Analyses 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

Crop Code	Crop Description
Corn	
COG	Corn grain
COS	Corn silage
Grasses, pastures, covercrops	
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
PNE	Pasture native grasses, Established
RYC	Rye cover crop
RYS	Rye seed production
TRP	Triticale peas
Small grains	
MIL	Millet
OAS	Oats 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
ASP	Asparagus
BDR/BND	Beans-dry
BLU/BLB	Blueberries
CEM	Cemetery
END	Endives
FAR	Fairway
FLA	Flowering Annuals
GRA	Grapes
GEN	Green
HRB	Herbs
IDL	Idle land
LAW	Lawn
LET	Lettuce
MIX/MVG	Mixed vegetables
MML	Muskmelon
ONS	Onion-seeded
OTH	Other
PAR	Pears
PER	Perennials
POP	Popcorn
PRK	Park
POT/PTO	Potatoes
PUM	Pumpkins
ROD	Roadside
ROS	Roses
ROU	Rough
RSF	Raspberries, Fall
RSP	Raspberries (homeowners)
RSS	Raspberries, Summer
SAG	Ornamentals adapted to pH 6.0 to 7.5
SQS	Squash, Summer
SQW	Squash, Winter
STE	Strawberries, Ever
STR	Strawberries (homeowners)
STS	Strawberries, Spring
SUN	Sunflowers
SWC	Sweet corn
TOM	Tomatoes
TRE	Christmas trees, Established

Ketterings, Q.M., H. Krol, W.S. Reid and D. Dewing (2003). Delaware County Soil Sample Survey 1995-2001. CSS Extension Bulletin E03-10. 39 pages.

Crop Code	Crop Description
TRF	Turf
TRT	Christmas trees, Topdressing