

Ketterings, Q.M., H. Krol, W.S. Reid and K. Evans (2003). Madison County Soil Sample Survey 1995-2001. CSS Extension Bulletin E03-18. 39 pages.

Soil Sample Survey

Madison Co.

Samples analyzed by CNAL in 1995-2001



Farming in Madison County

Summary compiled by

Quirine M. Ketterings, Hettie Krol, W. Shaw Reid and Kathe Evans



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

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Nutrient Management Spear Program

Department of Crop and Soil Sciences

817 Bradfield Hall, Cornell University

Ithaca NY 14853

W. Shaw Reid

Professor Emeritus

Department of Crop and Soil Sciences

Kathe Evans

Field Crops Educator

Cornell Cooperative Extension of Madison County

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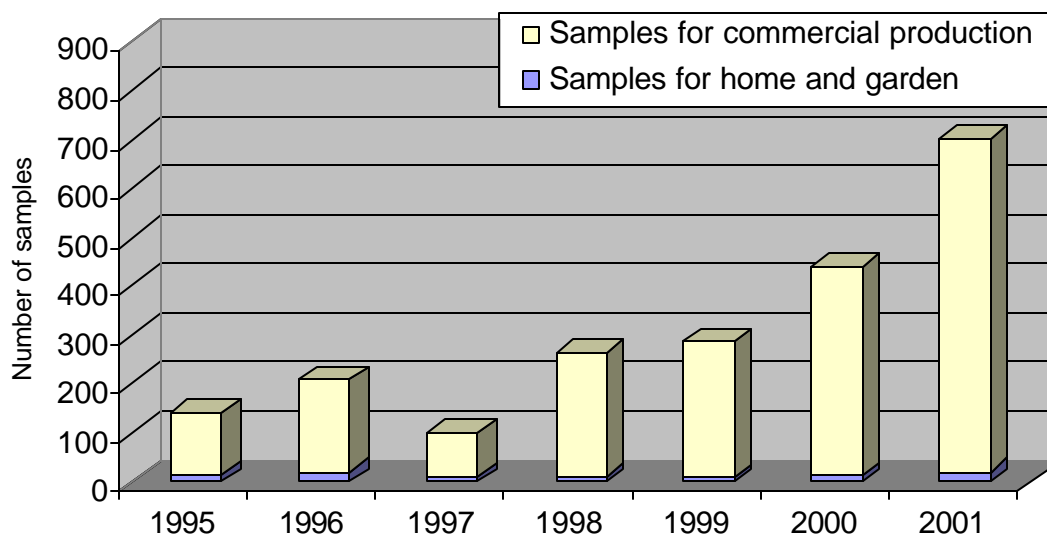
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1. General Survey Summary

Madison County lies adjacent to Oneida Lake. It comprises 423,300 acres and is mainly rural in nature. The county is divided into two distinctly different physiographic areas. The Ontario (Oneida) Lake Plain in the northern area of the county and the uplands of the Appalachian Plateau in the south are separated by the Helderberg Escarpment, an east-west limestone outcropping that bisects the county.

Dairy farming is the major agricultural enterprise and the cropping sequence in general relies on corn and alfalfa with some small grains being grown. The number of alternative livestock operations is increasing in the uplands of the county where abundant open lands are used for grazing. There are several vegetable and other horticultural operations in the northern lake-plain section of the county.

This survey summarizes the soil test results from Madison County soil samples submitted for analyses to the Cornell Nutrient Analysis Laboratory (CNAL) during 1995-2001. The total number of samples analyzed in these years amounted to 2150. Of these samples, 2039 samples (95%) were submitted to obtain fertilizer recommendations for commercial production while 111 samples (5%) were submitted as home and garden samples.



Homeowners		Commercial		Total
1995	16	1995	128	144
1996	23	1996	187	210
1997	12	1997	89	101
1998	13	1998	251	264
1999	10	1999	278	288
2000	15	2000	424	439
<u>2001</u>	<u>22</u>	<u>2001</u>	<u>682</u>	<u>704</u>
Total	111	Total	2039	2150

Forty one percent of the home and garden soil samples during 1995-2001 were submitted to request fertilizer recommendations for vegetable production while 12% of the samples were lawn soil samples, 12% were soils used to grow ornamentals, and 10% were other perennials. People submitting samples for commercial production requested fertilizer recommendations for corn silage or grain (42%), hay production (12%), alfalfa, alfalfa/grass or alfalfa/trefoil mixtures (29%), or pasture (5%), while a few producers were planning on growing other crops including birdsfoot trefoil, clover/grass mixtures, small grains and sweet corn.

Home and garden samples in Madison County were mostly sandy loam soils belonging to soil management group 4 (48%). Twenty eight percent belonged to soil management group 2. Group 3 was represented by 30% of all samples and 5% were classified as sandy (soil management group 5). The table on page 6 gives descriptions of each of the soil management groups.

Of the samples submitted for commercial production, 54% belonged to soil management group 3. Three percent were from soil management group 4. Very few of the samples belonged to either group 1 or group 5 while 41% were classified group 2. The six most common soil series, all belonging to soil management group 2 or 3, were Mardin (15%), Lansing (11%), Palmyra (7%), Howard (7%), Honeoye (7%) and Cazenovia (7%). These soils represent 12.7% (Mardin), 4.4% (Lansing), 4.2% (Palmyra), 2.1% (Howard), 9.8% (Honeoye) and 3.4% (Cazenovia) of the total 423,300 acres in the county.

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.

Organic matter levels, as measured by loss on ignition, ranged from less than 1% to over 35% with median values ranging from 4.2 to 5.5% organic matter for home and garden samples and values ranging from 4.1 to 4.6% for samples submitted for commercial production. Forty nine percent of the home and garden samples had between 2 and 5% organic matter with 9% testing between 2 and 2.9% organic matter, 23% between 3.0 and 3.9% organic matter and 17% between 4.0 and 4.9% organic matter. Forty six percent of the soils submitted for home and garden tested >4.9% in organic matter while 5% have less than 2% organic matter. Of the samples submitted for commercial production, 24% contained between 3 and 4% organic matter, 38% tested between 4.0 and 4.9% while 17% had organic matter concentrations of 5.0-5.9%. In total, 62% of the samples had organic matter levels between 4.0 and 6.9%.

Soil pH in water (1:1 extraction ratio) varied from pH 4.0 to 8.1 with the median for home and garden samples ranging from pH 6.6 to pH 7.4 and for samples submitted for commercial production ranging from pH 6.0 to 6.6. Of the home and garden samples, 60% tested between pH 6.0 and 7.4. For the samples submitted for commercial

production, 77% tested between pH 6.0 and 7.4 while 14% 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 in P.

Of the home and garden samples, 24% tested low, 13% were medium, 25% high and 38% tested very high. This meant that 62% tested high or very high in P. Phosphorus levels for samples for commercial production in Madison County were lower than the state average (50% tests high or very high in P). Nine percent of the samples tested very high in P. Thirty percent were low in P, 28% tested medium for P while 33% 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 above table represent very low, low, medium, high and very high. 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 and >269 lbs K/acre is classified as very high (see the table below).

Of the home and garden samples, 19% were classified as very low or low in potassium. Eleven percent tested medium, 30% high and 41% very high. For samples submitted for commercial production, 1% tested very low in K, 11% tested low, 20% tested medium, 28% tested high and 38% tested very high in potassium. As with phosphorus, there were no trends over the 6 years of soil sampling.

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

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 21 to almost 2140 lbs Mg/acre (Morgan extraction). There were no samples that tested very low in Mg. Most soils tested high or very high for Mg (95% of the homeowner soils and 97% of the soils of the commercial growers). No more than 5 of the homeowner soils and 3% of the commercial growers' soil tested low or medium in Mg. Thus, magnesium deficiency is not likely to occur in Madison County provided the soil pH is maintained in the desirable range.

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. Iron levels fell for 95-97% in the normal range with 5% of the home and garden samples and 3% of the samples for commercial production testing excessive for Fe. Similarly, most soils (95-99%) for both groups 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 lbs zinc per acre in the Morgan extraction are classified as low in Zn. Medium testing soils have between 0.5 and 1 lbs 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, 86% tested high for

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zinc while 14% tested medium and 1% was low in Zn. Of the samples for commercial production, 6% tested low in zinc, 33% tested medium while 61% 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	1	0	2	2
ATF	0	0	1	1	1	0	2	5	5
BLU	0	0	0	0	0	1	0	1	1
CEM	1	0	0	0	0	0	0	1	1
FAR	1	0	0	0	0	0	0	1	1
FLA	0	0	0	0	1	0	1	2	2
GRA	0	0	0	3	0	0	0	3	3
HRB	0	0	1	0	0	0	1	2	2
IDL	1	0	0	0	0	1	0	2	2
LAW	4	3	2	0	1	1	2	13	12
MVG	5	16	4	4	3	6	7	45	41
OTH	0	0	1	0	0	1	0	2	2
PER	0	0	0	2	4	3	2	11	10
ROS	0	0	1	0	0	0	1	2	2
RSP	0	0	1	0	0	0	1	2	2
SAG	2	3	0	2	0	1	5	13	12
TRF	0	1	0	1	0	0	0	2	2
Unknown	1	0	1	0	0	0	0	2	2
Total	16	23	12	13	10	15	22	111	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	1	5	2	1	6	1	4	20	1
AGE/AGT	19	21	7	39	46	108	203	443	22
ALE/ALT	4	40	5	5	8	31	31	124	6
APP	0	0	0	0	0	2	0	2	0
BDR/BND	0	0	0	0	0	3	0	3	0
BGE/BGT	1	0	0	1	3	7	1	13	1
BLB	0	0	3	0	0	1	0	4	0
BNS	0	0	1	0	0	0	0	1	0
BRP	0	0	1	0	0	0	0	1	0
BSS	0	3	1	10	12	7	1	34	2
BWI	0	0	0	0	0	1	0	1	0
BWS	1	0	0	0	0	0	0	1	0
CGE/CGT	8	0	5	2	8	8	6	37	2
CLE/CLT	1	0	2	1	2	0	4	10	0
COG/COS	64	88	37	113	122	160	266	850	42
GIE/GIT	0	0	1	2	10	11	18	42	2
GPF	0	0	0	1	0	0	0	1	0
GRE/GRT	12	9	12	27	43	47	47	197	10
IDL	0	0	0	1	1	0	0	2	0
MIX	1	0	0	1	1	1	4	8	0
OAS	11	4	1	3	0	5	38	62	3
OAT	0	3	0	1	0	3	7	14	1
OTH	0	0	0	0	2	0	1	3	0
PGE/PGT	0	4	0	0	1	9	9	23	1
PIE/PIT	0	7	1	24	2	3	5	42	2
PLE/PLT	1	1	0	3	0	4	7	16	1
PNE/PNT	0	0	0	2	0	0	13	15	1
PUM	0	0	1	3	0	0	2	6	0
RYC	0	0	0	3	0	0	0	3	0
RYS	0	0	0	1	0	0	0	1	0
SOF	0	0	0	3	1	0	1	5	0
SOY	0	0	0	1	0	6	0	7	0
SSH	0	0	0	0	0	0	1	1	0
STS	0	0	1	1	0	0	0	2	0
SWC	2	0	5	1	1	1	2	12	1

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Current year crop	1995	1996	1997	1998	1999	2000	2001	Total	%
WHS	0	0	3	0	0	0	0	3	0
WHT	0	0	0	0	3	0	0	3	0
Unknown	2	2	0	1	6	5	11	27	1
Total	128	187	89	251	278	424	682	2039	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)	6	8	3	2	2	3	4	28
SMG 3 (silt loam)	7	5	2	4	3	5	4	30
SMG 4 (sandy loam)	2	9	7	7	4	7	12	48
SMG 5 (sandy)	1	1	0	0	1	0	2	5
SMG 6 (mucky)	0	0	0	0	0	0	0	0
Total	16	23	12	13	10	15	22	111

3.2 Samples for Commercial Production

Soil series for samples submitted for commercial production:

Name	SMG	1995	1996	1997	1998	1999	2000	2001	Total
Alden	3	0	0	0	1	0	0	1	2
Alluvial	3	0	0	0	0	0	0	1	1
Angola	2	0	0	0	0	0	0	1	1
Appleton	2	6	0	2	0	2	2	5	17
Arkport	4	1	0	0	0	1	0	2	4
Arnot	3	0	1	0	2	3	5	1	12
Aurora	2	1	1	1	5	2	2	8	20
Bath	3	4	5	11	9	5	8	13	55
Camillus	3	0	0	0	0	1	7	0	8
Canandaigu	3	0	0	0	0	3	0	0	3
Cazenovia	2	4	15	4	14	26	13	57	133
Chenango	3	0	6	1	3	4	13	15	42
Collamer	3	0	0	0	0	0	1	0	1
Colonie	5	0	0	4	0	0	0	0	4
Conesus	2	0	1	2	1	2	11	9	26
Farmington	3	0	0	0	0	0	0	4	4
Fonda	2	0	0	0	1	0	0	0	1
Fredon	4	3	1	0	0	7	0	8	19
Galen	4	0	0	0	0	1	0	0	1
Halsey	4	0	0	0	0	0	0	1	1
Hamlin	2	0	2	0	0	0	0	2	4
Herkimer	3	3	2	2	3	0	3	2	15
Hilton	2	2	0	2	2	1	0	0	7
Honeoye	2	6	20	1	9	6	19	78	139
Howard	3	7	9	1	18	17	20	67	139
Lairdsville	2	4	4	3	16	27	26	11	91
Lakemont	1	0	0	0	0	2	0	0	2
Lamson	4	0	0	0	0	1	10	0	11
Langford	3	0	0	0	0	0	9	0	9
Lansing	2	9	47	10	36	27	32	73	234
Lima	2	6	6	3	2	7	5	6	35
Lockport	2	0	1	0	0	9	1	1	12
Lordstown	3	6	6	7	20	10	26	17	92
Lyons	2	0	0	0	0	0	0	1	1
Mardin	3	21	15	10	37	41	100	87	311
Middlebury	3	0	0	0	2	0	4	0	6

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Name	SMG	1995	1996	1997	1998	1999	2000	2001	Total
Minoa	4	1	1	0	0	1	1	0	4
Niagara	3	0	0	1	0	2	0	0	3
Odessa	2	2	1	2	1	2	0	0	8
Ontario	2	10	1	0	0	7	7	1	26
Ovid	2	4	1	1	1	1	1	12	21
Palms	6	0	0	0	0	0	0	1	1
Palmyra	3	15	19	7	16	0	18	67	142
Phelps	3	0	6	2	3	1	9	25	46
Raynham	3	0	0	1	0	0	0	0	1
Schoharie	1	0	0	0	1	3	2	9	15
Stockbridge	3	5	11	2	26	23	31	34	132
Swanton	4	0	0	3	0	0	0	0	3
Teel	2	3	2	0	9	5	8	18	45
Tuller	3	0	0	0	0	0	2	2	4
Valois	3	0	0	0	0	2	5	0	7
Volusia	3	2	1	4	8	3	12	20	50
Wampsville	3	1	0	0	1	4	0	0	6
Wassaic	4	1	0	0	1	2	1	4	9
Wayland	2	0	2	0	1	2	2	4	11
Weaver	3	1	0	0	0	3	0	0	4
unknown	-	0	0	2	2	12	8	14	38
total	-	128	187	89	251	278	424	682	2039

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	0	2	2	3	1	3	3	2	16
1996	0	2	3	5	5	5	3	0	23
1997	0	0	1	4	2	1	1	3	12
1998	0	0	1	4	4	0	2	2	13
1999	0	0	2	1	1	3	0	3	10
2000	0	1	1	4	1	2	0	6	15
2001	0	0	0	5	5	3	4	5	22
Total	0	5	10	26	19	17	13	21	111

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	1.2	1.6	2.7	2.3	2.0	1.3	3.4	
Highest:	11.6	6.8	35.1	7.4	22.5	15.0	12.2	
Mean:	5.0	4.2	7.4	4.6	8.6	5.9	6.0	
Median:	4.7	4.2	4.3	4.2	5.5	5.5	5.2	

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	0	13	13	19	6	19	19	13	100
1996	0	9	13	22	22	22	13	0	100
1997	0	0	8	33	17	8	8	25	100
1998	0	0	8	31	31	0	15	15	100
1999	0	0	20	10	10	30	0	30	100
2000	0	7	7	27	7	13	0	40	100
2001	0	0	0	23	23	14	18	23	100
Total	0	5	9	23	17	15	12	19	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	0	13	32	44	22	13	4	128
1996	0	0	16	37	83	36	13	2	187
1997	0	3	6	20	30	17	8	5	89
1998	0	0	13	55	90	55	28	10	251
1999	2	4	50	70	71	51	19	11	278
2000	0	6	43	87	169	76	30	13	424
2001	0	2	67	188	279	97	32	17	682
Total	2	15	208	489	766	354	143	62	2039

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	2.3	2.1	1.6	2.3	0.2	1.7	1.5	
Highest:	28.8	23.2	8.7	11.0	10.1	31.3	15.3	
Mean:	4.6	4.5	4.6	4.7	4.2	4.6	4.3	
Median:	4.3	4.3	4.6	4.6	4.1	4.4	4.2	

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	10	25	34	17	10	3	100
1996	0	0	9	20	44	19	7	1	100
1997	0	3	7	22	34	19	9	6	100
1998	0	0	5	22	36	22	11	4	100
1999	1	1	18	25	26	18	7	4	100
2000	0	1	10	21	40	18	7	3	100
2001	0	0	10	28	41	14	5	2	100
Total	0	1	10	24	38	17	7	3	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	0	0	0	0	3	2	4	6	1	0	16
1996	0	1	1	0	5	6	5	5	0	0	23
1997	0	0	2	2	0	2	3	3	0	0	12
1998	0	0	3	2	1	3	2	2	0	0	13
1999	0	1	0	1	1	3	2	2	0	0	10
2000	0	1	0	0	2	1	4	7	0	0	15
2001	0	0	1	1	6	5	7	2	0	0	22
Total	0	3	7	6	18	22	27	27	1	0	111

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	6.2	4.7	5.3	5.2	4.9	4.7	5.4	
Highest:	8.0	7.8	7.6	7.7	7.6	7.9	7.8	
Mean:	-	-	-	-	-	-	-	
Median:	7.4	6.7	7.0	6.6	6.8	7.4	6.8	

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	0	0	0	0	19	13	25	38	6	0	100
1996	0	4	4	0	22	26	22	22	0	0	100
1997	0	0	17	17	0	17	25	25	0	0	100
1998	0	0	23	15	8	23	15	15	0	0	100
1999	0	10	0	10	10	30	20	20	0	0	100
2000	0	7	0	0	13	7	27	47	0	0	100
2001	0	0	5	5	27	23	32	9	0	0	100
Total	0	3	6	5	16	20	24	24	1	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	0	0	1	11	41	41	25	9	0	0	128
1996	0	0	11	39	62	61	11	3	0	0	187
1997	2	1	12	25	25	15	9	0	0	0	89
1998	0	2	15	26	88	82	34	4	0	0	251
1999	0	1	8	46	67	75	53	25	3	0	278
2000	0	0	2	43	137	145	67	29	1	0	424
2001	0	2	16	95	204	192	130	41	2	0	682
Total	2	6	65	285	624	611	329	111	6	0	2039

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	5.0	5.1	4.0	4.9	4.7	5.2	4.9	
Highest:	7.7	7.7	7.3	7.6	8.1	8.0	8.1	
Mean:	-	-	-	-	-	-	-	
Median:	6.6	6.3	6.0	6.4	6.6	6.6	6.5	

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	0	1	9	32	32	20	7	0	0	100
1996	0	0	6	21	33	33	6	2	0	0	100
1997	2	1	13	28	28	17	10	0	0	0	100
1998	0	1	6	10	35	33	14	2	0	0	100
1999	0	0	3	17	24	27	19	9	1	0	100
2000	0	0	0	10	32	34	16	7	0	0	100
2001	0	0	2	14	30	28	19	6	0	0	100
Total	0	0	3	14	31	30	16	5	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	4	2	4	2	0	1	3	0	1	16
1996	0	4	4	7	0	1	2	3	1	1	23
1997	0	4	2	3	0	0	0	2	0	1	12
1998	0	5	0	2	3	1	0	0	1	1	13
1999	0	2	1	1	1	2	1	2	0	0	10
2000	0	3	2	5	0	0	0	0	0	5	15
2001	0	5	3	6	1	0	0	1	1	5	22
Total	0	27	14	28	7	4	4	10	3	14	111

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

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	1	2	2	1	2	1	2	
Highest:	378	221	238	241	144	593	631	
Mean:	60	50	50	55	60	153	103	
Median:	25	12	7	27	65	18	22	

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	25	13	25	13	0	6	13	0	6	100
1996	0	17	17	30	0	4	9	13	4	4	100
1997	0	33	17	25	0	0	0	17	0	8	100
1998	0	38	0	15	23	8	0	0	8	8	100
1999	0	20	10	10	10	20	10	20	0	0	100
2000	0	20	13	33	0	0	0	0	0	33	100
2001	0	23	14	27	5	0	0	5	5	23	100
Total	0	24	13	25	6	4	4	9	3	13	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	48	28	34	8	3	3	1	1	2	128
1996	0	71	40	65	6	2	2	0	1	0	187
1997	0	43	18	19	4	4	0	0	1	0	89
1998	0	67	84	87	12	0	1	0	0	0	251
1999	0	97	70	93	11	4	0	2	0	1	278
2000	0	119	122	152	15	10	0	3	3	0	424
2001	0	175	210	226	33	14	10	3	5	6	682
Total	0	620	572	676	89	37	16	9	11	9	2039

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:	757	164	175	96	280	200	380	
Mean:	23	13	14	11	13	13	18	
Median:	6	6	4	7	6	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	38	22	27	6	2	2	1	1	2	100
1996	0	38	21	35	3	1	1	0	1	0	100
1997	0	48	20	21	4	4	0	0	1	0	100
1998	0	27	33	35	5	0	0	0	0	0	100
1999	0	35	25	33	4	1	0	1	0	0	100
2000	0	28	29	36	4	2	0	1	1	0	100
2001	0	26	31	33	5	2	1	0	1	1	100
Total	0	30	28	33	4	2	1	0	1	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	1	0	0	0	5	6
1996	0	0	1	2	5	8
1997	0	0	0	1	2	3
1998	0	0	0	0	2	2
1999	0	0	0	1	1	2
2000	0	0	1	1	1	3
2001	0	0	0	1	3	4
Total (#)	1	0	2	6	19	28
Total (%)	4	0	7	21	68	100
Soil Management Group 3						
	<45	45-79	80-119	120-199	>199	Total
	Very Low	Low	Medium	High	Very High	
1995	0	3	1	2	1	7
1996	0	0	0	2	3	5
1997	0	1	0	1	0	2
1998	0	0	1	2	1	4
1999	1	0	0	0	2	3
2000	0	1	0	0	4	5
2001	0	0	1	2	1	4
Total (#)	1	5	3	9	12	30
Total (%)	3	17	10	30	40	100

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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	2	2
1996	1	3	4	1	0	9
1997	0	0	0	5	2	7
1998	1	1	1	4	0	7
1999	0	0	0	1	3	4
2000	1	0	1	2	3	7
2001	0	4	1	2	5	12
Total (#)	3	8	7	15	15	48
Total (%)	6	17	15	31	31	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	1	0	1
1996	0	1	0	0	0	1
1997	0	0	0	0	0	0
1998	0	0	0	0	0	0
1999	0	1	0	0	0	1
2000	0	0	0	0	0	0
2001	0	0	0	2	0	2
Total (#)	0	2	0	3	0	5
Total (%)	0	40	0	60	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	3	1	3	8	16
1996	1	4	5	5	8	23
1997	0	1	0	7	4	12
1998	1	1	2	6	3	13
1999	1	1	0	2	6	10
2000	1	1	2	3	8	15
2001	0	4	2	7	9	22
Total #	5	15	12	33	46	111

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	31	44	74	54	40	48	65	
Highest:	1017	974	636	501	901	1163	1140	
Mean:	264	233	250	215	327	403	281	
Median:	186	145	189	181	263	226	190	

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

Summary (%)	Very Low	Low	Medium	High	Very High	Total
1995	6	19	6	19	50	100
1996	4	17	22	22	35	100
1997	0	8	0	58	33	100
1998	8	8	15	46	23	100
1999	10	10	0	20	60	100
2000	7	7	13	20	53	100
2001	0	18	9	32	41	100
Grand Total	5	14	11	30	41	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	1	0	0	1
1999	2	0	0	2	1	5
2000	0	1	1	0	0	2
2001	0	0	2	4	3	9
Total (#)	2	1	4	6	4	17
Total (%)	12	6	24	35	24	100
Soil Management Group 2						
	<40	40-69	70-99	100-164	>164	Total
	Very Low	Low	Medium	High	Very High	
1995	0	4	10	18	25	57
1996	1	17	25	30	31	104
1997	0	7	8	10	6	31
1998	0	4	17	29	48	98
1999	4	9	28	32	53	126
2000	1	11	23	39	55	129
2001	0	26	50	89	122	287
Total (#)	6	78	161	247	340	832
Total (%)	1	9	19	30	41	100
Soil Management Group 3						
	<45	45-79	80-119	120-199	>199	Total
	Very Low	Low	Medium	High	Very High	
1995	0	4	20	21	20	65
1996	1	10	21	15	34	81
1997	0	1	15	20	13	49
1998	1	17	33	39	59	149
1999	2	13	29	44	34	122
2000	1	34	55	76	107	273
2001	0	42	59	100	155	356
Total (#)	5	121	232	315	422	1095
Total (%)	0	11	21	29	39	100

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Soil Management Group 4						
	<55	55-99	100-149	150-239	>239	Total
	Very Low	Low	Medium	High	Very High	
1995	0	0	2	3	1	6
1996	0	2	0	0	0	2
1997	1	2	0	0	0	3
1998	0	0	0	1	0	1
1999	7	2	2	2	0	13
2000	1	2	2	3	4	12
2001	1	7	4	1	2	15
Total (#)	10	15	10	10	7	52
Total (%)	19	29	19	19	13	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	4	0	0	4
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	4	0	0	4
Total (%)	0	0	100	0	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	1	0	0	0	0
Total (#)	0	1	0	0	0	0
Total (%)	0	100	0	0	0	100

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

Summary (#)	Very Low	Low	Medium	High	Very High	Un-known	Total
1995	0	8	32	42	46	0	128
1996	2	29	46	45	65	0	187
1997	1	10	27	30	19	2	89
1998	1	21	51	69	107	2	251
1999	15	24	59	80	88	12	278
2000	3	48	81	118	166	8	424
2001	1	76	115	194	282	14	682
Grand Total	23	216	411	578	773	38	2039

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	50	36	51	42	4	38	42	
Highest:	757	1581	1483	1162	1574	1020	1107	
Mean:	247	190	179	209	180	199	203	
Median:	139	123	126	164	138	159	160	

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

% summary	Very Low	Low	Medium	High	Very High	Un-known	Total
1995	0	6	25	33	36	0	100
1996	1	16	25	24	35	0	100
1997	1	11	30	34	21	2	100
1998	0	8	20	27	43	1	100
1999	5	9	21	29	32	4	100
2000	1	11	19	28	39	2	100
2001	0	11	17	28	41	2	100
Grand Total	1	11	20	28	38	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	0	0	0	16	16
1996	0	1	1	4	17	23
1997	0	0	0	0	12	12
1998	0	1	1	2	9	13
1999	0	0	0	1	9	10
2000	0	1	0	1	13	15
2001	0	0	0	1	21	22
Total	0	3	2	9	97	111

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	203	36	232	50	179	40	197	
Highest:	1614	659	1464	1596	1336	1810	1168	
Mean:	631	361	655	421	596	627	491	
Median:	561	420	603	295	390	561	432	

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	0	0	0	100	100
1996	0	4	4	17	74	100
1997	0	0	0	0	100	100
1998	0	8	8	15	69	100
1999	0	0	0	10	90	100
2000	0	7	0	7	87	100
2001	0	0	0	5	95	100
Total	0	3	2	8	87	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	1	4	34	89	128
1996	0	1	5	43	138	187
1997	0	6	9	36	38	89
1998	0	1	6	81	163	251
1999	0	1	3	58	216	278
2000	0	1	9	90	324	424
2001	0	2	6	95	579	682
Total	0	13	42	437	1547	2039

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	56	52	21	61	43	63	55	
Highest:	1927	957	890	1658	1946	2140	1808	
Mean:	393	324	248	309	425	342	368	
Median:	304	271	175	233	311	280	323	

Prorcent 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	1	3	27	70	100
1996	0	1	3	23	74	100
1997	0	7	10	40	43	100
1998	0	0	2	32	65	100
1999	0	0	1	21	78	100
2000	0	0	2	21	76	100
2001	0	0	1	14	85	100
Total	0	1	2	21	76	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	15	1	16
1996	21	2	23
1997	11	1	12
1998	12	1	13
1999	10	0	10
2000	14	1	15
2001	22	0	22
Total	105	6	111

Percentages:

	0-49	>49	Total
	Normal	Excessive	
	94	6	100
	91	9	100
	92	8	100
	92	8	100
	100	0	100
	93	7	100
	100	0	100
	95	5	100

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	2	2	1	2	2	1	2	
Highest:	52	183	894	50	18	130	30	
Mean:	11	16	81	15	9	15	8	
Median:	7	5	6	6	7	5	5	

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	124	4	128
1996	185	2	187
1997	78	11	89
1998	237	14	251
1999	269	9	278
2000	420	4	424
2001	674	8	682
Total	1987	52	2039

Percentages:

	0-49	>49	Total
	Normal	Excessive	
	97	3	100
	99	1	100
	88	12	100
	94	6	100
	97	3	100
	99	1	100
	99	1	100
	97	3	100

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	1	1	1	1	1	1	1	
Highest:	140	594	222	117	129	170	218	
Mean:	11	14	22	14	11	8	7	
Median:	5	8	8	6	6	5	4	

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:				Percentages:		
	0-99	>99	Total	0-99	>99	Total
	Normal	Excessive		Normal	Excessive	
1995	16	0	16	100	0	100
1996	23	0	23	100	0	100
1997	11	1	12	92	8	100
1998	13	0	13	100	0	100
1999	10	0	10	100	0	100
2000	12	3	15	80	20	100
2001	21	1	22	95	5	100
Total	106	5	111	95	5	100

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	13	8	20	9	10	12	14	
Highest:	97	82	110	55	85	159	102	
Mean:	40	35	52	34	48	55	41	
Median:	35	35	48	36	50	40	36	

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	128	0	128
1996	187	0	187
1997	88	1	89
1998	244	7	251
1999	277	1	278
2000	424	0	424
2001	678	4	682
Total	2026	13	2039

Percentages:

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

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	10	14	6	11	6	6	4	
Highest:	97	86	121	170	201	83	246	
Mean:	31	40	31	29	31	23	35	
Median:	31	37	27	27	28	21	32	

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	1	3	12	16
1996	0	3	20	23
1997	0	2	10	12
1998	0	1	12	13
1999	0	3	7	10
2000	0	1	14	15
2001	0	2	20	22
Total	1	15	95	111

Percentages:

<0.5	0.5-1.0	>1	Total
Low	Medium	High	
6	19	75	100
0	13	87	100
0	17	83	100
0	8	92	100
0	30	70	100
0	7	93	100
0	9	91	100
1	14	86	100

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	0.2	0.8	0.8	0.7	0.6	0.7	0.9	
Highest:	13.2	40.8	19.8	15.3	41.0	62.6	89.9	
Mean:	4.1	6.4	5.3	4.1	15.3	11.4	9.2	
Median:	3.1	2.0	2.4	2.2	11.1	3.8	3.4	

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	9	65	54	128
1996	4	76	107	187
1997	2	35	52	89
1998	30	93	128	251
1999	22	82	174	278
2000	31	170	223	424
2001	25	147	510	682
Total	123	668	1248	2039

Percentages:

<0.5	0.5-1.0	>1	Total
Low	Medium	High	
7	51	42	100
2	41	57	100
2	39	58	100
12	37	51	100
8	29	63	100
7	40	53	100
4	22	75	100
6	33	61	100

	1995	1996	1997	1998	1999	2000	2001	
Lowest:	0.2	0.1	0.4	0.1	0.1	0.1	0.1	
Highest:	31.6	6.8	8.4	8.2	429.9	32.4	15.3	
Mean:	1.7	1.4	1.8	1.3	3.9	1.4	1.9	
Median:	0.9	1.1	1.2	1.1	1.3	1.1	1.5	

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
BNS	Beans-snap
BRP	Broccoli-transplanted
CEM	Cemetery
END	Endives
FAR	Fairway
FLA	Flowering Annuals
GRA	Grapes
GEN	Green
GPF	Grapes, French-American
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

Ketterings, Q.M., H. Krol, W.S. Reid and K. Evans (2003). Madison County Soil Sample Survey 1995-2001. CSS Extension Bulletin E03-18. 39 pages.

Crop Code	Crop Description
SWC	Sweet corn
TOM	Tomatoes
TRE	Christmas trees, Established
TRF	Tree fruits
TRT	Christmas trees, Topdressing