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Test Levels in Soil Profiles of Michigan Corn Fields

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INTRODUCTION

Chemical soil tests are used in crop growth problem solving, as a basis for fertilizer and lime recommendations and for monitoring the soil environment. Soil test summaries provide valuable information concerning a rapidly changing environment for plants, animals and man.

The first summary of Michigan soil test levels was made in 1959 and represented a compilation of results from 57 county laboratories (7). At about the same time, detailed studies were made on 92 profiles representing 35 soil series and a wide range in properties (11). Grass was growing where most of the profiles were sampled. This investigation represented the first time soil profiles were systematically sampled for soil test purposes and the first time the soil management group concept (5) was used to summarize soil test results.

By 1962 the Michigan State University Central Soil Testing Laboratory had been established, permitting soil test summaries to be related to soil management groups as well as to counties from which the sample originated (6, 8). In these studies, soil management group assignments were made in the laboratory on the basis of surface soil texture.

After 10 years, the test results from the laboratory were again summarized to show how soil test levels had changed with time (4). In general, mineral soils had become more acid and lime requirements had increased. In 10 years, available phosphorus levels increased approximately 100%, and exchangeable potassium levels 50%. In that study, tests were summarized by both soil management groups and by areas in the state. A similar study was made for organic soils in 1973 (9). All the summaries were based on test results from surface soil samples collected by an individual farmer or a farm advisor.

No summaries have been published on tests of soil used for a specific crop, although such data have been compiled (3). Few data are available on test levels in horizons below the plow layer. The purpose of this investigation was to determine test levels in the profiles of soils used for corn production in Michigan. Because corn is the most extensively grown crop, it was assumed that test levels would approximate conditions for other field crops grown in rotation with corn in the southern section of the state.

[1]Appreciation is expressed to Drs. E. P. Whiteside and R. E. Lucas for assistance in preparing this manuscript.

PROCEDURES

Soil profile samples were collected in September 1974, with the assistance of a professional soil classifier. The soil series was identified at sampling time. Soil management group assignments were made in the field on the basis of the dominant profile texture and the natural drainage conditions under which the soil developed.

Soil profiles representing specific management groups were collected on the basis of the number of acres of corn and the proportions of each management group in the counties studied.

Before sampling, a minimal standard was established. No less than two profiles were sampled per county and no less than two profiles represented a single soil management group. All counties south of the Oceana-Bay tier were included in this study.

With two exceptions, corn was growing in the fields sampled. In the exceptions, corn was the previous crop.

The specific site within a sampled field represented a location with little or no soil erosion and where the average slope was less than 6%.

Sample A represented the Ap horizon (plow layer). Sample B most frequently represented the Bt horizon, but in some of the more sandy soils represented the upper portion of a thick B horizon. Sample C usually represented the C horizon or parent material, but in some instances represented the lowest portion of a B horizon that could be reached with a 5-ft bucket auger or the underlying material of a two-storied soil.

In the laboratory, the samples were air dried and ground to pass a 10-mesh sieve. The pH was determined with a glass electrode potentiometer using a 1-to-2 soil-to-water ratio. Available phosphorus was evaluated with the Bray P1 procedure (1). Exchangeable potassium was determined by extracting the soil with neutral normal ammonium acetate (1-to-8 soil-to-extracting solution ratio, shaken for 5 minutes).

RESULTS AND DISCUSSION

The number of soil profiles sampled and the approximate number of acres of corn grown in each county are shown in Table 1. While there was not a close relationship between the number of acres of corn and the number of soil profiles sampled, there was a strong trend. For example, only two profiles were sampled in Wayne County, which produces the least corn. Six profiles were sampled in Huron County and seven in Sanilac County. These two counties are the largest in the study area and each produces relatively large acreages of corn.

The number of soil profiles collected per soil management group was proportional to the approximate number of acres within each group in the southern section of Michigan (Table 2). In this study, the number of samples representing organic soils overemphasizes the importance of this group of soils in corn production. Also, no profiles from the Oc management group were collected because only a few acres are present in the state and they are not used extensively for corn production.

To better illustrate how soils were grouped, the soil series name of the profiles sampled in each management group are shown in Table 3. Several series were sampled more than once. For example, the Kalamazoo series was sampled in five counties. The soil

Table 1. Number of soil profiles sampled and approximate number of acres of corn grown per county[a]

County	Number of soil profiles sampled	Acres of corn 1000	County	Number of soil profiles sampled	Acres of corn 1000
Allegan	3	71	Livingston	3	33
Barry	2	37	Macomb	3	21
Bay	5	19	Mecosta	3	23
Berrien	2	33	Midland	3	17
Branch	3	83	Monroe	3[b]	46
Calhoun	3	77	Montcalm	3	42
Cass	2	50	Muskegon	2	12
Clinton	4	63	Newaygo	4	21
Eaton	3	65	Oakland	2	13
Genesee	3	33	Oceana	2	11
Gratiot	4	72	Ottawa	2	38
Hillsdale	3	78	Saginaw	4	43
Huron	6	107	Sanilac	7	89
Ionia	3	63	Shiawassee	3	50
Ingham	3[b]	66	St. Clair	2	38
Isabella	4	56	St. Joseph	3	60
Jackson	2	61	Tuscola	6	69
Kent	2	38	Van Buren	3	34
Kalamazoo	4	50	Washtenaw	5	61
Lapeer	6	52	Wayne	2	4
Lenawee	3	109			

[a]Michigan Agricultural Statistics.
[b]One profile represents 1974 soybean crop.

Table 2. Number of soil profiles collected to represent each soil management group

Dominant soil profile texture	Symbol	Natural drainage: Well drained a	Somewhat poorly drained b	Poorly drained c
Clay, 40-60%	1	3	3	3
Clay loam	1.5	6	6	7
Loam	2.5	15	13	12
Sandy loam	3	17	3	3
Loamy sand	4	10	5	3
Sand	5	4	4	4
Two-storied soils	3/2		2	
	4/1, 4/2	2	3	
	5/2	2		
Organic soils	M, M/m, M/4, M/3			5

Table 3. Soil series sampled in each soil management group

Dominant soil profile texture	Symbol	Natural drainage Well drained a	Somewhat poorly drained b	Poorly drained c
Clay, 40-60%	1	Kent St. Clair	Nappanee Selkirk	Charity Hoytville
Clay loam	1.5	Morley Nester	Blount Del Ray Pert	Lenawee Pewamo Sims
Loam	2.5	Celina Dighton Guelph Isabella Kidder Miami	Capac Conover Londo Sanilac Shebeon	Brookston Kilmanagh Parkhill Tappan
Sandy loam	3	Emmet Fox Hillsdale Kalamazoo Lapeer Warsaw	Locke Matherton	Barry Sebewa
Loamy sand	4	Boyer Montcalm Oshtemo Spinks	Brady Gladwin Otisco Thetford Wasepi	Deford Gilford
Sand	5	Chelsea Croswell Graycalm Rubicon	AuGres Tedrow	Granby Roscommon
Two-storied soils	3/2		Metamora Macomb	
	4/1		Rimer	
	4/2	Metea	Selfridge	
	5/2	Melita Ottawa		
Organic soils	M/4			Adrian
	M			Carlisle
	M/m			Edwards
	M/3			Linwood
	M/3			Palms

series in Table 3 are considered to be a good representation of the soils where corn is grown in Michigan.

So that tests for other elements can be related to those described in this report and to future soil test inventories, a description of each profile sample site is included in Appendix A.

SOIL pH

A summary of the soil pH levels is shown in Table 4. The median, not the mean, was the average used because of problems associated with manipulating logarithms (pH is a logarithm).

The pH levels ranged from 4.6 in an Ap horizon to 8.6 in the parent material of another soil. In general, the average pH levels were significantly higher than those reported in previous surveys (4, 9). An explanation of this situation is not evident because the use of lime on acid soils in Michigan has not increased greatly since the 1972 survey.

The surface layers of well-drained "a" soils tended to have lower pH levels than those of naturally poorly drained "c" soils. Also, the coarse-textured surface layers tended to have lower average pH levels than the fine-textured surface layers of the well-drained soils.

With only one exception, the median pH of the Ap horizon of the naturally poorly drained mineral soils was greater than 7.0, and with only two exceptions this was the situation for the somewhat poorly drained "b" soils.

The average pH tended to increase with increased depth in the profile. This situation undoubtedly reflects the relatively young nature of Michigan soils, as well as the fact that the parent materials of many Michigan soils are calcareous.

When the soil management group is estimated in the laboratory it is difficult to distinguish between natural drainage classes. The statement made in a previous summary that "soil pH tends to be highest in the clay and clay loam soils and lowest in the loamy sand and sandy soils" is valid only for the naturally well-drained soils (4).

The range in pH levels within any single soil management group was relatively wide, but no wider than expected. Undoubtedly the management used on some of the more sandy, poorly buffered, well-drained soils caused a decrease in pH, thus expanding the natural range in pH levels.

AVAILABLE SOIL PHOSPHORUS

Wide ranges in available soil phosphorus were found in this study (Table 5). Test levels range from 1 lb/acre in several of the subsurface horizons to 315 lb/acre in an Ap horizon. This suggests that a significant increase in available phosphorus levels has occurred.

With three exceptions, the average phosphorus levels were much higher in the Ap horizon than in lower horizons. With one exception, the average levels in the well-drained soils were higher in phosphorus than in the somewhat poorly and poorly drained soils. This in part reflects the longer use of fertilizers since some of the more naturally poorly drained soils have only recently been brought into intensive production. The test levels for phosphorus

Table 4. The pH range and median levels in profiles of soil management groups

			pH range and median level[a] Natural drainage		
Dominant profile texture	Symbol	Profile sample	Well drained a	Somewhat poorly drained b	Poorly drained c
Clay, 40-60%	1	A	7.1-7.6 (7.3)[a]	5.8-5.9 (6.6)	6.6-8.0 (7.6)
		B	5.4-7.4 (6.7)	5.7-6.7 (6.5)	7.1-7.8 (7.7)
		C	7.9-8.1 (8.0)	7.9-8.0 (8.0)	7.6-8.1 (8.1)
Clay loam	1.5	A	5.9-7.7 (7.3)	6.2-8.0 (6.9)	6.5-8.1 (7.5)
		B	5.6-7.9 (7.1)	6.6-7.8 (7.5)	7.4-7.8 (7.6)
		C	6.7-8.3 (8.1)	7.8-8.4 (8.2)	7.4-8.2 (8.0)
Loam	2.5	A	5.5-7.7 (6.8)	5.6-8.3 (7.4)	7.0-8.0 (7.6)
		B	5.1-7.9 (6.8)	4.9-8.1 (7.6)	7.0-8.0 (7.6)
		C	5.7-8.3 (8.0)	7.1-8.4 (8.0)	7.7-8.2 (8.2)
Sandy loam	3	A	5.2-7.3 (6.0)	6.0-7.7 (7.6)	7.3-7.9 (7.4)
		B	4.8-7.2 (6.0)	5.3-7.8 (7.0)	7.9-8.1 (8.1)
		C	5.2-8.4 (6.2)	5.9-8.2 (8.2)	8.3-8.4 (8.4)
Loamy sand	4	A	5.8-8.1 (6.6)	6.4-7.5 (7.4)	5.0-7.4 (6.7)
		B	5.6-7.8 (6.9)	6.5-8.1 (7.5)	5.5-8.5 (7.1)
		C	6.0-8.0 (7.3)	6.6-8.6 (8.4)	4.9-8.2 (7.8)
Sand	5	A	4.6-8.1 (6.5)	5.8-7.6 (7.3)	6.5-7.6 (7.4)
		B	5.7-8.0 (7.2)	5.8-7.8 (7.4)	6.8-8.0 (7.6)
		C	5.6-7.8 (6.7)	5.8-8.2 (6.8)	6.8-8.1 (7.8)
Sandy loam over loam	3/2	A	---	7.6-7.8 (7.7)	---
		B	---	7.6-7.9 (7.8)	---
		C	---	8.1-8.5 (8.3)	---
Loamy sand over clay to loam	4/1, 4/2	A	5.8-6.4 (6.1)	5.8-7.8 (6.3)	---
		B	6.4-6.6 (6.5)	5.2-7.9 (7.3)	---
		C	7.8-7.8 (7.8)	7.0-8.4 (8.0)	---
Sand over loam to clay loam	5/2	A	5.7-6.4 (6.1)	---	---
		B	5.4-5.7 (5.6)	---	---
		C	6.1-6.1 (6.1)	---	---
Muck	M, M/m, M/3, M/4	A	---	---	5.7-7.0 (5.9)
		B	---	---	4.8-7.1 (5.9)
		C	---	---	5.6-7.6 (7.3)

[a]Median level in parentheses.

Table 5. Available phosphorus levels in the profiles of soil management groups

Dominant profile texture	Symbol	Profile sample	Pounds per acre P, range and mean[a] Natural drainage: Well drained a	Somewhat poorly drained b	Poorly drained c
Clay, 40-60%	1	A	12-105 (60)	24-33 (28)	23-69 (48)
		B	8-14 (11)	1-21 (12)	2-4 (3)
		C	1-4 (2)	3-13 (6)	1-1 (1)
Clay loam	1.5	A	10-181 (63)	6-135 (56)	3-172 (43)
		B	3-49 (19)	3-36 (11)	2-10 (6)
		C	2-23 (8)	1-9 (3)	1-113 (18)
Loam	2.5	A	3-192 (66)	3-177 (54)	4-128 (75)
		B	1-45 (19)	3-19 (10)	4-50 (12)
		C	1-23 (6)	1-134 (13)	1-12 (5)
Sandy loam	3	A	13-315 (103)	6-71 (42)	10-25 (19)
		B	4-246 (38)	4-46 (19)	3-7 (5)
		C	1-50 (18)	1-21 (8)	1-3 (2)
Loamy sand	4	A	23-216 (87)	20-71 (45)	8-105 (49)
		B	5-62 (24)	6-146 (46)	6-34 (16)
		C	2-26 (12)	1-50 (15)	5-25 (14)
Sand	5	A	45-259 (111)	15-113 (42)	8-59 (37)
		B	18-82 (46)	15-113 (44)	8-22 (14)
		C	8-24 (15)	6-35 (19)	1-12 (6)
Sandy loam over loam	3/2	A	----	17-29 (23)	----
		B	----	6-7 (7)	----
		C	----	2-2 (2)	----
Loamy sand over clay to loam	4/1, 4/2	A	13-49 (31)	58-132 (89)	----
		B	3-78 (41)	14-25 (18)	----
		C	1-13 (7)	5-8 (6)	----
Sand over loam to clay loam	5/2	A	43-102 (73)	----	----
		B	11-46 (29)	----	----
		C	10-33 (22)	----	----
Muck	M, M/m, M/3, M/4	A	----	----	13-143 (51)
		B	----	----	6-49 (18)
		C	----	----	3-13 (5)

[a]Mean level in parentheses.

in the surface soil appear to be increasing rapidly due to the use of very high rates of commercial fertilizer and livestock manure (4).

The great difference in phosphorus levels between the surface and subsurface samples illustrates the importance of preventing soil erosion. White and Doll concluded that about 10 lb/acre of P_2O_5 are required to increase phosphorus soil test levels 1 lb (10). Thus, for example, if the surface soil in management group 1a were to be eroded away, an average of 490 lb of P_2O_5 would be required to build the phosphorus levels of the subsoil up to the original level of 60 lb. This is equivalent to more than one-half ton of 0-46-0 per acre.

The average test levels in the well-drained soils were high enough, with one exception, for at least 90 bu/acre of shelled corn to be produced without the use of phosphate fertilizer (2). This is significant in light of the current worldwide phosphate fertilizer shortage. This situation stresses the importance of basing phosphate use on a good soil testing program.

EXCHANGEABLE SOIL POTASSIUM

As with phosphorus, the test levels for potassium covered a wide range varying from 9 to 720 lb/acre (Table 6). The low level probably represented a situation where the subsoil was naturally low, but the high level undoubtedly reflects an accumulation of potassium from the use of large amounts of manure or fertilizer.

In contrast with the phosphorus test levels, there was no consistent difference in average potassium test levels in the three drainage classes. But corn grown on the fine-textured soils (1 or 1.5) would not be expected to respond to potassium with such high average test levels.

The average levels of exchangeable potassium tended to decrease with depth in the profile except on soils with two-storied parent materials. This again suggests that erosion would cause a significant loss of available nutrients.

The levels of exchangeable potassium in the finer-textured soils tended to be much higher than in the coarser-textured soils. This was in agreement with the findings of Doll *et al.* (4).

TRENDS IN SOIL TEST LEVELS

This study was not designed to evaluate trends in soil test levels, but attempts to do this will undoubtedly

Table 6. Exchangeable potassium levels in profiles of soil management groups

Dominant profile texture	Symbol	Profile sample	Pounds per acre, range and mean[a] Natural drainage: Well drained a	Somewhat poorly drained b	Poorly drained c
Clay, 40-60%	1	A	187-480 (347)[a]	222-392 (309)	267-720 (516)
		B	151-300 (210)	178-252 (214)	200-491 (355)
		C	109-190 (150)	142-175 (156)	130-387 (283)
Clay loam	1.5	A	150-442 (265)	253-533 (360)	120-549 (284)
		B	150-265 (213)	116-303 (204)	120-307 (206)
		C	130-240 (152)	107-196 (150)	142-491 (259)
Loam	2.5	A	71-373 (201)	70-686 (235)	80-526 (225)
		B	80-293 (154)	109-387 (166)	70-220 (145)
		C	33-140 (97)	50-400 (118)	90-180 (121)
Sandy loam	3	A	76-627 (270)	124-240 (175)	100-278 (173)
		B	44-396 (148)	110-196 (160)	50-160 (103)
		C	9-420 (88)	22-80 (49)	30-70 (45)
Loamy sand	4	A	55-360 (159)	98-265 (164)	175-300 (220)
		B	36-142 (69)	18-89 (53)	22-120 (74)
		C	10-142 (50)	11-80 (39)	11-70 (37)
Sand	5	A	55-131 (78)	44-90 (68)	44-120 (76)
		B	44-169 (72)	22-70 (43)	11-22 (18)
		C	33-87 (59)	11-60 (38)	9-22 (18)
Sandy loam over loam	3/2	A	----	110-133 (122)	----
		B	----	89-120 (105)	----
		C	----	53-110 (82)	----
Loamy sand over clay to loam	4/1, 4/2	A	130-300 (215)	50-293 (178)	----
		B	44-130 (87)	20-220 (105)	----
		C	98-130 (114)	76-267 (141)	----
Sand over loam to clay loam	5/2	A	278-400 (339)	----	----
		B	50-62 (56)	----	----
		C	20-142 (81)	----	----
Muck	M, M/m, M/3, M/4	A	----	----	55-640 (317)
		B	----	----	53-267 (146)
		C	----	----	11-142 (100)

[a]Mean level in parentheses.

be made. Therefore, the data have been regrouped to be most comparable with test levels previously reported (4).

In Table 7, soil profile textures of clay, 1, and clay loam, 1.5, have been combined. In agreement with the procedure used in the soil testing laboratory, the loam, 2.5, profile texture was labeled 2. For each profile texture, the three drainage classes were combined into one average.

In this study, the average levels for pH in 1974 of all soil groups were equal to or higher than those reported in 1971. Average phosphorus levels were higher in the finer-textured soils and lower in the coarse-textured soils in 1974. Except in sand soils, 5, potassium levels were higher in 1974.

LIME AND FERTILIZER REQUIREMENTS FOR CORN

If test levels in the surface soil can be used to evaluate fertilizer and lime requirements of corn grown in Michigan, certain conclusions concerning current requirements of fertilizer and lime can be drawn.

Only 20 out of 135 fields tested had a pH below 6.0. Therefore, assuming that maximum corn production can be obtained at pH 6.0 or above, only 15% (300,000 acres) of an estimated 2 million acres is in immediate need of lime.

Table 7. A comparison of soil test levels in surface soils of this study with those determined in 1971

Management group symbol	pH 1971	pH 1974	P 1971	P 1974	K 1971	K 1974
1	6.4	7.1	41	51	215	322
2	6.6	7.1	51	65	200	220
3	6.4	6.4	87	84	193	245
4	6.3	6.8	101	69	169	170
5	6.1	6.8	116	63	144	74

In regard to phosphate fertilizers with yield goals in the range of 120 to 150 bu/acre, no yield increases can be expected when test levels are above 80 lb. Of the 135 fields tested, 40 had tests above this level. This is equal to 30% of the fields or 600,000 acres. All are currently receiving significant amounts of phosphate fertilizer. If phosphate fertilizer shortages are critical, this represents 600,000 acres where yields would not be significantly reduced if no phosphate was used.

To achieve the state average of 80 bu/acre, a minimum test level of 40 lb of phosphorus is required if no fertilizer is used. Of the 135 samples tested, 79 had levels in excess of 40 lb. This is equal to 59% or equivalent to 1,800,000 acres that could produce 80 bu without phosphate fertilizer.

Regardless of texture, any soil that tests in excess of 240 lb/acre of potassium should contain ample potassium to produce 100 or more bu/acre of shelled corn. In these studies, 51 samples tested in excess of 240 lb/acre. This is 38%, which is equivalent to 760,000 acres.

These data illustrate well that if farmers used fertilizer on the basis of soil test information, current fertilizer shortages would be less severe. Less fertilizer would be used on high testing soils and more would be available for low testing soils.

SUMMARY AND CONCLUSIONS

Soil profile samples were collected from 135 locations and tested in the Central Laboratory of Michigan State University. If soil samples submitted to the laboratory by farmers and others are representative of soil conditions in Michigan and if the sampling procedure used in these studies is also representative, it is logical to conclude that test levels for pH, available phosphorus and exchangeable potassium are continuing to increase at a rapid rate.

Generally, test levels are now high enough that soil testing should be used as much to predict a lack of response from commercial fertilizer as to determine how much and what kind of fertilizer and lime should be used. This is a significant change from the past and also a pertinent consideration in today's economy, where fertilizer shortages are real and prices are rapidly increasing. Within every soil management group in southern Michigan there was a wide range in test levels, thus emphasizing that, in addition to the kind of soil and expected yield, soil testing is important in determining today's fertilizer needs.

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APPENDIX A.
LOCATION OF SOIL PROFILE SAMPLE SITES

County	Township	Section	Quarter section	Soil series	Soil management group
Allegan	Wayland	23	NW	Granby	5c
	Wayland	35	SW	Spinks	4a
	Lee	17	NE	Tedrow	5b
Barry	Rutland	34	NE	Ottawa	5/2a
	Woodland	23	NE	Miami	2.5a
Bay	Frankenlust	7	NW	Metamora	3/2b
	Frankenlust	8	NE	Londo	2.5b
	Frankenlust	2	NW	Tappan	2.5c-c
	Hampton	30	NE	Parkhill	2.5c
	Merritt	9	SW	Selfridge	4/2b
Berrien	Berrien	1	NW	Kalamazoo	3a
	Bainbridge	16	SW	Chelsea	5a
Branch	Butler	33	SE	Barry	3c
	Girard	34	SE	Locke	3b
	Sherwood	22	NE	Hillsdale	3a
Calhoun	Albion	14	NW	Matherton	3b
	Eckford	6	NE	Kalamazoo	3a
	Pennfield	36	SW	Kalamazoo	3a
Cass	Marcellus	32	SW	Kidder	2.5a
	Volinia	31	SW	Kalamazoo	3a
Clinton	Bath	19	NW	Miami	2.5a
	Dewitt	13	NE	Conover	2.5b
	Greenbush	28	SW	Adrian	M/4c
	Greenbush	24	SW	Gilford	4c
Eaton	Carmel	7	SE	Sebewa	3c
	Carmel	10	NW	Miami	2.5a
	Eaton Rapids	18	NW	Carlisle	Mc
Genesee	Argentine	9	SE	Lenawee	1.5c
	Gaines	27	NE	DelRey	1.5b
	Clayton	26	NW	Brookston	2.5c
Gratiot	Washington	14	SE	Sims	1.5c
	Washington	12	SW	Pert	1.5b
	Washington	10	SW	Hoytville	1c
	Emerson	34	SW	Parkhill	2.5c
Hillsdale	Wright	4	SE	Matherton	3b
	Litchfield	27	SW	Hillsdale	3a
	Litchfield	32	SW	Brady	4b
Huron	Sebewaing	24	NW	Kilmanagh	2.5c
	Fairhaven	24	NE	Shebeon	2.5b
	Oliver	14	NW	Sanilac	2.5b
	Colfax	5	SE	Shebeon	2.5b
	Sheridan	12	SE	Granby	5c
	Sheridan	12	SE	AuGres	5b
Ionia	Berlin	24	SW	Brookston	2.5c
	Berlin	36	SW	Conover	2.5b
	Sebewa	31	NE	Miami	2.5a
Ingham	Vevay	4	NE	Conover	2.5b
	LeRoy	20	SE	Brookston	2.5c
	Lansing	36	SE	Kidder	2.5a
Isabella	Lincoln	24	NE	Nester	1.5a
	Lincoln	14	SE	Gladwin	4b
	Lincoln	17	SW	Graycalm	5a
	Rolland	21	NW	Menominee	4/2a
Jackson	Blackman	19	SW	Spinks	4a
	Parma	24	NW	Hillsdale	3a
Kent	Alpine	32	SE	Nester	1.5a
	Lowell	34	NE	Conover	2.5b
Kalamazoo	Charleston	32	NE	Kalamazoo	3a
	Comstock	36	SW	Warsaw	3a
	Pavilion	11	SW	Granby	5c
	Pavilion	10	SE	Palms	M/3c
Lapeer	Lapeer	15	NW	Morley	1.5a
	Lapeer	10	SW	Blount	1.5b
	Lapeer	3	SW	Kidder	2.5a
	Imlay	16	NE	Linwood	M/3c
	Imlay	15	SE	Nappanee	1b
	Almont	24	SW	Sebewa	3c
Lenawee	Riga	13	NW	Hoytville	1c
	Fairfield	22	NE	Nappanee	1b
	Seneca	28	NE	Blount	1.5b
Livingston	Conway	35	SW	Miami	2.5a
	Handy	1	NW	Brookston	2.5c
	Cohoctah	6	NW	Spinks	4a
Macomb	Washington	7	NW	Fox	3a
	Bruce	3	SE	Lapeer	3a
	Bruce	15	NW	Miami	2.5a
Mecosta	Millbrook	16	SE	Dighton	2.5a
	Millbrook	17	SE	Montcalm	4a
	Hinton	16	SW	Rubicon	5.3a
Midland	Porter	34	NW	Selfridge	4/2b
	Porter	18	SE	Crosswell	5a
	Jasper	30	NW	Capac	2.5b
Monroe	LaSalle	31	NE	Pewamo	1.5c
	LaSalle	31	NE	Pewamo	1.5c
	Whiteford	18	SE	St. Clair	1a
Montcalm	Bloomer	10	SW	Nester	1.5a
	Bushnell	10	SE	Otisco	4b
	Reynolds	15	NW	Montcalm	4a
Muskegon	Holton	2	SW	Selkirk	1b
	Moorland	32	NE	Deford	4c
Newaygo	Ensley	3	SW	Emmet	3a
	Ensley	19	NW	AuGres	5b
	Grant	24	NE	Edwards	M/mc
	Grant	35	NE	Roscommon	5c
Oakland	Addison	36	SE	Macomb	3/2b
	Oakland	13	NE	Hillsdale	3a
Oceana	Greenwood	35	NW	Kent	1a
	Greenwood	2	SE	Isabella	2.5a
Ottawa	Polkton	1	NE	Nester	1.5a
	Wright	30	NW	Sims	1.5c
Saginaw	Swan Creek	9	NE	Charity	1c
	Chesaning	33	NW	Sims	1.5c
	Swan Creek	6	SE	Tedrow	5b
	Blumfield	4	SE	Parkhill	2.5c
Sanilac	Greenleaf	1	NE	Guelph	2.5a
	Greenleaf	25	NW	Melita	5/2a
	Evergreen	24	SW	Montcalm	4a
	Evergreen	36	NW	Parkhill	2.5c
	Evergreen	36	SW	Capac	2.5b
	Buel	5	NE	Alcona	3a
	Marlette	35	SE	Capac	2.5b
Shiawassee	Burns	32	SW	Conover	2.5b
	Venice	24	SW	Brookston	2.5c
	Vernon	4	NW	Celina	2.5a
St. Clair	Mussey	19	NW	Pewamo	1.5c
	Mussey	28	SE	Blount	1.5b
St. Joseph	Colon	7	SW	Kalamazoo	3a
	Nottawa	15	NW	Warsaw	3a
	Nottawa	19	NW	Oshtemo	4a
Tuscola	Millington	5	SE	Spinks	4a
	Watertown	23	SW	Kalamazoo	3a
	Watertown	10	NE	Guelph	2.5a
	Almer	22	NE	Boyer	4a
	Almer	10	NE	Londo	2.5b
	Columbia	35	NW	Parkhill	2.5c
VanBuren	Hartford	12	NE	Metea	4/2a
	Geneva	36	NE	Rimer	4/1b
	Geneva	12	NE	Granby	4c
Washtenaw	Salem	34	SW	Morley	1.5a
	Superior	2	NE	St. Clair	1a
	York	12	NE	Oshtemo	4a
	Augusta	18	SE	Blount	1.5b
	Lima	23	NE	Miami	2.5a
Wayne	Northville	13	NW	Wasepi	4b
	Van Buren	17	SW	Thetford	4b

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