Northeast Region SARE Program 2000

Comparing Soil Nutrient Levels to Seasonal Weather Fluctuations

Final Report

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Klaas and Mary-Howell Martens

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Project Title: Comparing Soil Nutrient Levels to Seasonal Weather Fluctuations
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Adequate soil nutrient levels are critical to healthy plant growth. As organic farmers, we are aware of the importance of the regular monitoring of soil nutrients and have questioned the validity of using one annual or biennial soil test, drawn at various times throughout the year with no adjustment made for season, weather, or stage of crop growth. Since this is not a topic we have seen dealt with in university or extension publications, we wanted this information for both our own use, and to share with other organic farmers. We also feel that standard university soil test recommendations are often not easily interpreted for long-term organic fertility management.

The possibility that natural seasonal nutrient fluctuations may affect soil test results and therefore their applicability raises many interesting questions. Might a single soil test need to be adjusted or re-calibrated for the time of year and stage of crop growth? For example, do cold wet winter or early spring conditions affect the measurable available nutrients? We know these conditions depress soil microbiological activity and with it, the breakdown of organic matter and mineral materials. Might a soil test taken at those times underestimate the levels of certain key nutrients, especially phosphorus, which are highly dependent on microbiological activity and temperature? If a soil test is drawn in the fall shortly after harvest before crop residue decomposes, would this also underestimate nutrient levels that will be available in the spring. Conversely, are nutrient levels ever high enough during the summer on organically farmed fields that runoff or leaching may be a concern? How effective and how fast are organic fertilizer materials in raising the availability of key nutrients at the time of peak nutrient need? How long does it take after an application of lime or other fertilizer materials until the soil test shows the full effect of the added nutrients?

As organic farmers, long term planning of crop rotations is an important part of our fertility program. A typical crop rotation includes alternating ~~crop~~ soil building and ~~crop~~ soil depleting crops, and might include a small grain with legume cover crop, followed by corn the next year, and then followed by soybeans in the third year. This crop is then followed by a winter small grain, underseeded to a legume which then often is used as a hay crop. This rotation has worked well for us, but we feel we are assuming many things about which crops are soil building, which crops are soil depleting, without really knowing if our assumptions are correct.

Project Methods:

For the second phase of this project, we continued to sample from the 6 representative fields used in the 1999-2000 study. They are at different points in the same rotation and therefore, grew different crops in 2000 than they did in 1999. All fields are of the same soil type, with similar drainage patterns and the same fertilizer program. The fields have been fully certified organic for at least 3 years and therefore have been without chemical fertilizer for at least 6 years. We have maintained detailed long term cropping, yield, and treatment records on each of the fields since 1988. In 2000, we added 15 more fields to our study and compared the results of two different soil tests done on split samples taken on each of our testing days. We looked at test results using A&L's standard extraction and compared them to results found using the Mehlich III extraction.

We contracted with Allan Buddle of the Fertrell Co. to draw soil tests every 6 weeks for 10 months from each location (March - December). Each test was drawn from the same uniform 4 acre area within each of the fields to give the most consistent samples possible. Allan is trained to take such tests properly. The soil tests were analyzed by A & L Laboratories. These tests allowed us to obtain the base saturation of each cation, and gave a measurement of both the readily available phosphorus (P1) and longer term phosphorus (P2), as well as levels of key trace elements (S, Zn, B, Mn, Fe and Cu). In 2000 we tested all these nutrients using the Mehlich extraction also.

In the extremely cold and wet 2000 season, we noticed soil test levels for some nutrients were much lower than we had anticipated, causing us to be concerned that we may have had some nutrient deficiencies. We had a tissue test done to see whether the plants were showing deficiencies of boron, phosphorus, and potassium as the soil tests suggested they might.

We compared the results within each field, tracking the availability of each nutrient over time. For our report, we have graphed the fluctuations in nutrient availability, and have drawn rudimentary conclusions concerning the possible effects that cropping, seasonal fluctuations, and specific weather patterns may have on available nutrient levels. Our technical advisors have helped us analyze and interpret the data and extrapolate what the results ~~may~~ might mean for other farms in the Northeast.

Our results

The weather conditions in both 1999 and 2000 were unusual. Temperatures seemed to warm up earlier than in the season in 1999. In 1999, we had early warm dry conditions which may have stimulated soil biological activity earlier than usual and may have reduced water-soluble nutrient leaching and runoff. New York also experienced a severe drought during the summer of 1999 with very little rain, high temperatures and frequent desiccating wind during most of the growing season. The soil became very dry, although judging both from the appearance of the plants and the yields at harvest, organic crops definitely seem to have fared much better than the conventional crops grown by our neighbors. This may have indeed caused the soil test results to reflect non-typical conditions.

In 2000, we had nearly opposite weather from 1999. Temperatures stayed way below normal all summer while rainfall was heavy and incessant during most of the growing season. On August 1, a flood caused by 8 inches of rain and followed by several more heavy rains did serious soil and crop damage. Soil test levels for phosphorus climbed after warm dryer periods and dropped dramatically after cool wetter periods especially after the August floods. These observations are consistent with the theory that phosphorus levels rise when biological activity is high and fall when conditions are not favorable for life in the soil.

We feel that it is significant however, that our tissue tests showed adequate levels of fertility despite low soil test results. Boron was especially interesting. While soil test results were in the low to very low range for boron, the tissue tests showed very high to excessive readings. We feel this is important to note because the low soil test readings taken alone could have led us to apply extra boron while the tissue tests showed that this could have been a serious mistake.

The nitrogen status of all crops in this area deteriorated seriously after the flood in August. Particularly in low spots, the plants turned yellow as soil denitrified and leached nitrogen in the wet anaerobic conditions. Some conventional crops had to be treated with additional nitrogen in August to correct N deficiencies. Organic crops regained good color without adding extra N showing us that the nitrogen from the legume plowdown resisted leaching and denitrification far better than N from fertilizer did.

Analysis of the data collected in 1999 showed considerable fluctuations in nutrient levels. Phosphorus (Table 1), in particular, showed major changes in availability which is highly correlated to time of year. This makes much sense, in light of the fact that phosphorus availability is usually associated with an active soil microbial population. As the soil warmed up, and as the microbes became more active, the average of P1 phosphorus availability doubled on all fields sampled, peaking in late May right when the crop would have needed it the most. This strongly suggested that the time of year the sample was taken should be considered along with sample results, especially for phosphorus, when developing fertilizer recommendations.

Our results in 2000 showed how dangerous it can be to make generalizations based on only one year of data. While phosphorus level did tend to climb moderately with the warming of the soil, they fell sharply as later whenever heavy rains came and saturated the fields. The lowest P reading we obtained during the entire 2 year period was the test taken after the August flood. In 2000, phosphorus did not increase dramatically as it did the previous year. We can safely say that we must avoid sampling soil after any event that impairs biological activity if we want to get accurate and useful test results.

Similar results were seen in 1999 with other essential plant nutrients. We found that magnesium (Table 2) held very steady throughout the season, and calcium showed minor fluctuation, with a slight decline right after plowing. The slight decline in calcium and potassium levels probably reflect crop removal during the growing season. Applications of gypsum did not appear to have any rapid effect on magnesium or calcium levels, but gypsum did have a dramatic effect on sulfur levels (Table 5), with a sharp but short-lived spike both after fall and early August applications. This is about what we would expect, because as an anion, sulfur would have a strong tendency to move through the soil profile with water.

Nutrient levels for zinc, copper and boron (Table 3) may be indicative of crop removal. The early rise in zinc may have been due to the zinc in starter fertilizer materials, yet boron in the starter fertilizers did not give a similar increase. Levels of iron and manganese (Table 4) peaked early in the season before plowing but then showed a steady decline. The relatively high manganese level is probably the result of high pH, as is the somewhat lower iron level. None of the crops showed Fe deficiencies on our farm despite the higher manganese level, even in soybeans which show iron deficiency easily.

Discussion

Dr. Julien Hountin of the Rodale Institute indicated to us that on soils such as ours, with a high pH and containing free lime and magnesium, he believed the phosphorus readings obtained by the Mehlich III extraction would be more reflective of phosphorus availability than the more common strong bray and week bray extractions used by most labs. He indicated that the divalent calcium and magnesium ions would bind with some of the free phosphorus ions, forming stable compounds (most notably tricalcium phosphate) and prevent them from being dissolved by the extracting materials used in the Bray soil tests, but still somewhat useable by the crop. The Mehlich extraction would pick up some of this phosphorus and show it in the test results.

When we compared the Mehlich III soil test for phosphorus results with those from the Bray extractions, it appears that Dr. Hountin may have a valid point. The crop growth and the tissue test results from the fields we sampled agreed more closely with the Mehlich test than with the Bray tests. This was especially true in the 2000 season when the conditions for soil biological activity were less favorable. On high calcium soils that have medium to low P readings with the Bray extraction, the high rates of phosphate fertilizers generally recommended may be unnecessary for high crop yields and detrimental to the soil in the long term , especially if soil tests are taken early in the season from cold soils.

On five fields recently added to our farm that had been intensively farmed by conventional vegetable growers before we started farming them organically, calcium and magnesium levels were much lower than on other land of the same soil type. These fields were not part of our study, but are mentioned here because they have much lower calcium and magnesium levels than those normally found in these soil types. On these fields, calcium saturations ranged from 40% to 62% with magnesium generally from 9% to 11%. The pH of these fields was obviously much lower than normal, ranging from 5.5 to 6.2. Significantly, The P1 and P2 levels of these fields were excessively high and the exchange capacities were much lower, between 5.5 to 6.6, rather than 10 to 12 normally found in this soil type. Potassium levels were about the same as normally found in this soil but with the much lower exchange capacities, K base saturation percentages were much higher.

It would be interesting to follow these observations up on soils with excessive P tests in areas like the Chesapeake bay watershed. If bringing calcium and magnesium levels up can reduce the solubility of phosphorus, as is generally believed to be true, and as these soil tests strongly imply, then perhaps phosphorus runoff could be reduced from such farms with better use of soil tests and proper use of liming materials.

Soil organic matter (Table 6) has us somewhat puzzled. In 1999 it fluctuated surprisingly over the season. It was fairly stable from February through May, but then it seemed to climb slowly in early summer and "spiked" in August. This is almost the inverse of what we had expected and was noted in every field regardless of crop and previous crop history. Because the organic matter levels were so consistent among the 6 fields, we do not feel this is simply the result of sampling error. The large amount of fresh material that was plowed into the soil in May did not raise organic matter levels in the late May soil test at all. During the summer, when we would have expected a decline in organic matter due to microbial breakdown, we saw it climb steadily. Drought conditions early in the season would have slowed decomposition, then timely rains in early August may have stimulated microbial and earthworm activity in the upper layers of soil.. Significant root mass of the plants in the fields would not have contributed to the organic matter test because visible organic particles such as root pieces or bits of straw are removed from samples in the lab before testing for OM. In 2000 we did not gain organic matter during the summer like we did the previous year and we ended the year with a net loss in organic matter level.

We feel that the soil microorganisms stimulated by plant root exudates may form a significant form of soil organic matter that is not widely recognized. When added soil organic matter is studied, usually only the weight of the above ground plant material is measured. Measuring root mass is much more difficult, although some researchers have done so. Research has produced estimates of the contribution to soil organic matter from crop residues, cover crop material, compost additions, and root systems but we have not seen any measurements of root exudate contributions to soil organic matter content. If large quantities of these exudates are produced and feed soil fungi and bacteria in the root zone, as many researchers believe, then they could be a major contributor to soil organic matter levels. This diverse microbial community combines materials in the root exudates with oxygen, nitrogen, and minerals from the soil to grow and multiply. Sticky products made by soil microorganisms help bind soil particles together in stable aggregates which resist compaction and erosion. When these organisms die, the remains become food for other organisms and more stable forms of organic matter.

Root exudates probably contribute to organic matter levels by stimulating microbial growth in the rhizosphere. Dr. Elaine Ingham has said that a large portion of the food manufactured by a plant is often given off as root exudates. These exudates feed a large mix of organisms in the rhizosphere around the roots that symbiotically help the plant by supplying many of the nutrients that it needs. These symbiotic relationships were described in detail over 50 years ago by Dr.William Albrecht. In Volume III in the Albrecht Papers, "Hidden Lessons in Unopened

Books", Albrecht discusses the findings of Dr. S.C. Hood of Hood Laboratories, in Tampa, Florida. Dr. Hood studied plant roots and their symbiotic relationship to the many microorganisms in the soil. He drew on work of many other scientists in the early to mid twentieth century including Krasnilikov who studied the precise makeup of root exudates and their effects. Ludwig Jost was a plant physiologist who recognized the relationships between roots and the soil fungi and bacteria that surround them as early as 1903. It's ironic that some of this knowledge that was gathered so long ago is now being 'discovered' by modern researchers who see this as a new field of study.

Some recent research has used emissions of CO2 as a measure of carbon loss and organic matter loss from the soil. The researchers conducting this work have concluded that since plowing releases a burst of CO2 from a field, then this is not a good agronomic practice since carbon is then released into the atmosphere. We question this conclusion. Respiration by an active microbial population would naturally produce CO2. Plowing, and other tillage operations that add oxygen to the soil, would stimulate a dynamic microorganism population, producing more respiration, and therefore, more CO2. Could higher field CO2 emissions indicate an actively multiplying soil microbial population, which could represent increasing organic matter, while lower CO2 emissions might indicate a more sterile soil?

After discussing soil testing with several other farmers and researchers at the 1999 MOFGA conference, we realize that the particular lab doing the testing could produce results very different from what other labs would obtain. For this reason, the November 1999 samples were each split in 2 parts - one set went to A &L Labs for analysis, the lab that has done the rest of the samples. The other set was sent to the University of Vermont soil testing program, after consultation with Dr. Fred Magdoff. The results found by UVT were remarkably consistent with those from A&L.

The second year of SARE funding for this project has allowed us to see whether the considerable nutrient level fluctuations we saw in 1999 were repeated under extremely different weather conditions. Because of the excessive rainfall and extreme cold in 2000, this second year of data has let us look at soil test results under opposite conditions than in 1999. The continued SARE funding in 2000 provided additional testing for a second year allowing us to expand our results. We feel that much more replication of similar tests under a wider range of years and conditions will be necessary before definitive conclusions that can be reached that will be truly helpful to optimize soil test recommendations. Still, our findings do point to limitations to using soil tests alone and show that many other factors should be considered along with test results in managing soil fertility.

We sincerely hope that others continue this line of study..

The Farm Operation

We currently are farming over 1300 acres, all under organic management. All but 60 acres were be fully certifiable in 2000. Our principle crops include corn, soybeans, edible dry beans, small grains, hay, and sweet corn. We have been certified organic since 1994, and currently are certified by OCIA and Organic Forum. Approximately 380 of our acres are owned, with the balance rented. A large percentage of the rented land had been abandoned by commercial farmers, due to poor yields. Since we started farming the land organically, soil condition and yields have improved dramatically. We are full time farmers. Most of the land is of the Honeoye and Lima soil group.

Klaas, a life long farmer, has extensive experience with growing field crops. He holds an AAS from SUNY Cobleskill. He is the past president of New York Certified Organic, Inc., an organic farmers education and certification group which is the New York Chapter of OCIA and currently serves as the Education/Program Director for the group. He consults with several farmers who are converting to organic practices. Mary-Howell holds a MS from Cornell University in Vegetable Breeding. She worked 10 years in grape breeding at the New York State Agricultural Experiment Station and as an Instructor at Finger Lakes Community College teaching Plant Structure and Function. She is also the Chapter Administrator of New York Certified Organic, she is a full partner in the farm operation, and serves on the USDA Advisory Committee for Agricultural Biotechnology.

How will the project help Northeast farmers:

Soil testing and fertility programs are often a bit of a mystery to many farmers. We have shared this soil fertility information during the past 2 years through our certification group, New York Certified Organic, Inc, both orally at chapter meetings and as periodic updates in our monthly newsletter. We also spoke about this information at the Nov. 1999 MOFGA conference in Bar Harbor, ME, at the Dec. 1999 Acres USA conference in Minneapolis, the 2001 NOFA-NJ conference, the 2001 NOFA-VT conference, the Greater Limestone Valley organic transition conference, the 2001 SCOAR conference at Asilomar Ca., and both the Feb. 2000 and 2001 Pennsylvania Certified Organic conferences in Bird-in-Hand, PA, and an Extension Training Program in sustainable agriculture at the Rodale Institute in PA in April 2001. The information was also shared at a meeting of the Leatherstocking Organic Network of New York farmers in Cooperstown, NY in March 2000, at several meetings of the Yates County Soil and Water Conservation District, and a meeting with the staff and clients of Agricultural Consulting Services of Rochester, NY. We collaborated with Eric and Anne Nordell, contributing both data and ideas for an article they wrote for the Small Farm Journal. Klaas spoke of the research at a meeting hosted by Dr. Thomas Bjorkman and Dr. Steve Reiners in Geneva, NY early in the year 2000, mainly involving commercial vegetable producers. This particular meeting primarily concerned a different SARE funded project on phosphorus leaching. Now that two years of this data is complete, it will be written up as an article in Acres USA.

By sharing our findings with many other farmers and researchers, we believe that we have sparked more work that will help our greater understanding of this subject. Dr. Thomas Bjorkman, one of our collaborators, has done a similar experiment but with more frequent tests to give a higher 'resolution' to the fertility fluctuations we are looking at. Dave Mattocks, another of our collaborators, is taking the timing of samples into account when developing fertilizer recommendations from soil tests for his clients. Eric and Ann Nordell, while not listed as collaborators have become de facto collaborators with us and have exchanged data and ideas with us concerning our study and one that they are doing where the same fields have been tested twice a year for a long period and nutrient levels are being followed. Dr. Julien Hountin, research scientist a the Rodale institute has discussed our work with us and offered some valuable ideas as have many of our local Cornell University and extension people.

Our Chapter has hosted lectures on soil chemistry and soil microbiology, and will be considering soil physical structure at a meeting during the winter. As we and other members of our Chapter have learned more about soil fertility, we have become aware that time of sampling may be a critical variable in interpreting soil test results and we have seen no research where this factor has been studied. As organic farmers, we are not relying on highly soluble and rapidly available fertilizers and therefore must plan fertility programs further in advance and must learn to work with the natural cycling of nutrients. The better we can understand our soil test results, the better we can plan effective rotations and fertility amendments.

From these results in this research project, we feel it is important to recognize that a soil test provides a 'snap shot' of soil conditions at a particular date which may indeed not reflect soil conditions at other times throughout the growing season. Soil fertility levels appear to be quite dynamic, and this should be taken into account, particularly before applying large amounts of amendments based on the results from just one test. The yields on all these fields were extremely high in 1999 and good in 2000 with very low applications of fertility amendments. Had we followed standard soil test interpretations, based on soil tests taken on most of the dates, we would have detrimentally over-applied fertilizers well beyond what was needed for optimum crop growth.

These results of this project will not only benefit organic farmers. By understanding the natural fluctuations of nutrients, any farmer would be able to use soil test information to precisely more optimize plant response while minimizing the possibility of applying excessive amounts of fertilizer which would be expensive and might harm the environment.

field# **avg** 1999 Crop: 1998 Crop: 2000 Crop:

date	OM	P1	P2	K	Mg	Ca	pH	CEC	S	Zn	Mn	Fe	Cu	B	K%	Mg%	Ca%
4/97	**3.3**	12.0	33.0	79	173	1540	**6.8**	9.7	11	2.6	45	31	2.1	1.0	**2.1**	14.8	79.2
2-10	**3.3**	9.5	29.3	99	214	1750	**6.8**	11.2	23	3.2	43	34	2.5	1.0	**2.3**	16.1	78.2
3-20	**3.2**	11.0	32.3	93	204	1803	**6.8**	11.3	10	3.5	57	43	2.6	0.6	**2.1**	15.0	79.4
5-28	**3.3**	21.5	51.0	95	206	1600	**6.7**	10.4	8	3.8	54	38	2.5	0.7	**2.4**	16.5	76.9
7-4	**3.7**	19.5	51.0	84	202	1750	**6.8**	11.0	13	3.5	56	37	2.9	0.5	**2.0**	15.3	79.5
8-23	**4.3**	18.3	55.7	81	188	1716	**6.9**	10.7	30	3.4	54	33	2.2	0.5	**2.0**	14.9	80.1
11-12	**3.5**	14.2	31.2	79	187	1550	**6.9**	9.7	9	2.8	54	33	2.4	0.7	**2.1**	16.0	79.6
2/10	**4.7**	11.2	32.2	85	195	1683	**6.9**	10.5	20	3.4	46	29	2.3	0.7	**2.1**	15.5	80.2
4/1	**3.5**	12.3	38.3	77	190	1617	**7.0**	10.0	10	3.3	64	38	2.7	0.5	**2.0**	15.9	81.2
5/1	**4.2**	14.7	35.2	76	180	1600	**6.7**	10.1	7	2.6	46	33	2.6	0.6	**2.0**	14.8	79.3
6/10	**3.4**	11.0	31.8	72	182	1550	**6.7**	10.0	9	3.2	40	32	2.3	0.8	**1.9**	15.3	77.7
7/20	**3.2**	13.5	37.3	89	187	1600	**6.6**	10.4	12	3.2	41	36	2.3	0.5	**2.2**	15.0	76.7
9/2	**3.3**	9.7	26.3	68	163	1567	**6.7**	9.9	14	3.1	49	28	2.0	0.5	**1.8**	13.8	79.3
10/20	**3.6**	8.7	35.3	78	191	1767	**6.7**	11.1	34	3.0	53	40	2.4	0.4	**1.8**	14.5	79.8

Soil Amendments/Fertilizer

	P1	P2
Feb 10	100 (2.3)	100 (1.7)
March 20	116 (1.9)	110 (1.6)
May 28	226 (1.0)	174 (1.0)
July 4	205 (1.1)	174 (1.0)
Aug 23	193 (1.2)	190 (0.9)
Nov 12	149 (1.5)	106 (1.6)
01 Feb 10	118 (1.9)	110 (1.6)
01 April 1	129 (1.8)	131 (1.3)

Rainfall record

	1999:	2000:
April	1.05"	2.5"
May	1.05"	3.5"
June	1.84"	3.85"
July	1.82" (0.9"on7/31)	1.6"
Aug	2.09"	7.9"
Sept	5.02"	3.5"
Oct	2.38"	2.75"
Nov	2.45"	

Observations

field# 23A — 1999 Crop: **Spelt** — 1998 Crop: **DRK'S** — 2000 Crop: **Sweetcorn**

date	OM	P1	P2	K	Mg	Ca	pH	CEC	S	Zn	Mn	Fe	Cu	B	K%	Mg%	Ca%
4/97	3.3	12L	34M	63L	185VH	1570H	7.1	9.6	11M	2.9M	48H	38H	2.4H	0.9M	1.7	16.1	82.2
2/10	3.3	10L	30M	70L	211VH	1820H	6.9	11.2	17H	3.7H	57VH	42H	2.6H	0.9M	1.6	15.7	81.3
3/20	2.6	13L	35M	75L	203VH	1870H	7.0	11.2	8M	3.7H	62VH	49H	2.8H	0.5L	1.7	15.1	83.2
5/28	3.2.	23M	54H	62L	209VH	1700H	7.2	10.4	6L	4.3H	71VH	47H	2.8H	0.6M	1.5	16.7	81.7
7/04	3.9	17L	48H	58L	192VH	1700VH	7.0	10.2	10M	3.5H	64VH	48H	3.1VH	0.7M	1.5	15.6	82.9
8/23	4.1	13L	49H	51VL	185VH	1600H	7.1	9.7	42VH	3.5H	54VH	44H	2.3H	0.5L	1.4	15.9	82.7
11/12	4.0	12L	35M	62L	165VH	1500VH	7.0	9.0	8M	2.6M	57VH	41H	1.9H	0.6M	1.8	15.2	83.0
2/10	4.1	15L	36M	77L	164VH	1500H	6.9	9.2	9M	3.3M	48H	36H	2.2H	0.7M	2.1	14.9	81.6
4/01	3.0	14L	36M	54VL	161VH	1500H	6.9	9.1	7L	2.6M	48H	45H	2.7H	0.7M	1.5	14.7	82.4
5/01	3.3	13L	33M	49VL	157H	1500H	6.9	9.1	5L	2.3M	38H	37H	2.3H	0.7M	1.4	14.4	82.8
6/10	2.9	8VL	29M	47VL	175VH	1600H	6.9	9.7	5L	2.7M	52VH	39H	2.2H	0.7M	1.2	15.0	82.4
7/20	3.5	11L	31M	54VL	188VH	1500H	6.4	10.1	12M	3.4M	47H	47H	2.7H	0.5L	1.4	15.5	74.2
9/02	2.9	8VL	26M	59L	166H	1600H	6.7	10.0	17H	5.5H	51VH	36H	2.0H	0.6M	1.5	13.9	80.1
10/20	4.4	7VL	33M	67L	199VH	1800H	6.8	11.2	62VH	3.6H	59VH	50H	2.6H	0.5L	1.5	14.9	80.7

Soil Amendments/Fertilizer

3-97 - 8 tons leaves
5/9/97 - 1000# compost 2-4-2.5
6/23/98 - 200# GSS/gyp
11/10/98 -13oz Vitazyme
8/6/99 - 1300# Gypsum
8/10/99 - 350# 2-4-4/G

Rainfall record

1999:
April 1.05"
May 1.05"
June 1.84"
July 1.82"
(0.9"on7/31)
Aug 2.09"
Sept 5.02"
Oct 2.38"
Nov 2.45"

Observations

1996 - corn: 169bu/a
cut field badly at harvest/ tiled wet areas next spring - the field was unmanageably lumpy in 1997
1997 - soybeans: 30bu/a
1998 - DRK's 2160#/a
1999 - spelt 3520#/a
1999 -heavy growth of clover about 2 tons DM/a by winter

field# 23B — 1999 Crop: **Corn** — 1998 Crop: **Wheat** — 2000 Crop: **DRK's**

date	OM	P1	P2	K	Mg	Ca	pH	CEC	S	Zn	Mn	Fe	Cu	B	K%	Mg%	Ca%
4/97	**3.7**	13L	33M	78L	178VH	1530H	**6.7**	9.8	11M	2.7M	39H	30H	2.5H	0.9M	**2.0**	**15.2**	**78.3**
2/10	**3.1**	13L	33M	129M	219VH	2140H	**6.9**	13.0	43VH	3.9H	47H	36H	2.8H	1.1M	**2.5**	**14.0**	**82.1**
3/20	**3.0**	14L	38M	111M	205VH	2000VH	**7.0**	12.0	13H	4.1H	62VH	49H	3.2VH	0.8M	**2.4**	**14.2**	**83.4**
5/28	**3.1**	27H	57H	124M	205VH	1700H	**6.9**	10.7	9M	4.6H	54VH	39H	3.0H	0.7M	**3.0**	**16.0**	**79.6**
7/04	**3.8**	22M	65VH	94L	199VH	1900VH	**7.1**	11.4	17H	5.5H	63VH	38H	3.6VH	0.7M	**2.1**	**14.5**	**83.3**
8/23	**3.9**	24M	69VH	104M	166M	2300VH	**7.5**	13.2	21VH	4.1H	72VH	31H	2.3H	0.6M	**2.0**	**10.5**	**87.5**
11/12	**3.3**	18M	39M	98M	191VH	1700VH	**7.0**	10.3	7L	4.2H	56VH	32H	2.3H	0.8M	**2.4**	**15.4**	**82.2**
2/10	**4.6**	13L	33M	84L	198VH	1900VH	**6.9**	11.5	28VH	4.2H	46H	26H	2.6H	0.7M	**1.9**	**14.3**	**82.4**
4/1	**3.2**	13L	46H	76L	192VH	1700VH	**7.1**	10.3	14H	4.1H	53VH	33H	3.1VH	0.9M	**1.9**	**15.5**	**82.6**
5/1	**4.0**	19M	44H	92L	172VH	1600VH	**6.7**	10.1	11M	3.4M	49H	34H	3.1VH	1.0M	**2.3**	**14.2**	**79.0**
6/10	**4.0**	15L	43H	97M	188VH	1700H	**6.6**	11.0	16H	5.4H	48H	37H	3.3VH	1.2M	**2.3**	**14.3**	**77.5**
7/20	**3.1**	18M	47H	107M	190VH	1700H	**6.7**	10.8	17H	3.9H	40H	34H	2.6H	0.5L	**2.5**	**14.6**	**78.4**
9/2	**3.2**	15L	33M	72L	141H	1400H	**6.6**	8.9	13H	3.4M	53VH	32H	2.6H	0.4L	**2.1**	**13.2**	**78.8**
10/20	**4.6**	17L	54H	90L	189H	2100H	**6.8**	12.3	15H	4.1H	57VH	43H	2.8H	0.4L	**1.9**	**12.8**	**85.3**

Soil Amendments/Fertilizer

1/23/97- 700#wood ash .2-.6-2.2
3-97 - 6 tons leaves
8-97 - 1000# compost 2-4-2.5
9/5/97 - 200# blue Hi K
9/16/97- 200# GSS 2-4-2
2/7/98 - 150# Blue N
8-98 - 100# K2SO4
8-98 - 1000# compost 2-4-2.5
9-98 - 500# Gypsum
5/7/99- 200# GSS/gyp

Rainfall record

1999:
April 1.05"
May 1.05"
June 1.84"
July 1.82"
(0.9"on7/31)
Aug 2.09"
Sept 5.02"
Oct 2.38"
Nov 2.45"

Observations

1997- combined 65 bu/a oats
1998- combined 48 bu/a wheat- very heavy clover + straw plow down (7 tons DM) for 1999
1999-combined180 bu/a corn

field# 23C — 1999 Crop: **Corn** — 1998 Crop: **Wheat** — 2000 Crop: **Soybeans**

date	OM	P1	P2	K	Mg	Ca	pH	CEC	S	Zn	Mn	Fe	Cu	B	K%	Mg%	Ca%
8/13	3.8	10L	40M	75L	170H	1600H	6.6	10.2	11M	2.9M	43H	25H	2.4H	0.9M	1.9	13.9	78.3
2/10	3.3	8VL	26M	106M	227VH	1830H	6.6	12.0	35VH	3.7H	40H	25H	2.6H	0.9M	2.3	15.7	76.1
3/20	2.9	11L	33M	98L	217VH	1900H	6.6	12.3	12M	5.7H	46H	30H	2.6H	0.8M	2.0	14.7	77.3
5/28	3.3	22M	42M	95L	201VH	1600H	6.5	10.7	13H	4.0H	48H	26H	2.4H	0.4L	2.3	15.6	74.7
7/04	3.5	16L	48H	75L	229VH	2000H	6.6	12.9	21VH	4.0H	51VH	25H	2.8H	0.7M	1.5	14.8	77.7
8/23	5.6	17L	51H	76L	206VH	1800H	6.3	12.2	21VH	3.5H	47H	19H	2.2H	0.6M	1.6	14.1	73.8
11/12	3.2	12L	20L	69L	195VH	1600H	6.7	10.3	8M	3.4M	46H	21H	2.1H	0.7M	1.7	15.8	78.0
2/10	4.6	9L	30M	73L	197VH	1800H	6.7	11.3	32VH	3.4M	38H	22H	2.1H	0.6M	1.7	14.5	79.4
4/1	3.2	14L	37M	67L	190VH	1700H	7.0	10.3	20VH	3.1M	70VH	31H	2.6H	0.3VL	1.7	15.4	82.9
5/1	4.1	12L	30M	77L	185VH	1700H	6.7	10.7	7L	3.1M	42H	21H	2.9H	0.8M	1.8	14.4	79.3
6/10	4.0	11L	33M	75L	179VH	1600H	6.4	10.6	14H	4.5H	37H	23H	2.3H	0.8M	1.8	14.0	75.2
7/20	3.1	11L	31M	74L	181VH	1700H	6.6	10.8	18VH	3.5H	38H	24H	2.2H	0.5L	1.8	13.9	78.4
9/2	3.5	11L	26M	47VL	150H	1600	6.6	10.0	18VH	3.1M	52VH	27H	2.0H	0.3VL	1.2	12.5	80.3
10/20	3.3	9L	34M	63L	183H	1900	6.7	11.7	16H	3.5H	47H	27H	2.6H	0.5L	1.4	13.0	81.1

6

Soil Amendments/Fertilizer

8-97 - 1000# compost 2-4-2.5
2/7/98 - 150# Blue N
8-98 - 100# K2SO4
8-98 - 1000# compost 2-4-2.5
9-98 - 500# Gypsum
5/7/99- 200# GSS/gyp
6/19/99: 1.0 Qt Fertrel folier #3 + 5 oz Vitazyme/ acre + crop specific additive
11/23/99- 500# compost 2-4-2.5

Rainfall record

1999:
April 1.05"
May 1.05"
June 1.84"
July 1.82"
(0.9"on7/31)
Aug 2.09"
Sept 5.02"
Oct 2.38"
Nov 2.45"

Observations

1997 - 2700# DRK's
1998 - 52 bu/a wheat - very heavy clover + straw plow down (7 tons DM) for 1999
1999 - 187bu/a corn

field# 23D   1999 Crop: **DRK'S**   1998 Crop: **CORN**   2000 Crop: **Spelt**

date	OM	P1	P2	K	Mg	Ca	pH	CEC	S	Zn	Mn	Fe	Cu	B	K%	Mg%	Ca%
4/14	3.3	13L	25L	115M	184VH	1460H	6.4	10.0	11M	2.8M	46H	25H	2.2H	1.8H	2.9	15.3	72.8
2/10	3.4	12L	31M	135H	218VH	1620H	6.8	10.6	14H	3.6H	53VH	36H	2.7H	0.9M	3.3	17.2	76.6
3/20	4.1	16L	39M	113M	214VH	1740H	6.7	11.3	9M	3.4M	61VH	40H	2.5H	0.4L	2.6	15.8	77.1
5/28	2.9	22M	53H	131H	198VH	1400H	6.5	9.4	7L	3.5H	53VH	41H	2.3H	1.0M	3.6	17.5	74.4
7/04	3.9	26M	49H	130M	195VH	1500H	6.4	10.4	12M	3.2M	48H	31H	2.6H	0.4L	3.2	15.6	72.2
8/23	4.4	23M	61VH	113M	198VH	1500H	6.9	9.6	16H	3.7H	60VH	31H	2.3H	0.5L	3.0	17.2	78.4
11/12	3.7	16L	27M	118M	190VH	1400H	6.7	9.3	7L	2.7M	49H	27H	3.1VH	0.7M	3.3	17.0	75.2
2/10	4.5	13L	32M	103M	217VH	1600H	6.9	10.2	9M	4.0H	51H	24H	2.3H	0.5L	2.6	17.7	78.3
4/1	3.7	17L	39M	126M	203VH	1500H	6.9	9.6	5L	4.2H	83VH	32H	2.5H	0.3VL	3.3	17.5	77.7
5/1	4.6	21M	40M	105M	166VH	1400H	6.9	8.8	5L	2.8M	50H	34H	2.5H	0.7M	3.1	15.8	79.8
6/10	3.1	13L	29M	106M	176VH	1400H	6.7	9.1	5L	2.5M	37H	26H	2.0H	0.5L	3.0	16.0	76.5
7/20	3.2	12L	31M	99M	183VH	1400H	6.6	9.3	5L	3.0M	34H	27H	2.1H	0.4L	2.7	16.3	75.0
9/2	3.5	11L	24L	86L	155H	1300H	6.2	9.1	5L	2.5M	42H	25H	1.9H	0.4L	2.4	14.2	71.3
10/20	3.3	6VL	32M	106M	193VH	1500H	6.5	10.1	27VH	2.7M	48H	32H	2.3H	0.5L	2.7	15.9	74.0

Soil Amendments/Fertilizer

8-97: 15 tons/a cow manure
9-97: 1000# compost 2-4-2.5
9/6/97- 50#/a K2SO4
5/8/98: 200#/a GSS
12/28/98:700#/a compost2-4-2.5
6/8/99: 300#/a 2-4-4 gyp

Rainfall record

1999:
April 1.05"
May 1.05"
June 1.84"
July 1.82"
(0.9"on7/31)
Aug 2.09"
Sept 5.02"
Oct 2.38"
Nov 2.45"

Observations

1999- planted spelt in Oct
1999- 2960# DRK's
1998- 200bu/a corn
1997- 44bu/a Rye (removed 2t straw) - heavy clover plowed down about 5 t DM by spring 98

field# 27E   1999 Crop: **Spelt**   1998 Crop: **DRK's**   2000 Crop: **Sweetcorn**

date	OM	P1	P2	K	Mg	Ca	pH	CEC	S	Zn	Mn	Fe	Cu	B	K%	Mg%	Ca%
4/3	**2.8**	15L	39H	70L	149H	1500VH	**6.9**	9.0	11M	2.5M	47H	35H	1.8H	0.6M	**2.0**	**13.7**	**82.9**
2/10	**3.8**	10L	29M	71L	204VH	1580H	**6.8**	10.1	15H	2.3M	32H	34H	2.1H	1.0M	**1.8**	**16.9**	**78.4**
3/20	**3.5**	10L	32M	74L	195VH	1760H	**6.8**	10.9	10M	2.2L	71VH	45H	2.4H	0.4L	**1.7**	**14.9**	**80.5**
5/28	**3.1**	23M	54H	77L	210VH	1600H	**6.8**	10.2	5L	3.5H	50H	46H	2.2H	0.6M	**1.9**	**17.1**	**78.1**
7/4	**3.8**	22M	58H	76L	189VH	1700VH	**7.2**	10.3	9M	2.5M	60VH	42H	2.6H	.3VL-	**1.9**	**15.3**	**82.8**
8/23	**4.0**	22M	62VH	78L	201VH	1700H	**6.9**	10.5	59VH	3.1M	47H	40H	2.1H	0.4L	**1.9**	**15.9**	**80.8**
11/12	**3.3**	17L	38M	66L	183VH	1600H	**7.1**	9.7	17H	2.5M	63VH	38H	2.7H	0.6M	**1.7**	**15.7**	**82.5**
2/10	**5.7**	11L	34M	90L	199VH	1600H	**6.7**	10.4	9M	3.2M	52VH	34H	2.3H	0.6M	**2.2**	**16.0**	**77.3**
4/1	**4.0**	11L	40M	73L	197VH	1700H	**6.9**	10.5	7L	2.8M	80VH	48H	2.6H	0.5L	**1.8**	**15.7**	**81.2**
5/1	**5.0**	12L	35M	65L	206VH	1800H	**6.6**	11.6	6L	2.2L	53VH	41H	2.5H	0.7M	**1.4**	**14.8**	**77.8**
6/10	**3.4**	9L	28M	50VL	187VH	1500H	**6.4**	10.1	10M	2.0L	31H	35H	2.2H	0.7M	**1.3**	**15.4**	**74.4**
7/20	**3.4**	21M	52H	118M	197VH	1600H	**6.5**	10.7	10M	2.8M	37H	44H	2.3H	0.5L	**2.8**	**15.3**	**74.5**
9/2	**3.3**	7VL	24L	70L	173H	1800VH	**6.9**	10.8	19VH	1.9L	48H	30H	1.7H	0.5L	**1.7**	**13.4**	**83.6**
10/20	**3.1**	6VL	30M	63L	182VH	1600H	**6.6**	10.3	63VH	2.2L	57VH	44H	2.2H	0.3VL	**1.6**	**14.7**	**77.8**

Soil Amendments/Fertilizer

8/10/99 - 350# 2-4-4 G
8/06/99 - 1250# Gypsum
11/10/98 - 10 oz. Vitazyme
06/23/98 - 200# GSS 2-4-2
07/XX/97 - 140# K2SO4
04/30/97 - 1000# Compost
01/23/97 - 400# Wood Ash

Rainfall record

1999:
April 1.05"
May 1.05"
June 1.84"
July 1.82"
(0.9"on7/31)
Aug 2.09"
Sept 5.02"
Oct 2.38"
Nov 2.45"

Observations

7/99 3714# spelt /a+ 2000# straw(seeding smothered in some spots-good late growth
10/98 1928#DRK'S /a
1997 sold 2.5 t /a alfalfa (left one cutting in field)
1996 sold 6.1 t /a alfalfa

field# 27F — 1999 Crop: **Corn** — 1998 Crop: **Clover** — 2000 Crop: **DRK's**

date	OM	P1	P2	K	Mg	Ca	pH	CEC	S	Zn	Mn	Fe	Cu	B	K%	Mg%	Ca%
4/3	**3.1**	9L	28M	71L	169VH	1580H	**6.8**	9.8	11M	1.9L	45H	34H	1.4H	0.8M	**1.9**	**14.4**	**80.8**
2/10	**3.1**	4VL	24L	85L	206VH	1510H	**6.6**	10.1	14H	1.8L	29H	33H	2.0H	1.0M	**2.2**	**17.0**	**74.9**
3/20	**2.8**	6VL	25L	88L	191VH	1550H	**6.5**	10.3	6L	1.9L	39H	42H	2.1H	0.5L	**2.2**	**15.4**	**75.0**
5/28	**3.9**	12L	44H	83L	215VH	1600H	**6.4**	11.0	8M	2.7M	49H	35H	2.2H	0.8M	**1.9**	**16.3**	**72.8**
7/4	**3.4**	14L	38M	72L	205VH	1700H	**6.7**	10.9	11M	2.1L	49H	37H	2.5H	.2VL	**1.7**	**15.7**	**78.1**
8/23	**3.8**	11L	42M	62L	172VH	1400H	**6.7**	9.0	23VH	2.2L	44H	35H	2.0H	0.6L	**1.8**	**15.9**	**77.8**
11/12	**3.5**	10L	28M	61L	199VH	1500H	**6.7**	9.8	7L	1.5L	51VH	38H	2.2H	0.8M	**1.6**	**17.0**	**76.9**
2/10	**4.9**	6VL	28M	80L	194VH	1700VH	**7.0**	10.3	26VH	2.3M	42H	34H	2.0H	0.9M	**2.0**	**15.7**	**82.4**
4/1	**4.1**	5VL	32M	63L	198VH	1600H	**6.9**	9.9	8M	2.7M	49H	39H	2.6H	0.5L	**1.6**	**16.6**	**80.4**
5/1	**4.1**	11L	29M	69L	191VH	1600H	**6.6**	10.4	5L	2.0L	46H	31H	2.3H	0.9M	**1.7**	**15.3**	**77.0**
6/10	**3.1**	7VL	29M	58L	188VH	1500H	**6.9**	9.3	5L	1.9L	33H	29H	1.9H	0.7M	**1.6**	**16.8**	**80.3**
7/20	**3.0**	8VL	32M	81L	181VH	1700H	**6.7**	10.7	11M	2.5M	47H	37H	2.1H	0.5L	**1.9**	**14.1**	**79.5**
9/2	**3.5**	6VL	25L	75L	192VH	1700H	**6.9**	10.4	11M	2.0L	48H	19H	1.5H	0.5L	**1.8**	**15.3**	**81.4**
10/20	**2.7**	5VL	29M	78L	199VH	1700H	**6.8**	10.7	20VH	1.8L	51VH	42H	1.9H	0.4L	**1.9**	**15.5**	**79.7**

Soil Amendments/Fertilizer

05/11/99 - 250#GSS/gyp
08/XX/98 - 200# BlueHiK
08/XX/98 - 1000# Compost
08/XX/97 - 1000# Compost

Rainfall record

1999:
April 1.05"
May 1.05"
June 1.84"
July 1.82"
(0.9"on7/31)
Aug 2.09"
Sept 5.02"
Oct 2.38"
Nov 2.45"

Observations

1999 145 bu /a corn
1998 sold 2.1 t clover /a (left second cutting)
1997 sold 51 bu wheat /a (left straw and heavy seeding)

field# avg

1999 Crop: 1998 Crop: 2000 Crop:

date	OM	P1	P2	K	Mg	Ca	pH	CEC	S	Zn	Mn	Fe	Cu	B	K%	Mg%	Ca%
5/1	4.2	14.7	35.2	76	180	1600	6.7	10.1	7	2.6	46	33	2.6	0.6	2.0	14.8	79.3
Mellic	4.2	23.2		73	206	1862	6.7	11.7	17	2.2	134	139	2.5		1.6	14.7	79.7
6/1	3.4	11.0	31.8	72	182	1550	6.7	10.0	9	3.2	40	32	2.3	0.8	1.9	15.3	77.7
Mellic	3.4	21.3		72	204	1795	6.7	11.5	16	2.2	127	130	2.5		1.6	14.8	78.4
7/20	3.2	13.5	37.3	89	187	1600	6.6	10.4	12	3.2	41	36	2.3	0.5	2.2	15.0	76.7
Mellic	3.2	25.7		95	202	1783	6.6	11.6	17	2.4	121	140	2.4		2.1	14.6	77.1
9/2	3.3	9.7	26.3	68	163	1567	6.7	9.9	14	3.1	49	28	2.0	0.5	1.8	13.8	79.3
Mellic	3.3	17.8		73	189	1727	6.7	10.9	18	2.6	118	126	2.2		1.8	14.4	78.6
10/20	3.6	8.7	35.3	78	191	1767	6.7	11.1	34	3.0	53	40	2.4	0.4	1.8	14.5	79.8
12/14	2.9	15.5	24.8	81	187	1733	6.7	11.0	57	5.5	44	31	2.1	0.8	1.9	14.2	79.0

Plant tissue analysis - sample date: 7/27/00

NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

D=deficient L=low S=sufficient H=high VH=very high

field# 23A   1999 Crop: **Spelt**   1998 Crop: **DRK'S**   2000 Crop: **Sweetcorn**

date	OM	P1	P2	K	Mg	Ca	pH	CEC	S	Zn	Mn	Fe	Cu	B	K%	Mg%	Ca%
5/01	**3.3**	13L	33M	49VL	157H	1500H	**6.9**	9.1	5L	2.3M	38H	37H	2.3H	0.7M	**1.4**	**14.4**	**82.8**
Mellic	**3.3**	22M		50VL	195VH	1890VH	**6.9**	11.4	15H	2.3M	122VH	146VH	2.4H		**1.1**	**14.3**	**83.2**
6/1	**2.9**	8VL	29M	47VL	175VH	1600H	**6.9**	9.7	5L	2.7M	52VH	39H	2.2H	0.7M	**1.2**	**15.0**	**82.4**
Mellic	**2.9**	17L		49VL	187VH	1710H	**6.9**	10.4	11M	2.0L	123VH	131VH	2.3H		**1.2**	**15.0**	**82.4**
7/20	**3.5**	11L	31M	54VL	188VH	1500H	**6.4**	10.1	12M	3.4M	47H	47H	2.7H	0.5L	**1.4**	**15.5**	**74.2**
Mellic	**3.5**	24M		63L	191VH	1550H	**6.4**	10.4	17H	2.3M	111VH	161VH	2.2H		**1.5**	**15.3**	**74.3**
9/02	**2.9**	8VL	26M	59L	166H	1600H	**6.7**	10.0	17H	5.5H	51VH	36H	2.0H	0.6M	**1.5**	**13.9**	**80.1**
Mellic	**2.9**	14L		62L	188VH	1750H	**6.7**	11.0	21VH	6.0H	129VH	126VH	2.2H		**1.4**	**14.3**	**79.8**
10/20	**4.4**	7VL	33M	67L	199VH	1800H	**6.8**	11.2	62VH	3.6H	59VH	50H	2.6H	0.5L	**1.5**	**14.9**	**80.7**
12/14	**3.5**	15L	32M	81L	188H	1900H	**6.7**	11.8	152V	3.9H	51VH	45H	2.2H	0.9M	**1.8**	**13.3**	**80.5**

Plant tissue analysis - sample date: 7/27/00

N	S	P	K	Mg	Ca	Na	B	Zn	Mn	Fe	Cu
4.26	0.32	0.37	2.41	0.30	0.52	0.01	44	39	54	232	15
H	S	S	L	S	S	S	VH	S	S	S	S
norm	norm	norm	norm	norm	norm	norm	norm	norm	norm	norm	norm
2.90	0.19	0.33	2.50	0.21	0.31	0.01	7	29	30	50	7
4.00	0.40	0.50	4.00	0.50	0.85	0.03	25	50	100	250	20
%	%	%	%	%	%	%	ppm	ppm	ppm	ppm	ppm

D=deficient L=low S=sufficient H=high VH=very high

New Button

field# **23B** 1999 Crop: **Corn** 1998 Crop: **Wheat** 2000 Crop: **DRK's**

date	OM	P1	P2	K	Mg	Ca	pH	CEC	S	Zn	Mn	Fe	Cu	B	K%	Mg%	Ca%
5/1	4.0	19M	44H	92L	172VH	1600VH	6.7	10.1	11M	3.4M	49H	34H	3.1VH	1.0M	2.3	14.2	79.0
Mellic	4.0	29H		83L	191VH	1840H	6.7	11.5	23VH	2.8M	131VH	144VH	3.0H		1.8	13.8	79.8
6/1	4.0	15L	43H	97M	188VH	1700H	6.6	11.0	16H	5.4H	48H	37H	3.3VH	1.2M	2.3	14.3	77.5
Mellic	4.0	28H		83L	192VH	1810H	6.6	11.5	21VH	3.3M	144VH	148VH	3.2VH		1.8	13.9	78.4
7/20	3.1	18M	47H	107M	190VH	1700H	6.7	10.8	17H	3.9H	40H	34H	2.6H	0.5L	2.5	14.6	78.4
Mellic	3.1	32H		102M	190VH	1800H	6.7	11.4	20VH	3.0M	119VH	141VH	2.9H		2.3	13.9	79.3
9/2	3.2	15L	33M	72L	141H	1400H	6.6	8.9	13H	3.4M	53VH	32H	2.6H	0.4L	2.1	13.2	78.8
Mellic	3.2	26M		83L	172VH	1590H	6.6	10.2	17H	2.5M	115VH	133VH	2.7H		2.1	14.1	77.9
10/20	4.6	17L	54H	90L	189H	2100H	6.8	12.3	15H	4.1H	57VH	43H	2.8H	0.4L	1.9	12.8	85.3
12/14	3.0	17L	33M	98M	185VH	1800H	6.8	11.1	33V	4.2H	44H	31H	2.4H	0.8M	2.3	13.8	81.0

Plant tissue analysis - sample date: 7/27/00

N	S	P	K	Mg	Ca	Na	B	Zn	Mn	Fe	Cu
5.52	0.29	0.24	3.21	0.54	3.01	0.01	61	33	68	296	9
H	S	L	H	S	VH	S	H	S	S	H	S
norm	norm	norm	norm	norm	norm	norm	norm	norm	norm	norm	norm
4.00	0.26	0.31	2.01	0.30	0.50	0.01	25	25	30	50	8
5.20	0.60	0.50	3.00	0.60	2.00	0.03	60	50	150	250	20
%	%	%	%	%	%	%	ppm	ppm	ppm	ppm	ppm

D=deficient L=low S=sufficient H=high VH=very high

field# 23C — 1999 Crop: **Corn** — 1998 Crop: **Wheat** — 2000 Crop: **Soybeans**

date	OM	P1	P2	K	Mg	Ca	pH	CEC	S	Zn	Mn	Fe	Cu	B	K%	Mg%	Ca%
5/1	4.1	12L	30M	77L	185VH	1700H	6.7	10.7	7L	3.1M	42H	21H	2.9H	0.8M	1.8	14.4	79.3
Mellic	4.1	20M		75L	207VH	1950H	6.7	12.2	22VH	2.5M	143VH	122VH	2.7H		1.6	14.1	79.8
6/1	4.0	11L	33M	75L	179VH	1600H	6.4	10.6	14H	4.5H	37H	23H	2.3H	0.8M	1.8	14.0	75.2
Mellic	4.0	23M		73L	207VH	1940H	6.4	12.8	20VH	3.0M	127VH	114VH	2.9H		1.5	13.5	76.1
7/20	3.1	11L	31M	74L	181VH	1700H	6.6	10.8	18VH	3.5H	38H	24H	2.2H	0.5L	1.8	13.9	78.4
Mellic	3.1	21M		81L	202VH	1890H	6.6	12.1	25VH	2.6H	128VH	115VH	2.7H		1.7	14.0	78.4
9/2	3.5	11L	26M	47VL	150H	1600	6.6	10.0	18VH	3.1M	52VH	27H	2.0H	0.3VL	1.2	12.5	80.3
Mellic	3.5	21M		55VL	184H	1870H	6.6	11.7	23VH	2.5M	115VH	129VH	2.5H		1.2	13.1	79.8
10/20	3.3	9L	34M	63L	183H	1900	6.7	11.7	16H	3.5H	47H	27H	2.6H	0.5L	1.4	13.0	81.1
12/14	3.0	16L	26M	68L	179VH	1700H	6.8	10.5	31V	3.5H	45H	29H	2.1H	0.7M	1.7	14.2	81.2

Plant tissue analysis - sample date: 7/27/00

N	S	P	K	Mg	Ca	Na	B	Zn	Mn	Fe	Cu
5.77	0.31	0.26	2.29	0.58	1.46	0.01	16	40	92	258	12
H	S	L	S	S	S	S	L	S	S	H	S
norm	norm	norm	norm	norm	norm	norm	norm	norm	norm	norm	norm
4.00	0.26	0.31	2.01	0.30	0.50	0.01	25	25	30	50	8
5.20	0.60	0.5	3.00	0.60	2.00	0.03	60	50	150	250	20
%	%	%	%	%	%	%	ppm	ppm	ppm	ppm	ppm

D=deficient L=low S=sufficient H=high VH=very high

field# 23D   1999 Crop: **DRK'S**   1998 Crop: **CORN**   2000 Crop: **Spelt**

date	OM	P1	P2	K	Mg	Ca	pH	CEC	S	Zn	Mn	Fe	Cu	B	K%	Mg%	Ca%
5/1	4.6	21M	40M	105M	166VH	1400H	6.9	8.8	5L	2.8M	50H	34H	2.5H	0.7M	3.1	15.8	79.8
Mellic	4.6	30H		103M	191VH	1660H	6.9	10.3	12M	2.4M	146VH	144VH	2.4H		2.6	15.5	80.6
6/1	3.1	13L	29M	106M	176VH	1400H	6.7	9.1	5L	2.5M	37H	26H	2.0H	0.5L	3.0	16.0	76.5
Mellic	3.1	28H		103M	187VH	1550H	6.7	10.0	10M	2.2L	134VH	126VH	2.2H		2.6	15.5	77.3
7/20	3.2	12L	31M	99M	183VH	1400H	6.6	9.3	5L	3.0M	34H	27H	2.1H	0.4L	2.7	16.3	75.0
Mellic	3.2	24M		112M	198VH	1580H	6.6	10.5	8M	2.4M	123VH	129VH	2.2H		2.7	15.8	75.5
9/2	3.5	11L	24L	86L	155H	1300H	6.2	9.1	5L	2.5M	42H	25H	1.9H	0.4L	2.4	14.2	71.3
Mellic	3.5	22M		86L	164VH	1320H	6.2	9.3	8M	2.0L	99VH	121VH	1.9H		2.4	14.7	70.8
10/20	3.3	6VL	32M	106M	193VH	1500H	6.5	10.1	27VH	2.7M	48H	32H	2.3H	0.5L	2.7	15.9	74.0
12/14	2.8	14L	24L	98M	172VH	1500H	6.5	9.9	27VH	5.1H	36H	27H	1.9H	0.7M	2.5	14.4	75.6

Plant tissue analysis - sample date: 7/27/00

NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

D=deficient L=low S=sufficient H=high VH=very high

field# 27E   1999 Crop: **Spelt**   1998 Crop: **DRK's**   2000 Crop: **Sweetcorn**

date	OM	P1	P2	K	Mg	Ca	pH	CEC	S	Zn	Mn	Fe	Cu	B	K%	Mg%	Ca%
5/1	5.0	12L	35M	65L	206VH	1800H	6.6	11.6	6L	2.2L	53VH	41H	2.5H	0.7M	1.4	14.8	77.8
Mellic	5.0	20M		64L	230VH	1950H	6.6	12.6	16H	1.7L	134VH	145VH	2.5H		1.3	15.2	77.5
6/1	3.4	9L	28M	50VL	187VH	1500H	6.4	10.1	10M	2.0L	31H	35H	2.2H	0.7M	1.3	15.4	74.4
Mellic	3.4	18M		60VL	219VH	1830H	6.4	12.2	19VH	1.5L	106VH	144VH	2.3H		1.3	14.9	74.9
7/20	3.4	21M	52H	118M	197VH	1600H	6.5	10.7	10M	2.8M	37H	44H	2.3H	0.5L	2.8	15.3	74.5
Mellic	3.4	38H		128M	224VH	1950H	6.5	12.9	19VH	2.0L	112VH	164VH	2.6H		2.5	14.5	75.6
9/2	3.3	7VL	24L	70L	173H	1800VH	6.9	10.8	19VH	1.9L	48H	30H	1.7H	0.5L	1.7	13.4	83.6
Mellic	3.3	13L		76L	208VH	2050VH	6.9	12.3	24VH	1.5L	107VH	123VH	2.0H		1.6	14.0	83.0
10/20	3.1	6VL	30M	63L	182VH	1600H	6.6	10.3	63VH	2.2L	57VH	44H	2.2H	0.3VL	1.6	14.7	77.8
12/14	2.8	8VL	17L	68L	205VH	1800H	6.4	11.9	77VH	3.2M	39H	32H	2.0H	0.7M	1.5	14.3	75.3

Plant tissue analysis - sample date: 7/27/00

N	S	P	K	Mg	Ca	Na	B	Zn	Mn	Fe	Cu
4.60	0.38	0.39	2.62	0.30	0.59	0.01	52	38	66	162	16
H	S	S	S	S	S	S	VH	S	S	S	S
norm	norm	norm	norm	norm	norm	norm	norm	norm	norm	norm	norm
2.90	0.19	0.33	2.50	0.21	0.31	0.01	7	29	30	50	7
4.00	0.40	0.50	4.00	0.50	0.85	0.03	25	50	100	250	20
%	%	%	%	%	%	%	ppm	ppm	ppm	ppm	ppm

D=deficient L=low S=sufficient H=high YH=very high

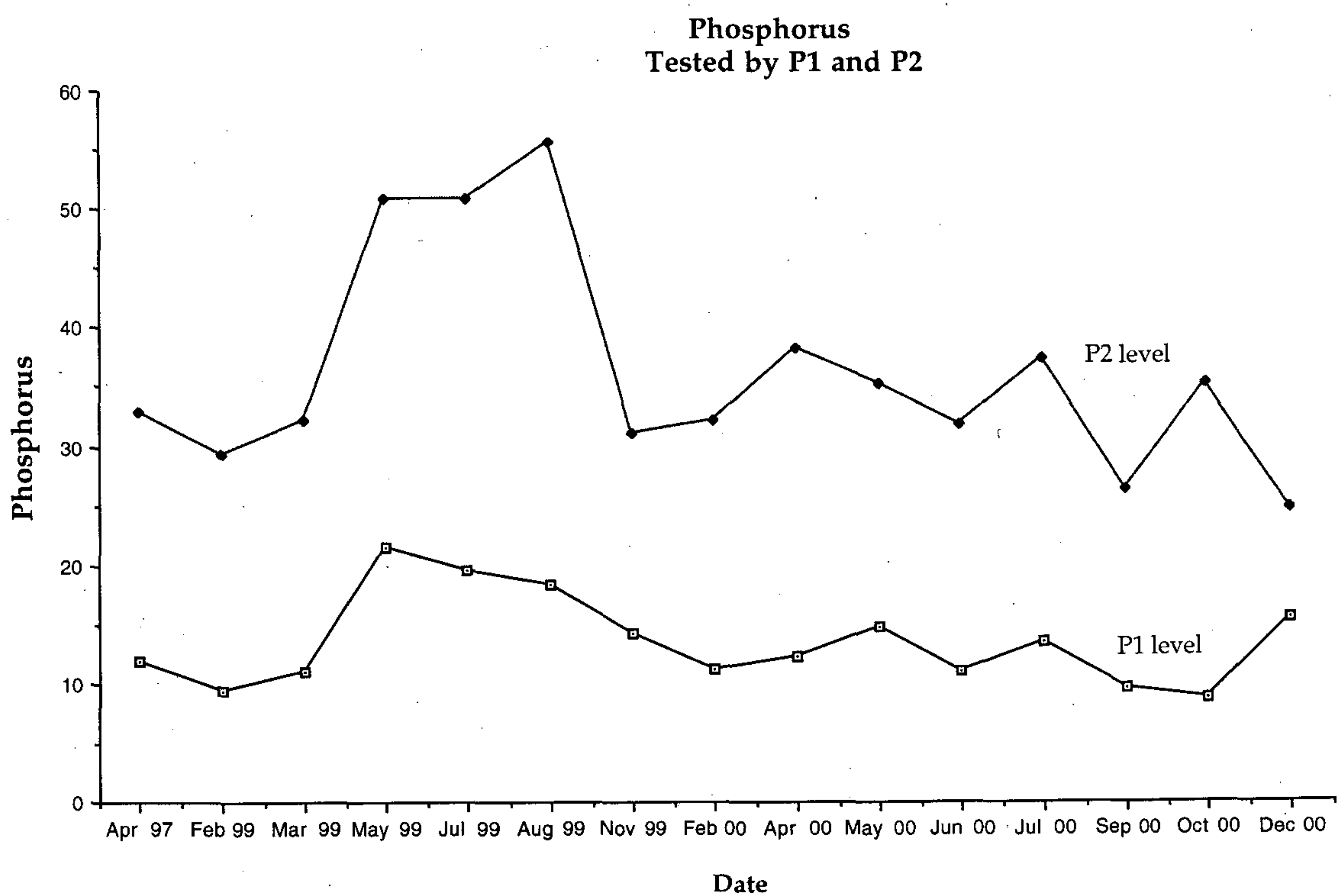
field# 27F   1999 Crop: **Corn**   1998 Crop: **Clover**   2000 Crop: **DRK's**

date	OM	P1	P2	K	Mg	Ca	pH	CEC	S	Zn	Mn	Fe	Cu	B	K%	Mg%	Ca%
5/1	4.1	11L	29M	69L	191VH	1600H	6.6	10.4	5L	2.0L	46H	31H	2.3H	0.9M	1.7	15.3	77.0
Mellic	4.1	18M		64L	224VH	1880H	6.6	12.2	16H	1.6L	126VH	133VH	2.2H		1.4	15.4	77.4
6/1	3.1	7VL	29M	58L	188VH	1500H	6.9	9.3	5L	1.9L	33H	29H	1.9H	0.7M	1.6	16.8	80.3
Mellic	3.1	14L		65L	231VH	1930H	6.9	11.9	12M	1.4L	125VH	118VH	2.3H		1.4	16.2	81.1
7/20	3.0	8VL	32M	81L	181VH	1700H	6.7	10.7	11M	2.5M	47H	37H	2.1H	0.5L	1.9	14.1	79.5
Mellic	3.0	15L		82L	208VH	1930H	6.7	12.1	15H	1.4L	135VH	131VH	2.0H		1.7	14.3	79.5
9/2	3.5	6VL	25L	75L	192VH	1700H	6.9	10.4	11M	2.0L	48H5	19H	1.5H	0.5L	1.8	15.3	81.4
Mellic	3.5	11L		77L	217VH	1780H	6.9	11.1	14H	1.3L	140VH	121VH	2.0H		1.8	16.4	80.5
10/20	2.7	5VL	29M	78L	199VH	1700H	6.8	10.7	20VH	1.8L	101VH	42H	1.9H	0.4L	1.9	15.5	79.7
12/14	2.5	9L	23L	72L	191VH	1700H	6.8	10.6	20VH	13.V	48H	42H	1.9H	1.1M	1.7	15.0	80.3

Plant tissue analysis - sample date: 7/27/00

N	S	P	K	Mg	Ca	Na	B	Zn	Mn	Fe	Cu
5.66	0.31	0.25	3.04	0.55	2.47	0.01	71	37	55	230	10
H	S	L	H	S	H	S	H	S	S	S	S
norm	norm	norm	norm	norm	norm	norm	norm	norm	norm	norm	norm
4.00	0.26	0.31	2.01	0.30	0.50	0.01	25	25	30	50	8
5.20	0.60	0.50	3.00	0.60	2.00	0.03	60	50	150	250	20
%	%	%	%	%	%	%	ppm	ppm	ppm	ppm	ppm

D=deficient L=low S=sufficient H=high VH=very high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Tested by P1 and P2
60
50
40
30
20
10
0
Phosphorus
P2 level
P1 level
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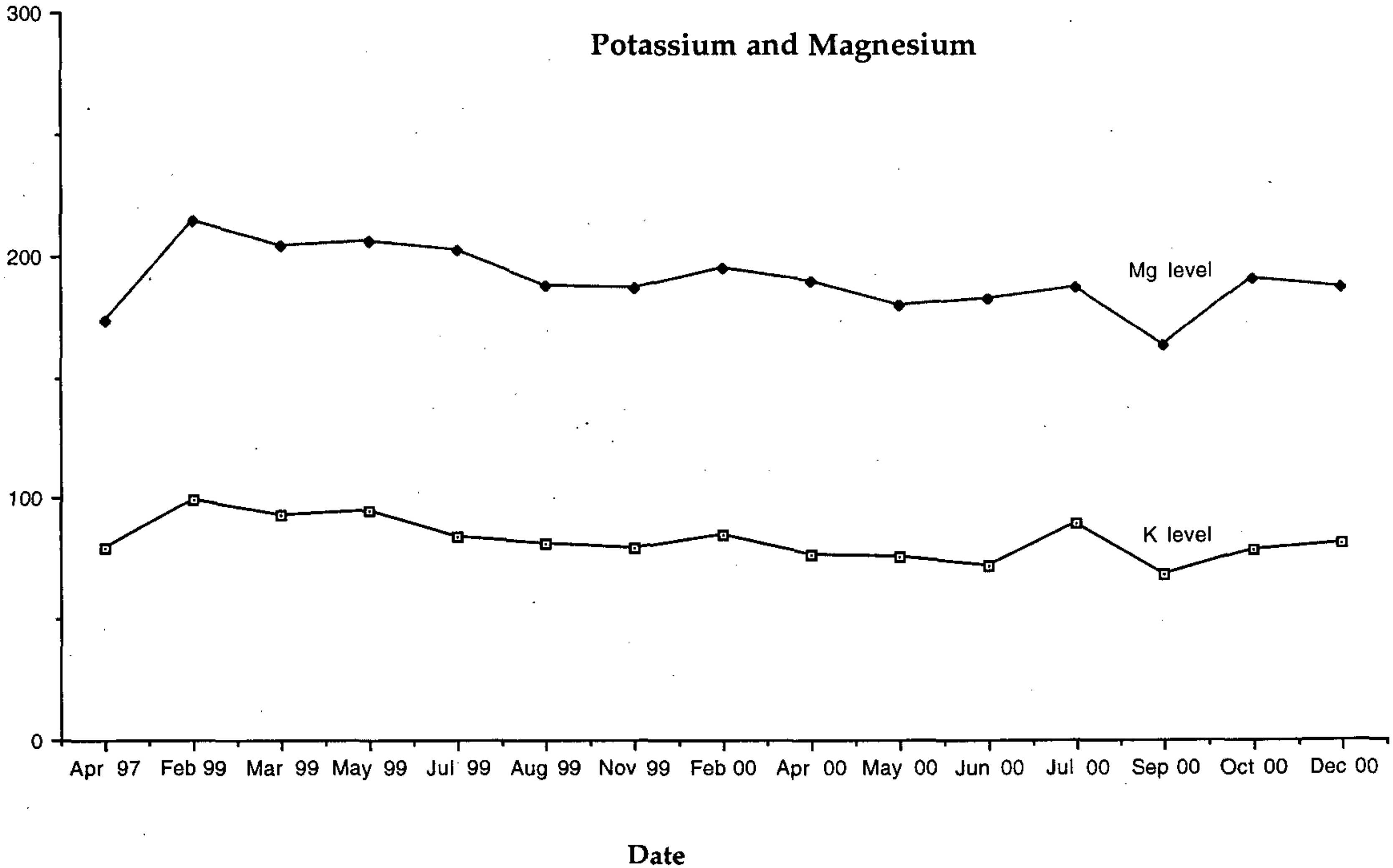
Feb 99
Mar 99
May 99
Jul 99
Aug 99
Nov 99
Feb 00
Apr 00
May 00
Jun 00
Jul 00
Sep 00
Oct 00
Dec 00
Date


Potassium and Magnesium
300
200
100
0
Mg level
K level
Apr 97
Feb 99
Mar 99
May 99
Jul 99
Aug 99
Nov 99
Feb 00
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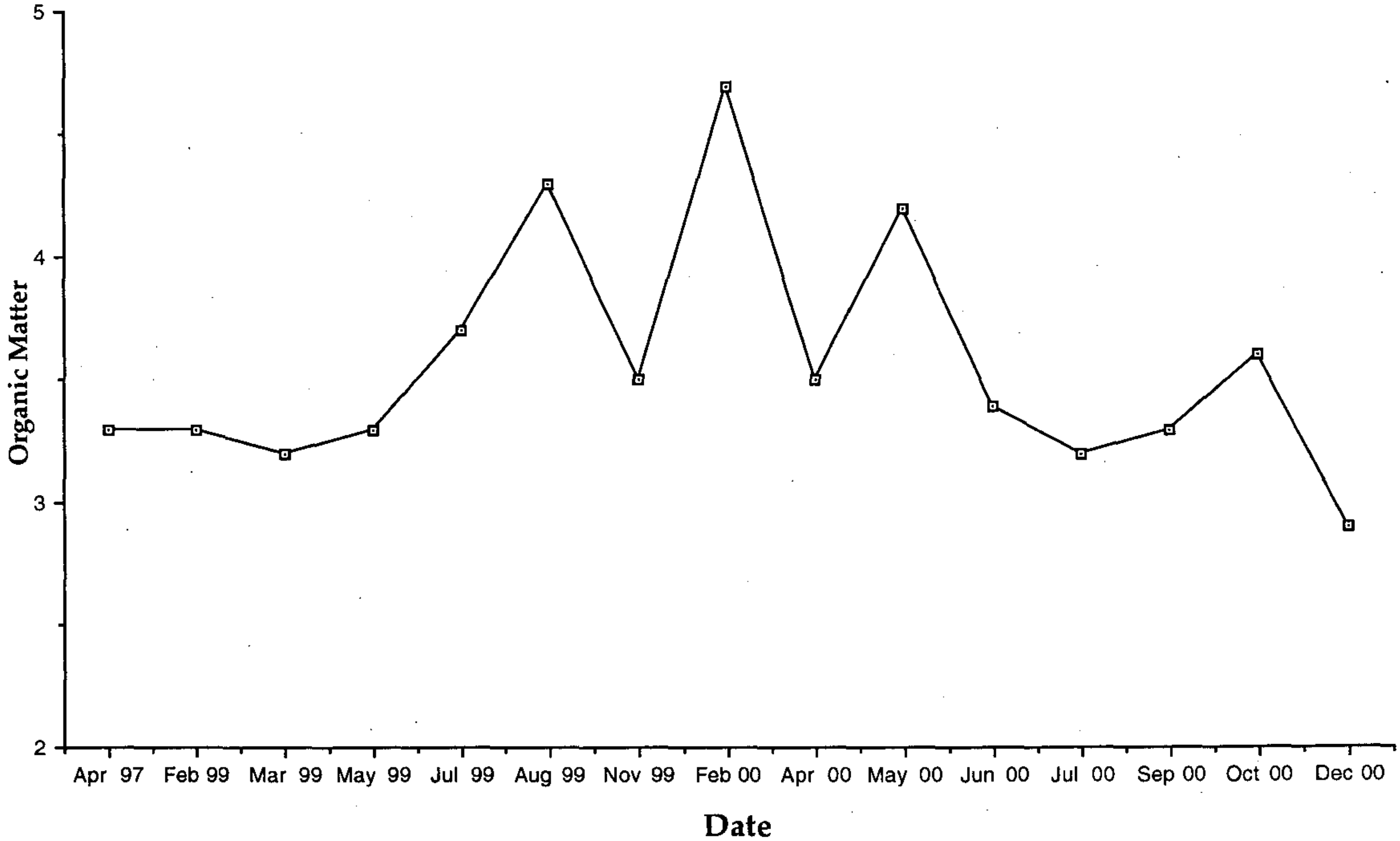
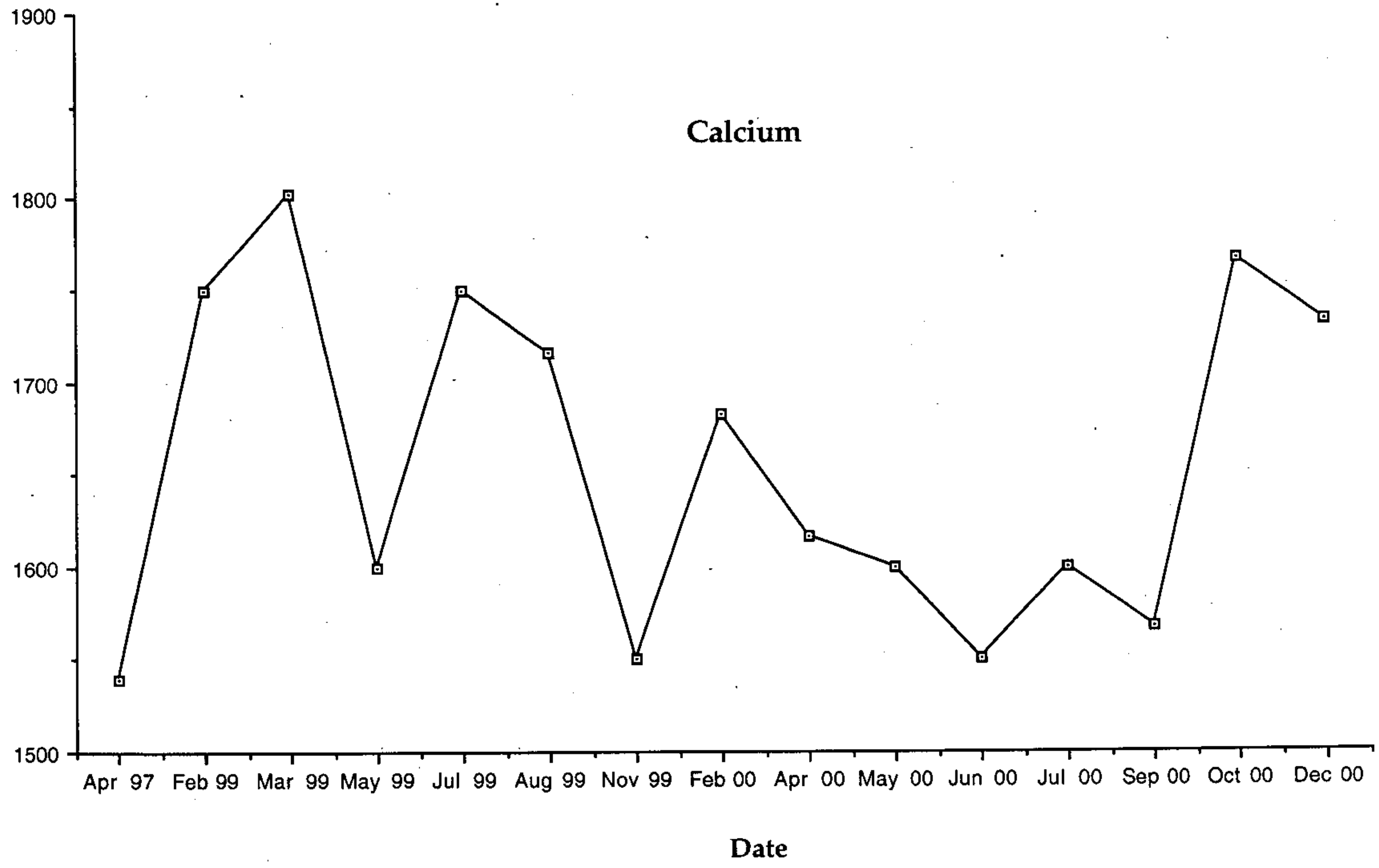
May 00
Jun 00
Jul 00
Sep 00
Oct 00
Dec 00
Date

Organic Matter



3D



Calcium
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1800
1700
1600
1500
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Feb 99
Mar 99
May 99
Jul 99
Aug 99
Nov 99
Feb 00
Apr 00
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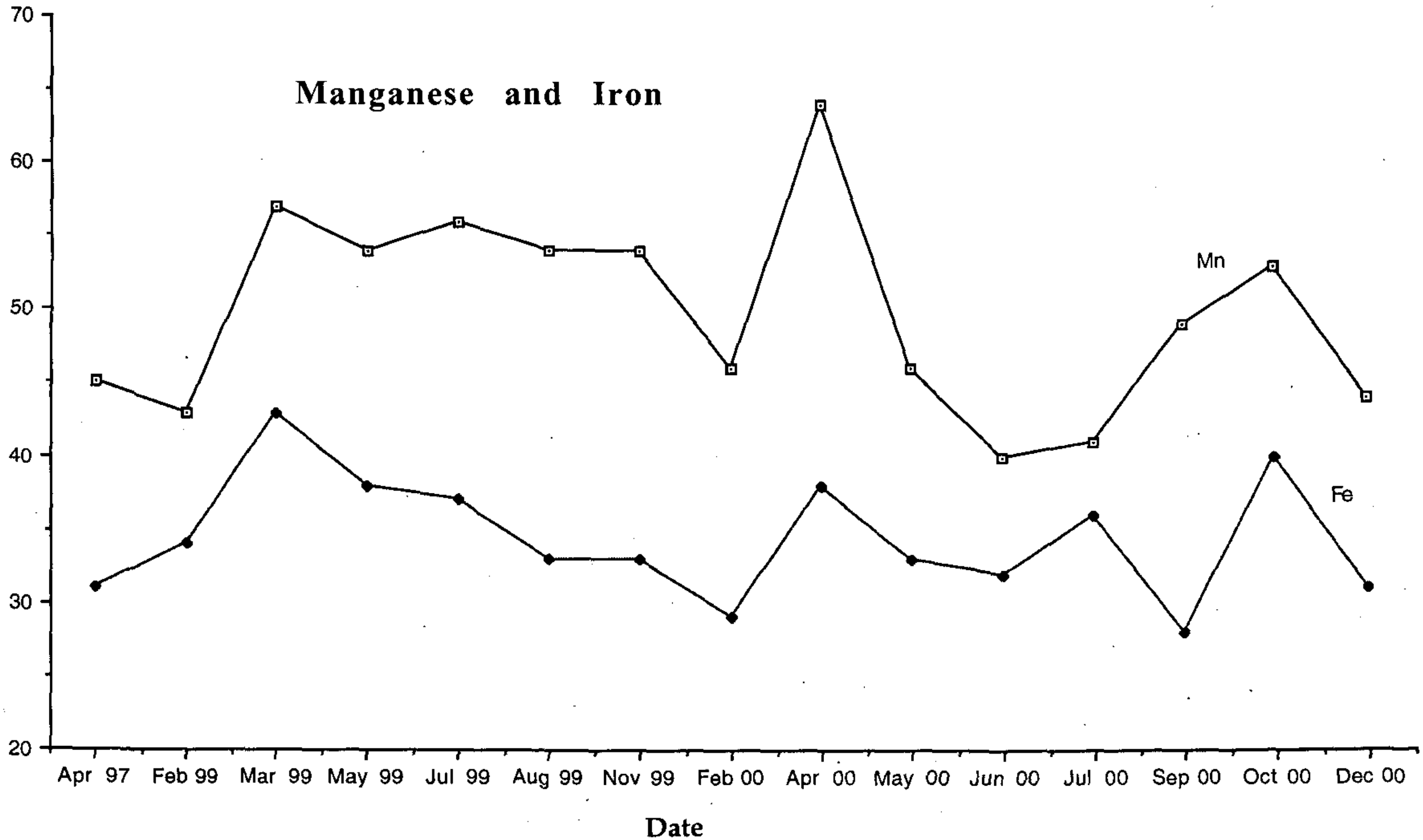
Sep 00
Oct 00
Dec 00
Date


Manganese and Iron
70
60
50
40
30
20
Mn
Fe
Apr 97
Feb 99
Mar 99
May 99
Jul 99
Aug 99
Nov 99
Feb 00
Apr 00
May 00
Jun 00
Jul 00
Sep 00
Oct 00
Dec 00
Date

32