Sulfur deficiency is rare in Pennsylvania because of the significant amount of S that is deposited in our rainfall. As the acid rain problem is reduced, S may become more limiting in the future. If both soil and plant S levels are below normal, it is recommended that part of the fertilizer N requirement of the crop be met with ammonium sulfate. A rate to supply 10 to 20 lb /A of S should be adequate for most crops in this situation. There is a higher likelihood of a sulfur deficiency on soils with below normal S levels that are also very low in organic matter and/or sandy-textured.

Copper and Zinc can accumulate in soil to levels that are toxic to plants. Toxicity to agronomic crops has not been observed in Pennsylvania even on soils testing 2 – 3 times the normal range, but has occurred in soils contaminated by industrial activity. Plant tissue analysis should be conducted on soils with more than 2 times the normal range to determine if levels are above normal. If both soils and crop tissues are above the normal range steps should be taken to prevent further addition of these elements to the soil. Certain agricultural practices, such as use of copper or zinc sulfate hoof baths, can add these elements to soil.

OTHER INFORMATION

The soil testing procedures currently used by the Penn State soil testing program are listed on the report. This information is useful if you compare analytical results from different labs. Direct comparisons can be made only between labs using *exactly* the same procedures. There are many different methods in use around the country, each with strong and weak points. Which test will be used in a given area is based on research to determine how well the test works under local conditions. The tests used by the Agricultural Analytical Services Lab at Penn State have been determined to work best for Pennsylvania conditions.

Keeping records

Keeping good records of soil test results can be very helpful for fine-tuning fertility management. To make the most of the result, collect samples regularly and consistently (e.g., same time of year, same depth). Once optimum soil test levels are attained, the goal is to maintain those levels. A decrease or increase in soil test level at a relatively constant yield might indicate under- or over-fertilization, respectively. Nutrient applications should be adjusted according to the observed trends. Soil test levels will vary from one test to the next; but if an unusual value is observed, the soil testing lab can recheck the results and/or you can submit a new sample for confirmation.

As with all Penn State Cooperative Extension programs your feedback and suggestions for improvement of the soil testing program are always welcome.

Prepared by: Douglas Beegle, Distinguished Professor of Agronomy; Richard Stehouwer, Professor of Environmental Soil Science; Ann Wolf, Director AASL (retired); and John Spargo, Director AASL

ST-4 (Revised 6/14)

County Extension Offices

Adams	(717) 334-6271
Allegheny	(412) 473-2540
Armstrong	(724) 548-3447
Beaver	(724) 774-3003
Bedford	(814) 623-4800
Berks	(610) 378-1327
Blair	(814) 940-5989
Bradford	(570) 265-2896
Bucks	(215) 345-3283
Butler	(724) 287-4761
Cambria	(814) 472-7986
Cameron	(814) 486-3350
Carbon	(570) 325-2788
Centre	(814) 355-4897
Chester	(610) 696-3500
Clarion	(814) 223-9028
Clearfield	(814) 765-7878
Clinton	(570) 726-0022
Columbia	(800) 851-9710
Crawford	(814) 333-7460
Cumberland	(717) 240-6500
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Delaware	(610) 690-2655
Elk	(814) 776-5331
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Fulton	(717) 485-4111
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Lebanon	(717) 270-4391
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Lycoming	(570) 433-3040
McKean	(814) 887-5613
Mercer	(724) 662-3141
Mifflin	(717) 248-9618
Monroe	(570) 421-6430
Montgomery	(610) 489-4315
Montour	(800) 851-9710
Northampton	(610) 746-1970
Northumberland	(800) 851-9710
Perry	(717) 582-5150
Philadelphia	(215) 471-2200
Pike	(570) 296-3400
Potter	(814) 274-8540
Schuylkill	(570) 622-4225
Snyder	(570) 837-4252
Somerset	(814) 445-8911
Sullivan	(570) 928-8941
Susquehanna	(570) 278-1158
Tioga	(570) 724-9120
Union	(570) 966-8194
Venango	(814) 437-7607
Warren	(814) 563-9388
Washington	(724) 228-6881
Wayne	(570) 253-5970
Westmoreland	(724) 837-1402
Wyoming	(570) 836-3196
York	(717) 840-7408

Soil Testing for Agronomic Crops ST-4

Penn State Agricultural Analytical Services Laboratory

PENNSTATE

(814) 863-0841 Fax (814) 863-4540
Agricultural Analytical Services Laboratory
The Pennsylvania State University
University Park PA 16802
http://www.aasl.psu.edu

SOIL TEST REPORT FOR:	ADDITIONAL COPY TO:
JOHN JONES HARMONY LANE SEWICKLEY PA 15143	SAM COOK TOP GROW ENTERPRISES 111 ALFALFA RD. SMITHVILLE PA 11111

DATE	LAB #	SERIAL #	COUNTY	ACRES	ASCS ID	FIELD ID	SOIL
07/01/2004	S00-00003	55	Allegheny	3.3		1234567891113	

SOIL NUTRIENT LEVELS			Below Optimum	Optimum	Above Optimum
[1]Soil pH	6.1				
[2]Phosphorus (P)	40	ppm			
[2]Potassium (K)	170	ppm			
[2]Magnesium (Mg)	50	ppm			

RECOMMENDATIONS: *(See back messages for important information)*

Limestone*: 3000 lb/A for a target pH of 6.5. **Magnesium (Mg):** 20 lb/A

**Calcium Carbonate equivalent*

Plant Nutrients: ***(If manure will be applied, adjust these recommendations accordingly. See back of report.)***

Year	Crop	Expected Yield	Nitrogen (lb N/A)	Phosphate (lb P_2O_5/A)	Potash (lb K_2O/A)	
1	Corn for Grain	100 Bu/A	100	20	0	*See ST2 for other crop recommendations*

Use a starter fertilizer. (See Back)

2	Corn for Silage	25 T/A	180	60	80	*See ST2 for other crop recommendations*

Use a starter fertilizer. (See Back)

3	Corn for Grain	160 Bu/A	160	30	0	*See ST2 for other crop recommendations*

Use a starter fertilizer. (See Back)

ADDITIONAL RESULTS:						Optional Tests:			[2]Trace Elements		
[2]Calcium (ppm)	[3]Acidity (meq/100 g)	[4]CEC (meq/100 g)	% Saturation of the CEC K	Mg	Ca	Organic Matter %	Nitrate-N ppm	Salts mmhos/cm	*See back for comments* Zinc ppm	Copper ppm	Sulfur ppm
2000	3.9	14.8	3.0	2.8	67.8				4.2	1.7	14.0

Test Methods: [1]1:1 soil:water pH, [2]Mehlich 3 (ICP), [3]Mehlich Buffer, [4]Summation of Cations

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Agronomy

The Penn State soil test report is divided into four parts:

***SOIL TEST REPORT FOR:* Sample information**

The top of the report provides information used to identify the sample including, the FIELD ID you provided and a unique LAB #. Check the FIELD ID to be sure that it is correct. Consistently identifying fields simplifies comparison of soil tests on the same fields over time to determine and react to trends.

The LAB # is important if you have a question or concern related to your lab results or recommendations. Should laboratory personnel need to retrieve your sample or soil test report to check a problem or answer a question, they will need to know the LAB #. Prompt action is important if you think there is a problem with your results, because soil samples are not retained indefinitely. If you suspect a problem with your soil analysis, contact the Agricultural Analytical Services Laboratory at (814) 863-0841.

Summaries of soil test results may be used in educational programs. However, individual results will not be released outside of Penn State without permission of the client. Password-protected access to your soil test report and soil test data is also available through the laboratory web site (www.aasl.psu.edu). Contact the laboratory for additional information and to obtain a password.

***SOIL NUTRIENT LEVELS*: Interpreting the results**

Soil nutrient levels are given as parts per million (ppm) elemental P, K, and Mg. The results of the laboratory analysis are meaningless by themselves; they must be interpreted by relating the lab values to known crop response under local conditions. Interpretation of results, based on crop response research, is given as a bar chart that indicates whether the level for each nutrient is below optimum, optimum, or above optimum for the crop to be grown. The definition for each category is given below.

Below Optimum soil test level indicates that the nutrient is probably deficient and that the deficiency will likely limit crop growth. There is a high probability of a profitable return from correcting a low level. The recommendation for a low-testing soil is designed to gradually build up the nutrient level to optimum and to maintain it at that level.

Optimum soil test level indicates that the nutrient is probably adequate and will likely not limit crop growth in a typical growing season. There is a low probability of a profitable return from increasing the soil test level above optimum. The recommendation for an optimum-testing soil is designed to offset crop removal in order to maintain the nutrient in the optimum range. If you are soil testing on an annual basis, no maintenance fertilizer is needed when the soil tests in the optimum range.

Above Optimum soil test level indicates that the nutrient is more than adequate and will not limit crop growth. There is a very low probability of a profitable return from applying a nutrient to a soil testing above optimum. Consequently, no fertilizer is recommended on these soils. Too much of a plant nutrient may cause a nutrient imbalance in the soil and, as a result, in the plant. Additional applications of fertilizers or manures to soils that are very high not only result in unsatisfactory economic returns, but they can also adversely affect plant growth and environmental quality.

RECOMMENDATIONS

The recommendations on the soil test report are made for a three year sequence of crops. These recommendations are made based on the soil test results and on the information you provided such as crop to be grown, expected yield, crop rotation and plow depth. Typical nutrient recommendations and guidelines for changing them to a different crop and/or yield level are given in ST-2 "Fertilizer Recommendation Table". Complete recommendation tables are also available on the lab web site: www.aasl.psu.edu

Limestone recommendation

Limestone is applied to neutralize the acidity in the soil and thus raise the soil pH to the optimum range for crop growth. The limestone recommendation is based on the amount of exchangeable acidity measured in the soil and the optimum soil pH level for the crop. The recommended limestone application is a one time application for the three years on the report. For most agronomic crops the optimum pH is 6.5. For alfalfa and barley the pH goal is 7.0. However, because only one limestone recommendation is made for three years, the recommendation on the report will adjust the pH for the most sensitive crop to be grown during this period. The actual pH goal used to make the limestone recommendation is indicated on the report.

The limestone recommendation is based on a liming material that is 100% calcium carbonate equivalent (CCE) in neutralizing power and based on liming an acre furrow slice approximately 7 inches deep. If a liming material is used that is not near to 100% CCE (90–110% CCE), the rate should be adjusted for lime quality. ST-2 "Liming Materials Conversion Table" gives the details for making this simple but important adjustment. If the limestone is going to be mixed with a larger volume of soil by deeper tillage, the recommendation is increased to account for this. Any adjustment for tillage depth is indicated on the report.

See PSU Agronomy Facts #3 "Soil Acidity and Aglime" for details on Limestone recommendations, liming material quality and liming practices.

Magnesium (Mg) recommendation

If the soil magnesium level is below the optimum level, magnesium will be recommended to raise the level to optimum. Agricultural limestone is generally the most economical and convenient source of magnesium for agronomic crops. In addition to the actual amount of magnesium recommended (lb Mg/A), the magnesium recommendation is also given as the minimum percentage of Mg in the recommended amount of limestone required to meet the magnesium needs. Mg requirements vary from crop to crop. However, because the Mg recommendation is linked to the limestone recommendation, only one Mg recommendation is made. This recommendation is based on the needs of the most sensitive crop to be grown during the three years.

Low Mg levels in soils may result in low Mg levels in forage crops especially if a significant amount of N and/or K fertilizer is applied. This can result in potentially fatal grass tetany in animals. Use caution if grazing in this situation. Apply the recommended Mg; however, be aware that if the K is very high and the Mg is low it may not be possible to correct this soil imbalance immediately. Therefore, it is critical that your feed rations are properly balanced based on the actual forage mineral content.

Nitrogen (N) recommendation

No soil analysis is used to make the N recommendations on the report. These recommendations are based on estimates of crop requirements for N as determined by crop response research under PA conditions. Most recommendations are based on the information you provided about the crop to be grown and the expected yield. The recommendations are given as pounds of N required per acre for each crop.

Growing a legume in a rotation preceding an N-requiring crop may result in a high level of residual N in the soil that can be utilized by the following crop. The N recommendations must be adjusted using the credits indicated on the report to take into account this residual N.

Nitrogen supplied by manure should also be considered. Residual N from past manure applications may reduce the amount of N required for the current crop. The N in manure applied for the current crop must also be accounted for. Manure N availability varies depending on how it is handled and applied. See the Manure Management section of the Penn State Agronomy Guide for details. Manure analysis is available from the Agricultural Analytical Services Lab at Penn State.

Nitrogen testing is not possible as part of a routine soil testing program. N is very dynamic in the soil plant system and the available N changes throughout the season. For N testing to be valid it must be conducted very near to the time when the crop has the most demand for N. Two in-season N tests, the Pre-sidedress Soil Nitrate Test (PSNT) and the Chlorophyll Meter Test are available to help with N management in corn. These tests are especially useful where manure is expected to contribute significantly to the N needs of the crop and can help guide sidedress N applications if necessary. See PSU Agronomy Facts #17 "Pre-sidedress Soil Nitrate Test for Corn" or PSU Agronomy Facts #53 "The Early-Season Chlorophyll Meter Test for Corn" for details.

Phosphorus (P) and Potassium (K) Recommendations

Recommendations are given as pounds of P_2O_5 and K_2O required per acre for each crop. The P and K recommendations are based on building below optimum testing soils up into the optimum range. Once an optimum level has been established the recommendation is designed to maintain that level by applying P and K to offset the amount that is removed by the harvested crop. The optimum ranges for agronomic crops are 30-50 ppm P and 100-150 ppm K for grain crops and 150 -200 ppm K for forage crops. Once the soil level is above optimum no P or K is recommended.

Very high soil test levels should be avoided as much as possible. High soil nutrient levels not only represent an economic loss but they may also indicate potential crop, animal, or environmental problems. Very high P levels in the soil may result in potentially harmful P loss to the environment. Best management practices may be necessary to reduce the potential for environmental problems with P. Very high K levels in the soil can lead to nutrient imbalances in forage crops which can cause serious health problems in animals. Use caution when grazing forage crops especially if the soil magnesium is not also in the high range. It may not be possible to correct these soil imbalances in the short term. Feed rations must be balanced accordingly.

Very high soil test levels are often a side effect of utilizing manure to supply the N needs of crops. Usually when manure is applied to meet the N requirements of a crop excess P and K will be applied. Over time this can lead to very high P and K levels in the soil. This should be monitored with regular soil testing and appropriate management action should be taken to limit applications in excess of crop needs or to minimize potential negative crop, animal or environmental consequences.

Recommendation Messages

An important part of the reports are the messages and comments that accompany the recommendations. Immediately under the amounts of nutrients needed are several messages specific for the actual results and recommendations. Important general comments about the results and recommendations are found on the back of the report. These comments and the material enclosed with the report are all part of the recommendation.

ADDITIONAL RESULTS

Test levels for calcium (Ca) and exchangeable acidity; and optional tests for organic matter, nitrate nitrogen and soluble salts are provided in this section. Also included here are calculated values for the soil cation exchange capacity (CEC) and percent saturation of the CEC by K, Mg, and Ca. These calculated values are not used in making recommendations. They are provided for reference only.

Zinc (Zn), copper (Cu), and sulfur (S) results are also given. Deficiencies of these nutrients are rare in Pennsylvania. Consequently, reliable interpretations and recommendations based solely on soil test results are not possible; however, results can be compared to ranges normally observed in PA soils (see Table below). Soil test levels below the normal range may indicate a possible deficiency, but do not guarantee a response to additions of these nutrients. Plant tissue analysis should be used to determine if the plants are deficient and to help guide fertilizer applications.

Normal ranges of Zn, Cu and S in Pennsylvania Soils (Mehlich 3 soil test)

Zn (ppm)	Cu (ppm)	S (ppm)
1.1 – 9.4	1.2 – 5.5	10 – 25

Zinc deficiency is most likely to occur on soils with below-normal Zn levels, high pH, a sandy texture or where soil P is high from fertilizer additions. If both soil and plant zinc levels are below normal and especially if any of the above conditions exist, the recommendation is to broadcast and incorporate 8 to 10 lb/A Zn once every 5 years or apply 2 lb/A of Zn in the starter. Copper deficiency has not been observed in Pennsylvania.