Prior to determining limestone and fertilizer recommendations for topsoil samples, subsoil and diagnostic samples are put in a separate dataset. This code is assigned to each observation. This code, along with soil pH and buffer pH readings, is used to merge in limestone recommendations from another stored data file.

Fertilizer recommendations depend on soil and crop codes and on phosphorus and potassium levels. For each possible combination of these four variables, there is an entry in a stored table of recommendations. For certain crops, this entry includes the recommended amount of nitrogen, phosphorus, and potassium. For other crops, this entry consists of a comment number which indexes a verbal fertilizer recommendation.

In addition to the limestone and fertilizer recommendations, comments appropriate to a particular sample are selected. Some comments are selected based on conditions such as abnormal nutrient levels or the presence or absence of recommendations, irrespective of crop. Other comments are automatically given for certain crops. Still other comments depend on the particular crop but are given only for certain nutrient levels and/or soil codes. For each sample, in order to append each appropriate comment, a number indexing that stored comment is output. This results in multiple observations for each sample.

Prior to merging the comment numbers with the stored comments, any duplicate comment numbers within a farmer's multiple sample request are flagged. This is accomplished by sorting by county, name, and comment number, and then legging these variables to determine if two or more consecutive observations are the same with regard to the three variables. If two or more consecutive observations are the same for these variables, then all but one of them is flagged so as not to obtain the text of the comment when merged. The observations which are not flagged are merged with the stored comment text file. A second copy of these observations is output to be used in the report writing. This provides for the use of the first copy in listing all comment numbers for each sample, and the second copy for writing a unique copy of each comment at the end of each farmer's report (see figure 3).

Once the final dataset is complete, three types of output files are created. One of these is a special forms print file which writes the individual farmer reports. Another is a report listing samples processed for referencing by the soil testing lab. The third file writes pertinent sample information to a SAS disk file for use in updating a tape-resident SAS master dataset. This master file can be analyzed periodically to generate summary statistics about the runs.
In writing individual farmer reports, there are three types of headers needed. The first of these (see figure 1) is a header for crops such as flowers and shrubs which receive limestone and fertilizer recommendations in pounds per 100 square feet. For these crops, verbal fertilizer recommendations are listed with the comments. For crops grown on larger areas such as lawns, gardens, and golf greens, the recommendations are given in pounds per 1000 square feet (see figure 2). Again appropriate verbal fertilizer recommendations are printed with the comments. The majority of the recommendations written are for agronomic crops which receive a third header (see figure 3). This header indicates limestone recommendations in tons per acre and fertilizer recommendations in pounds per acre. Comments give only instructional information for the agronomic crops. The report shown in figure 3 illustrates that any comment is listed only once on a farmer's report. Sample 1 and sample 2 both receive comment number 8, but the text of comment 8 is printed only once after both sample reports are printed. Since the entire report form is created as it is printed, the flexibility to print any number of samples followed by any number of comments is offered by SAS. Observations are sorted in a manner such that if a farmer has samples which require two or three of the headers, all reports for that farmer are printed together. Also, all farmer reports for a county are printed together.

ADVANTAGES OF USING SAS

There are many convenient features of SAS which are useful in organizing, programming, and maintaining a system such as soil test reporting. A few of these key features include the following:

1) Easy data handling - inputting, sorting, etc.
2) Easy modification of recommendation and comment files stored as SAS datasets through the use of PROC EDITOR
3) Convenient for each run to build a disk-resident SAS dataset for use in updating
4) Easy to build entire output form for farmer reports, and modify it as necessary
5) Build permanent master tape file as SAS dataset which is easy to access for generating summary statistics
6) Handy to update documentation of all stored datasets using PROC CONTENTS

CONCLUSION

The soil test reporting system discussed here serves as an example of the type of labor-saving system which could be applicable to a wide range of projects commonly undertaken by a public service university. The discussion illustrates the convenience and usefulness of SAS in the data management and reporting aspects of such a system.
## Soil Test Results

<table>
<thead>
<tr>
<th>Sample</th>
<th>Soil Buffer</th>
<th>P</th>
<th>K</th>
<th>Mg</th>
<th>Ca</th>
<th>Crop</th>
<th>Limestone Recommendations</th>
<th>Pounds Per 100 Sq. Ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. **Laboratory Sample:** 11201313
2. **Soil Buffer:** L12, 2, 6.0, 102 (1641, 1012020)
3. **Crop:** Shrubs
4. **Limestone Recommendations:**
   - P
   - K
   - Mg
   - Ca

### Fertilizer Recommendations and Comments:

1. **150 Uniformly spread fertilizer over area beginning 6 inches from the trunk and extending well beyond the end of branch spread. It is not necessary to remove the mulch before applying the fertilizer. Brush or rinse the fertilizer from the leaves and stems.**

2. **151 Any single application of nitrogen should not exceed 0.1 lb. of water-soluble nitrogen per 100 sq. ft.**

3. **194 Per 100 sq. ft., apply 2 pints of 0-4-0 or equivalent in early spring and then apply 1 cup ammonium nitrate or equivalent in early summer or apply 16-4-0 (50% water-insoluble nitrogen) at 2 pints per 100 sq. ft.**

---

# Soil Test Results

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</tr>
</tbody>
</table>

1. **Laboratory Sample:** 11201116
2. **Soil Buffer:** L12, 12121121, 25, 500
3. **Crop:** Garden, Inorganic
4. **Limestone Recommendations:**
   - P
   - K
   - Mg
   - Ca

### Fertilizer Recommendations and Comments:

1. **1 Soil acidity and low magnesium can be corrected with dolomitic limestone at the recommended rate.**

2. **96 About 3 weeks after plants are established, side dress with 7 pounds of calcium or sodium nitrate, or 3.5 pounds of ammonium nitrate.**

3. **97 One pint of fertilizer is equal to approximately 1 lb.**

4. **271 Per 1000 sq. ft., apply 25 pounds 5-10-10.**

---

156
<table>
<thead>
<tr>
<th>LAB. SAMPLE NO.</th>
<th>SOIL CODE PH</th>
<th>BUFFER PH</th>
<th>P</th>
<th>K</th>
<th>Mg</th>
<th>CA</th>
<th>Si</th>
<th>CROP TO BE GROWN</th>
<th>RECOMMENDATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1124791</td>
<td>3</td>
<td>6.3</td>
<td>66</td>
<td>94</td>
<td>52</td>
<td>800</td>
<td>SOYBEANS</td>
<td>01 01 50</td>
<td></td>
</tr>
<tr>
<td>1124802</td>
<td>3</td>
<td>5.7</td>
<td>121130</td>
<td>37</td>
<td>800</td>
<td>COTTON</td>
<td>0.75 70 0 50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**COMMENTS WHICH APPLY TO THIS SAMPLE ARE**

8. **PH**
9. **Mg**
10. **Ca**
11. **Si**
12. **Buffer**
13. **Soil test results**
14. **Recomendations**

**COMMENTS:**

8. *When no phosphorus and/or potassium are recommended and none is applied, sample again next year.*
9. *Apply inoculum when the field has been cropped for more than two years to non-leguminous crops.*
10. *Soybean and low magnesium can be corrected with dolomitic limestone at the recommended rate.*
11. *On land where excessive growth has caused problems with late maturity, insects, or boll rot, reduce the N rate 20 to 30 lbs. per acre. Where vegetative growth has been inadequate, increase the N rate 20 to 30 lbs. per acre. Total nitrogen may be reduced 20 to 30 lbs. when cotton follows soybeans or other legumes in rotation. Apply 1/4 to 1/3 of nitrogen preplant or at planting and the balance as a sidedressing. Sidedressing should be applied by June 19.*
12. *It is recommended that cotton fertilizer should supply 10 lbs. of sulfur per acre regardless of subsoil test results.*
13. *Apply 0.4 lb. of boron per acre in the fertilizer or in the insecticide spray in each or several applications so long as the total amount applied does not exceed 1.0 lb. of boron per acre.*

**APPROVED BY**

**FIGURE 3**