UGFertex

**A Windows Based Expert System
for Formulating Prescription Lime and
Nutrient Guidelines for Agronomic Crops**

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Acknowledgements/Disclaimer

Acknowledgments

UGFertex is based primarily on the Soil Test Handbook for Georgia. Programming for the original Prolog version was written by Dr. Steve Hodges, currently Extension Leader, Soil and Science Department, North Carolina State University. The authors are deeply indebted and most appreciative of his invaluable inputs. Suggestions by county agents and extension specialists who tested the Beta version of UGFertex have been most helpful in rewriting and redesigning this program.

Disclaimer

UGFertex is based on the University of Georgia soil test program and is correlated with the Mehlich 1 soil test extractant and the Adams-Evans buffer. Soil test inputs using other extractants or buffer solutions will cause invalid results. Unrealistic yield goals or excessive P and K buildup rates may not be economically feasible.

This program is based on the best available data. Since many uncontrollable variables can affect plant growth and nutrient requirements, the University of Georgia Cooperative Extension Service cannot be responsible for any losses incurred from the use of this program. The software is provided 'AS IS' and without warranty as to performance.

If you have any questions or problems while using UGFertex, please contact one of the following for help:

Technical Assistance	**Subject Matter Assistance**
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Chapter 1

This chapter explains how to install and start UGFertex on your system.

System Requirements

Operating system: Windows 95 or higher

Memory: 16 megabytes minimum; 32 recommended

Processor: 486 66MHz minimum; Pentium 100 MHz or greater recommended

Installing UGFertex

Insert the UGFertex CD into the CD drive.

For Windows NT users:

If you do not have Microsoft Access installed, you will need to install the database components of UGFertex separately:

- click the **Windows start button** (usually located in the lower left corner of your Windows Desktop)
- click **Run**
- type **D:\ADO\mdac_typo** (where "D" is the letter of your CD ROM drive)
- click **OK**

If the installation does not begin automatically…

- click the **Start** button (usually located in the lower left corner of your Windows Desktop)
- click **Run**
- type **D:\install** (where "D" is the letter of your CD ROM drive)
- click **OK**

Starting UGFertex

The installation procedure creates a new icon on your **Desktop** titled **UGFertex**. Double-click this icon to run UGFertex.

Chapter 2

Introduction

This chapter introduces UGFertex, shows you some of the things the program can do, and familiarizes you with some of the "nuts and bolts" of using the program.

About UGFertex

Fertilizer requirements for agronomic crops are a function of many cultural, management, and climatic factors. However, soil fertility recommendations are often based on a "typical" soil under non-irrigated conditions. Georgia agriculture is characterized by a diversity of crops and farm enterprises. Crops are generally grown in rotation, with carryover effects from one crop to the next. UGFertex allows the user to interactively select from 35 agronomic crops and/or cropping systems along with various management practices. Then, based on soil test results, it uses functions for soil management group, yield goal, irrigation, plow depth, soil buildup, prior crop, and manure applications to derive lime and nutrient guidelines for that crop-soil group combination. Many of the required inputs are selected from pop-up menus, allowing rapid, error-free entry of information. Important input values are checked to ensure they are within the acceptable range. Calculated values are automatically updated whenever an item is changed, making it easy to see the effect of changes.

UGFertex is an expert system written in the Delphi programming language. It contains an enormous amount of knowledge about crop fertilization and nutrient management. The knowledge base is maintained separately from the main program (inference engine) and contains detailed information on crops, soils, and manures. When data are entered into the program, the knowledge base is called upon in much the same way that experts handle such information. By separating the knowledge base from the inference engine, changes in knowledge do not affect the way the program works. Because of this, UGFertex is very flexible and easily updated as new information becomes available

Objectives, Capabilities, and Extension Audience

Objectives:

1. Provide prescription nutrient guidelines for *agronomic* crops based on soil test results and management factors affecting nutrient requirements.

2. Provide a means for looking at nutrient needs for various crop alternatives on a given soil.

3. Provide a method for estimating the nutrient value of animal manures and determining proper application rates of those manures.

4. Provide information on nutrient buildup requirements for the various soil management groups.

Specifically, this program will:

1. Calculate nitrogen (N), phosphate (P_2O_5), potash (K_2O), calcium (Ca), magnesium (Mg), sulfur (S), boron (B), manganese (Mn), zinc (Zn), and lime requirements for a selected crop based on soil test results, the soil management group, and a yield level obtainable with good management, reject unrealistic yield goals.

2. Modify the nutrient requirements based on the farmer's actual yield goal, previous crops, and presence or absence of irrigation.

3. Estimate P_2O_5 and K_2O additions required to raise soil test levels the number of index units entered by the user (default is 0).

4. Calculate the total nutrient requirement based on 1, 2, and 3.

5. Check to see if manure is to be applied, calculate the available nutrient levels in the manure (based on actual analysis or average values), calculate the rate of manure to apply (based on total N requirement), calculate excess and/or deficit of P_2O_5 and K_2O, estimate potential soil test P and K levels for the calculated excess P_2O_5 and K_2O levels, and determine the amount of additional commercial fertilizers required.

6. Provide additional comments to aid in timing and management of nutrient applications.

7. Provide a detailed graphic printout of the analysis for field records.

Recommended Extension Audience:

Persons requiring limestone and nutrient guidelines refined for their specific soil and management situations, and those agents and specialists involved in advising these persons.

Chapter 3

Program Design

1. Base nutrient guidelines

   Base nutrient guidelines are calculated from paired rating and nutrient guideline data, as shown in the example below. UGFertex compares the soil test value for each nutrient and determines the appropriate rating. It then uses regression analyses to determine the nutrient application guideline at the given soil test value.

2. Yield Goal Modifications

Rating	Soil P	Nutrient Guideline
	Pounds per Acre	
Low	0 - 30	80
Medium	31 - 60	40
High	61 - 100	0
Very High	>100	0

   Each Crop-Soil Group combination is assigned a Yield Potential by UGFertex. This value is affected by irrigation as described below. Modifications in nutrient guidelines result when the farmer's Yield Goal is different from the assigned Yield Potential. Modification of the N, P_2O_5, and K_2O guidelines are calculated as:

   Yield Goal Adjustment = (Yield Goal - Yield Potential) * Nutrient Removal per unit yield.

   The knowledge base contains the appropriate nutrient removal values for each crop.

3. Irrigation Modifications

   Irrigation may affect Yield Potential by 10 to 50 percent, depending on the crop and soil. Modified Yield Potentials are calculated as:

   Irrigated Yield Potential = (Base Yield Potential * Irrigation Factor) + Base Yield.

   The resulting change in nutrient recommendations (if any) are calculated as:

   Irrigation Adjustment = (Base Recommendation * Nutrient Irrigation Factor)
                         + Base Recommendation

   A separate factor for N, P_2O_5, and K_2O is maintained for each crop.

4. Lime Requirement

   Lime requirement is determined using the Adams-Evans procedure (1). UGFertex first calculates the Exchangeable Acidity, the Soil Base Unsaturation (actual) and the Base Unsaturation (desired) at the Target pH,

$$\text{Lime Requirement} = \frac{\text{Exchangeable Acidity}}{\text{Soil Base Unsaturation}} * \text{(Soil Base Unsaturation-Target Base Unsaturation)} * LE * DA$$

where LE = Lime Efficiency Factor, assumed to be 1.5,
and DA = Depth Adjustment Factor, which is 1.33

5. Previous Crop Modifications

The previous crop can affect residual N, P, and K values. Legumes in particular present opportunities for reduced N inputs, or management problems if residual N is not accounted for. Other crops can significantly reduce subsoil N or K levels. Previous crop effects are calculated as:

Prior Crop Adjustment = Retrieved Prior Crop Factor.

This factor may be either positive (requiring additional nutrient inputs) or negative. Factors are maintained for N, P_2O_5, and K_2O.

6. Calcium, Magnesium, and Zinc Sufficiency

Sufficiency levels of these elements are based on established levels associated with each crop and soil group combination.

7. Manganese Sufficiency

Sufficiency level of manganese is a function of crop, soil pH, and Mehlich 1 extractable Mn. For Georgia conditions the appropriate equation is:

Mn_{Suff} = ((Soil pH - 5.7) x 12.14)

At pH values less than 5.7, no recommendation is given for additional Mn.

8. Buildup Modifications

Soil buildup requirements are calculated as

Buildup Adjustment = Desired change in soil index * Buildup Factor (lbs/Index Unit)

Buildup units are associated with a soil group only, and are used only for P_2O_5 and K_2O adjustments. Buildup factors can vary considerably depending on soil texture, chemical, and mineralogical properties. The factors used in UGFertex are based on summarizing unpublished data of M.E. Sumner, The University of Georgia and data of Cope (5).

9. Final N, P_2O_5 and K_2O guidelines

Final Guideline = Base Guideline + Yield Goal Adjustment + Irrigation Adjustment
+ Buildup Adjustment + Prior Crop Adjustment - Starter N and P_2O_5

Note that the final application guidelines include *all* recommended nutrients, including nutrients required for soil buildup. The nitrogen and phosphorus in starter fertilizers are considered to be part of the total nutrient requirements and are considered in the final application guidelines.

10. Manure Calculations (Based on references 4, and 7)

a. Manure N Available (lbs/unit) — Current Year

Available Ammonium N = Ammonium N * Availability Factor

Available Organic N = (Total N - Ammonium N) * Decay Rate$_{\text{Year1}}$

Manure N Available = Available Organic N + Available Ammonium N

b. Residual Available N (lbs/acre) — Residual from Organic N Applied the Previous Year

$$\text{Residual Available N} = \text{Rate}_{prev} * (\text{Total N}_{prev} - \text{Ammonium N}_{prev}) * \text{Decay Rate}_{Year2}$$

c. Manure Rate (unit/acre) — unless overwritten by the user

Remaining N Required = Total N Recommendation - Starter N - Residual Available N

$$\text{Manure Rate} = \frac{\text{Remaining N Required}}{\text{Total Available N}}$$

d. Manure N (lb/acre) = Manure N Available * Manure Rate

e. Manure P_2O_5 (lb/acre) = Manure Rate * P_2O_5 Available

f. Manure K_2O (lb/acre) = Manure Rate * lbs K_2O Available

11. Additional Commercial Fertilizers (only when manure is added, similar for P_2O_5, K_2O)

Commercial N Required (lb/acre) = Total N Recommendation - Manure N - Starter N - Residual N

Chapter 4

The following information is required to use UGFertex. Pay close attention to the values you enter. UGFertex will check to make sure that you enter valid numbers. If you enter an invalid number, you will be prompted by an informational message telling what the acceptable range for the field is.

CAUTION: *Incorrect entries will produce invalid results.*

1. **Name, Field ID, and County -** Any combinations of letters or numbers are allowed. This information is used for identification purposes on the printout.

2. **Crop -Soil Management Group combination -** these items are linked since some crops are not recommended on some soils. Both are selected from menus.

3. **Prior Crop** - selected from menu. This item *must* be selected for proper calculation. The "Unknown" crop is provided as an option. The recommendation is not modified when this option is selected.

4. **Irrigation** [Click Irrigated or in box for "yes"; Click again for "no"] (Default is "no.")

5. **Yield Goal -** based on actual farmer experience in this field (Default is average Potential Yield for the selected soil management group.)

6. **Starter fertilizer -** lbs N and P_2O_5 applied as starter. Values may range from 0 to 20 lbs N/acre and 0 to 60 lbs P_2O_5/acre, and are included as part of the total nutrient guidelines. (Optional)

7. **Plow Depth -** in inches, used to modify lime requirement (default is 8 inches, 0-24 inches possible)

8. **Soil test results:**

   pH - normal values lie between 4.0 and 8.0.

   Lime Index - The maximum lime index value of 8.0 indicates very low extractable acidity levels. As the soil becomes more acid, this value will decrease to a minimum of 7.0. The default lime index value is 8.00.

   Target pH - this is the desired pH for the intended crop. If the pH is less than the default value, limestone is recommended to raise the pH to the Target pH. Default values are optimum for current crop, but can be changed if necessary (5.5-7.0).

   Extractable Nutrient Levels - The following inputs represent the Mehlich 1 extractable nutrient levels in the soil. They are *index numbers*, meaning they do not represent the total amounts of nutrients in the soil available to the crop during the growing season. Rather, they represent the extractable values that have been calibrated against actual crop responses to derive nutrient guidelines.

   P - Soil phosphorus index number. Values may range from 0 to 999.

   K - Soil potassium index number. Values may range from 0 to 999.

   Ca - Soil calcium index number. Values may range from 0 to 6000.

   Mg - Soil magnesium index number. Values may range from 0 to 500.

Zn - Soil zinc index number. Values may range from 0 to 40. Values in excess of 10 can cause toxicity in sensitive crops. (Note: Except for zinc on soil where peanuts are to be grown, this version of UGFertex does not check for potentially toxic levels of micronutrients.)

Mn - Soil manganese index number. Values may range from 0 to 100. (Note: Plant availability is a function of soil Mn and pH.)

9. When **Manure** is selected on the menu bar and a manure type and an application method are selected, GFertex allows calculation of nutrient inputs for the current year's application and Residual Available N from application made the previous year. The following inputs are required on the manure-working screen (see example screens in **Appendix A**).

Current Year

Manure type - selected from menu, type also determines manure units (weight or volume).

Application Method - selected from menu; based on application and incorporation methods, UGFertex estimates the amount of available ammonium N remaining in the manure.

Manure analysis - total N, ammonium-N, P_2O_5, and K_2O (average values provided by UGFertex can be overwritten with actual values if available).

Previous Year

Rate - amount of manure applied in previous year. Manure Type and Units are assumed to be the same as selected for **Current Year** Manure type above.

Previous Manure Analysis - Total N and Ammonium N only (P and K reflected in soil test). Average values provided by UGFertex may be overwritten with actual values from previous year, if available. Average values are shown in the table on page 11.

Manure Inputs on the Main Working Screen:

Manure Rate - calculated by program, but can be overwritten. All nutrients values affected by change will be automatically recalculated and the display updated. When the soil test P level reaches a level assumed potentially harmful to the environment, UGFertex will not calculate a manure application rate.

Nutrient content of different sources of animal manure

Source	N	P_2O_5	K_2O
	pounds per wet ton		
Broilers - Litter	59	58	45
Hens - Litter	42	66	34
Hens - Battery	34	28	14
Turkeys - Litter	61	57	41
Swine - Farm yard	13	12	9
Beef - Feedlot	22	20	30
Dairy - Farm yard	12	6	14
	pounds per thousand gallons		
Poultry - Slurry	62	59	37
Swine - Slurry	31	22	17
Beef - Oxidation ditch	11	17	42
Dairy - Slurry	25	8	25
Swine - Lagoon	5	2	5
Poultry - Lagoon	7	2	10

Sources: 7, 8, 10, 11 and 12

Chapter 5

Assumptions and Limitations of Calculated Values

Several factors affect the validity of results obtained from UGFertex. Therefore, results should be interpreted in consultation with an expert in the specific subject matter area. This program is designed for use as a guide in evaluating soil test results. When interpreting results, keep in mind the following:

1. The way in which crops respond to lime and fertilizers are affected by numerous factors such as climate, pests, tillage operations, erosion, timing of water and nutrient and pesticide applications, crop variety, and soil properties (texture, depth, presence or absence of restrictive layers) to name a few.

2. These guidelines are based on scientific studies under highly controlled conditions, and verified where possible by on-farm demonstrations. The primary source for the base guidelines is the *Soil Test Handbook for Georgia* (6). Your individual crops and soils may react somewhat differently than the soils used in these studies, especially where two or more soil groups occur in a field.

Interpretation of Results

1. Yield Potential is based on the average of the designated soil management group, assuming a high level of management and use of available technology. Yield potential of individual soils within the group may vary. When irrigation is available, yield potential for most crops is generally increased by 10 to 50%, depending on the crop and soil group. Base Nutrient Guidelines are increased by a similar amount.

2. UGFertex allows the user to adjust the Yield Goal above or below average Yield Potential based on personal experience in the field. Adjustments to the nutrient guidelines are based on the difference (positive or negative number of yield units) between the User's Yield Goal and the Yield Potential and the nutrients removed per yield unit in the harvested crop. This approach may underestimate the actual nutrient inputs to achieve extremely high yield levels, but we make the reasonable assumption that most growers are shooting for maximum profit rather than absolute maximum yields. Nutrient removal rates were obtained from many sources, but most values are from references (2 and 3).

3. The Manure Management section is somewhat over-simplified for reasons of clarity and ease of use. Users should be aware of the hazards of such simplicity. The following paragraphs outline some of the more important inadequacies of this approach. **Read them very carefully.**

   The Manure Rate is based solely on the N Required by the crop and the Available N in the manure (see page 8). UGFertex makes no attempt to adjust manure rates to account for N losses by denitrification and leaching. Required rates may be higher than shown. Conversely, this method of calculation fails to consider the potential problem of over-fertilization with P and K, which are present at relatively high concentrations in some manures. When this situation is encountered one may elect to adjust the manure application rate to reduce the excess. Click the manure application rate window and adjust the rate accordingly. Windows are provided on the input screen that show excess and deficit levels of N, P_2O_5, and K_2O. Alternatively, one

can select the buildup menu to determine how much the excess nutrient will build the soil test level. Manure rates may also be adjusted in this menu.

Using the representative values provided by UGFertex rather than an actual analysis of manure samples to calculate the manure rate could result in large differences between calculated values and nutrients actually applied. Actual analysis should be used whenever possible. Representative values were obtained from references (7, 8, 10, 11, and 12).

Many crops and soils require two or more N applications to reduce leaching losses. Only a portion of this N can realistically be supplied as manure.

UGFertex uses decay rates for each manure type to calculate the availability of N from organic sources (see Program Design, page 6, for calculations). Calculations and decay rates are based on concepts in references (7 and 8). We assume that the decay rates are valid for the Southeastern United States. Other values may be required in other regions.

Chapter 6

1. Starting UGFertex

   Be sure UGFertex has been installed as described in Chapter 1: Getting Started. From your Desktop, double-click the UGFertex icon. You will also find under **Windows Start Menu: Programs:** UGFertex. The opening screen appears.

   Notice the menu selections: **Record**, **Intro**, **Inputs**, **Manure**, **Buildup**, **Comments**, **Report**, **Notice**, and **Options**. These options allow you to enter the different sections of UGFertex. They may be chosen by clicking the desired selection with the mouse, or by pressing the ALT key plus the underscored letter of the option (ALT + I chooses **Inputs**). Select **Inputs** now.

2. Directions on data input

   This screen is composed of five sections. Three sections are normally visible and are discussed here. The remaining two sections are covered below in the discussion of the Manure Working Screen.

   Pressing TAB or ENTER advances the cursor from one field to the next. Shift-TAB moves the cursor to the previous field.

   Errors in typing can be corrected using any of the normal editing keys (arrow keys, Backspace, Del, Space). (Note: Data Entry is always in insert mode; pressing INSERT will not toggle between insert and overwrite modes as it does in word processors.)

   A. Crop and Management Information

   The cursor appears in the **Name** field. Type your name here. You may use any combination of capital or lowercase letters.

   TAB to **Field ID.** Type the name of the field in which the crop will be grown.

   TAB to **County**. This field is used for identification on the printout and for selecting the corresponding Soil Group. Select the county name "Miller" from the drop-down menu or start typing the first few letters of the county name. When the county name appears press TAB or ENTER.

   TAB to **Date**. This field defaults to the current date but can be changed.

   TAB to **Crop**. **Crop** is a Menu data field. Click the down arrow, shown to the right of the field, to display the menu. Use the scroll bar to view all the crops, and click the desired crop. Select "Cotton" now. Alternatively, you can type in the letters **c o t** and "Cotton" will appear. You can also use the DOWN and UP arrow keys to navigate the Crop data field.

TAB to **Soil**. The crop and soil management group are intimately linked. The Soil Group is selected based on the county name. For special situations you can override the selected Soil Group by selecting **Piedmont** or **Deep Sands** using the mouse, or by using the RIGHT or LEFT arrow keys. Select **Coastal Plain** now.

TAB to **Prior Crop**. Open the window as in the **Crop** data field. It too is a Menu data field. Select "Corn-Irrigated" for the **Prior Crop**.

TAB to **Irrigated**. The program assumes non-irrigated conditions for all crops except corn. If irrigation will be used, click **Irrigated** (which will be outlined) or click the box to the right of **Irrigated**. Note the change in the yield goal when this change is made. Yield should now be 1000 pounds of lint per acre. TAB to **Yield Goal**. UGFertex suggests a yield potential for the selected crop that can be obtained over several years using good management practices. The yield goal can be modified by the user to account for actual experiences in the field. Modifications of the yield goal will affect final nutrient guidelines. UGFertex will reject unrealistically high yield goals.

Starter fertilizers may be entered if they are to be used. These are a part of the total fertilizer guidelines and will appear on the printout. The values are also used in the manure calculations.

Plow depth is important for proper calculation of lime requirement. The default value is 8 inches. Greater plow depth increases lime requirement, while shallower depth decreases the value.

B. Soil Test Results (Values)

This section requires actual soil test data. Be very careful in entering data in this section, as errors can result in incorrect lime and nutrient guidelines. Move the cursor to the **pH** data field. Type the following values (in **bold**) for **pH** and **Lime Index**. (**Target pH** can be changed, but use of the default value is strongly encouraged). The Lime Requirement, rounded to the nearest 0.25 tons (500 lbs), is automatically calculated.

pH **5.6** Lime Index **7.50**	Target pH 6.0 Lime Requirement 1 tons/Acre

The next section of data fields is for entry of Mehlich 1 extractable P, K, Ca, Mg, Zn, and Mn values. Enter the soil test results in the box to the right of the appropriate nutrient. The soil fertility rating will be displayed under the nutrient symbol. A "Low" rating indicates a high chance for yield response from added fertilizers. Enter the following values:

Mehlich-1 Soil Test Values	P 41	K 112	Ca 520	Mg 55	Zn 5	Mn 8
	Medium	Medium	Medium	Medium	Sufficient	Sufficient

The Application Guidelines are given in the box in the lower left of the input screen. You will see that Ratings and Application Guidelines are calculated as the soil test index value is entered. The values should match those displayed above. The application guidelines should match those in the **No Starter** column below. **NOTE: Buildup and Starter Fertilizers are included in the Application Guidelines.**

To see how the use of starter fertilizer affects the application guidelines, enter 10 for Starter N, 34 for P_2O_5 in the designated box. The N and P_2O_5 values in the application guideline should now read 55 and 36, respectively.

Application Guidelines	No Starter	With Starter
N	65 lbs/ac	55
P_2O_5	70 lbs/ac	36
K_2O	70 lbs/ac	70
Ca	0	0
Mg	0	0
Zn	0	0
Mn	0	0
B	0.5 lbs/ac	0.5 lbs/ac
S	10 lbs/ac	10 lbs/ac

C. Soil Buildup

This optional section estimates nutrient inputs over and above the crop requirements to increase soil fertility levels. Results of this section are included in the overall nutrient guideline. In this example, Soil P level is 41, which is given a "Medium" soil test rating. A "High" rating requires that the Soil P levels be between 61 and 100. To build the next year's soil test to a high rating will require an increase of 20 (61 - 41 = 20) soil P units. Enter this number to calculate the additional lbs/acre of P_2O_5 required to build the soil P level by 20 units. A total of 160 lbs P_2O_5/acre will be required to build the soil test P level by 20 units. *Note:* The Application Guidelines have been automatically updated to include this increased requirement.

Similarly, an increase of 20 soil K units will raise K from 112 (Low-Medium) to 132 (Mid-Medium). Enter this number under soil K. A total of 100 lbs K_2O/acre will be required to build the soil test level by 20 units. The amounts of P_2O_5 and K_2O required for buildup is defaulted to one year. Depending on the current soil test level and the desired change, some application rates can be quite high and not economically feasible based on a one-year buildup. However, the amounts can be prorated over a period of years to fit the economic situation of the grower. To do this, simply enter the number of years in the space adjacent to Years to Build Change. In the example above, assume a 4-year buildup. The additional P_2O_5 and K_2O would then be 40 and 25 lbs per year, respectively for 4 years.

When manure is to be applied the **Buildup** screen also provides information relative to the potential soil test P and K levels resulting from excess P_2O_5 and K_2O in the manure. To illustrate, click the **Inputs** menu and select "Corn – Irrigated" from the Crop Menu. Click the **Manure** menu, select "Broiler Litter" as the manure type and "Broadcast -immediate application" as the application method. Click the **Buildup** menu. In the lower center portion of the screen you will find that 4.2 tons /ac of Broiler litter are required to meet the nitrogen needs of the crop. In the "Excess" column you will note this application rate results in an excess of 63lbs of P_2O_5 and 79 lbs of K_2O per acre. In the Soil Buildup summary at the top center of the screen in the section titled, "Soil test levels with excess P_2O_5 and K_2O," you find that these excess levels will build the soil test phosphorus (P) and potassium (K) levels to

approxi mately 49 and 128, respectively. Now click the **Manure** menu, scroll to the top of the Manure drop down window and select "None." Click the **Inputs** menu, then place the cursor in the Crop window and type **cot** or select Cotton from the drop down menu. Click "Irrigated" and proceed with the remainder of the tutorial.

SOIL BUILDUP	Phosphorus	Potassium
Desired Change in Index	20	20
Current Soil Test Levels	41	112
Soil Test Levels with Buildup	61	132
Soil Test Levels with Excess P_2O_5 and K_2O	49	128

Fertilizer Required				
P_2O_5	160 lbs/a/yr	K_2O	100 lbs/a/yr
Years to Build Change	1		

3. View Comments

Select the **Comments** menu to view additional management comments. UGFertex maintains two "Comments" sections. The first section is used when manure is not applied and the second "Comments" is used when manure is to be applied.

4. Manure Working Screen

Select the **Manure** menu. The Manure working screen has four components:

A. Manure Type and Application Method

These are Menu Data Fields. Method and timing of incorporation affect availability of ammonium N through their effects on volatilization. Select "Broiler – Litter" as the Manure Type, and "Broadcast - immediate incorporation" as the Application Method. Note that the "Availability Factor" is determined by the "Application Method."

B. Manure Analysis Section

This section contains average nutrient contents for the selected manure. These values should be replaced with actual values whenever available. If manure analysis data are available, the nutrient concentrations can be entered in the "Concentration" column and the lbs/units column will be updated. The "dry matter %" can be entered if this value is known or else use the default value.

C. Available N, P_2O_5, K_2O - Current Year

Based on the total N and Ammonium N values, UGFertex will calculate the amount of Ammonium N lost using the application method selected in A, above. The amount of N available from Organic N applied for the current year is also calculated. Results are summarized within the boxed-in area at the right of the screen. In addition, the amounts P_2O_5 and K_2O available the first year are calculated and are summarized within the boxed-in area at the right of the screen.

D. Available N - Previous Year

Some residual N remains from manure applications made the previous year. Values for Rate, Total N, and Ammonium N are required. The default values for these inputs are based on the current manure analysis. Using the default values for application of 3 tons broiler litter/acre with immediate incorporation, should give you 8 lbs residual N. Select the **Inputs** Menu. In the *lower-center* of the screen, UGFertex displays an overall summary of the manure analysis. This includes the manure type and the rate of manure required to meet the N requirements (minus any Residual N and Starter fertilizer N), the amounts of each nutrient supplied by this rate of manure, and the residual N available from previous manure applications. The manure rate can be changed and the amounts of nutrients supplied will be adjusted. In the *lower-right* corner of the screen, UGFertex summarizes the amounts of commercial fertilizer in addition to manure and starter fertilizers needed to meet the nutrient guidelines.

5. Modifying inputs - Any field you can place the cursor in can be changed.

A. Blank Data Fields

These data fields can be changed by simply entering new data over the old data. Any extra letters left from the old data can be removed using the Delete or Backspace keys.

B. Menu Data Fields

The fields for Crop-Soil Group and Prior Crop on the Inputs screen, and the Manure Type and Application Method fields on the Manure screen may be changed by selecting the desired item from the menu.

C. Calculated Data Fields

These fields are calculated by the program. They cannot be changed by the user.

D. Manure Data

You can choose the type of manure from the Manure screen, or select "None" if the decision is made to not apply any.

6. Viewing the Report

    Select the **Report** menu to view the report on-screen. Use the scroll bar to view the report in its entirety.

7. Printing the Report

    There are several options for printing the report. From the **Record** menu, choose **Print**. You may also click the printer icon on the Adobe tool bar. If you output to different printers, you can change printers by using the drop-down menu on the Adobe print command.

8. To save the data click **Record** and select **Save as new record**. If you need to refer to the data at some later date click **Record** and select **Open**. Navigate to the appropriate data and click **OK** at the bottom of the screen.

9. If you do not wish to save the data click **Record** and select **New**. Select **Yes** on the confirmation box. A clear window is opened.

10. Clicking the **Notice** menu displays the disclaimer.

11. From the **Options** menu, choose **Larger** or **Smaller** to change the program size for your viewing preference. The default size is 640 x 480.

12. Exiting UGFertex.

    From the **Record** menu, choose **Exit** to exit the program. Select **Yes** in the confirmation box.

Appendix A

Opening Screen

Inputs Screen

UGFerter
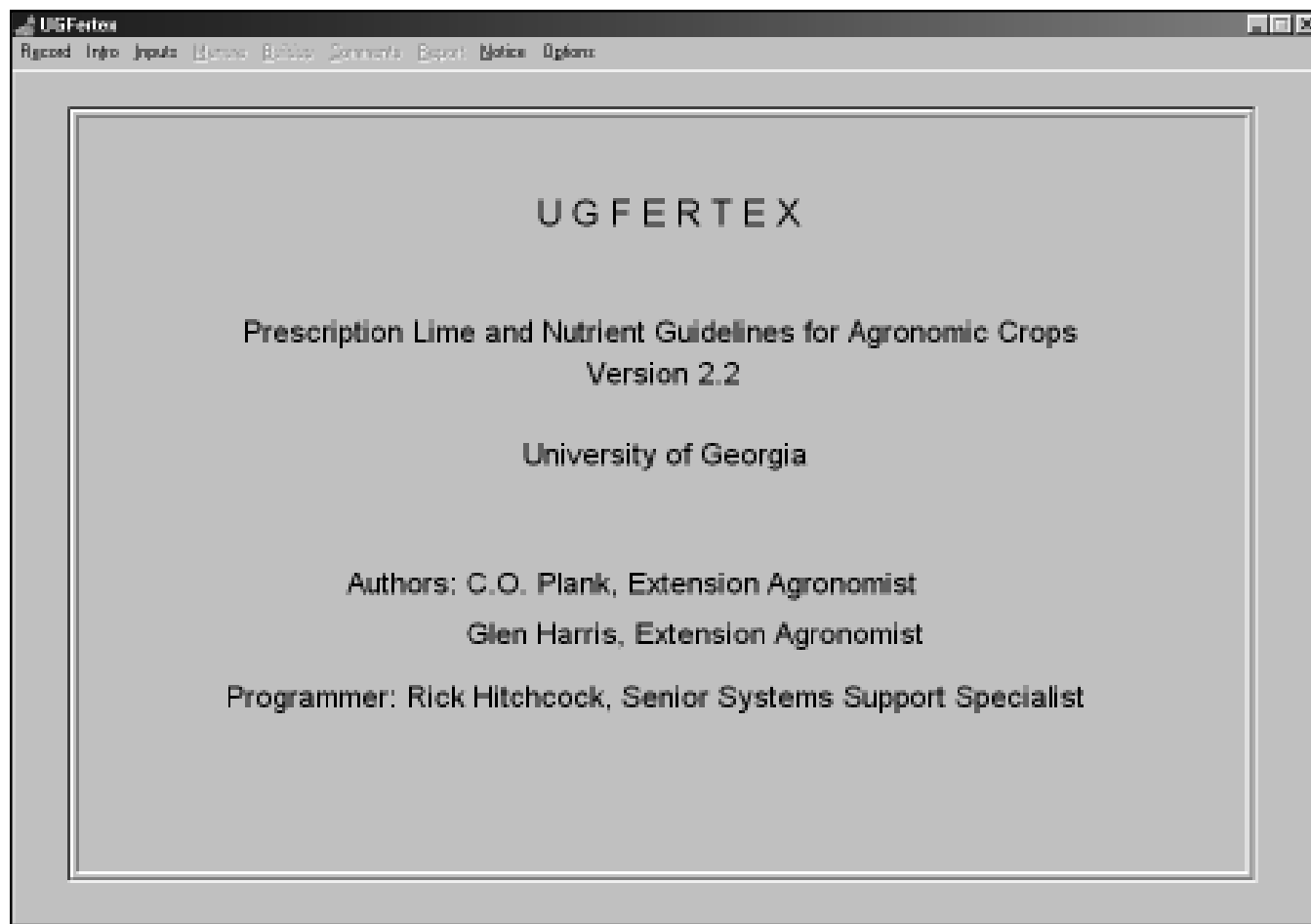
Record Intro Inputs Manure Buildup Comments Report Notice Option:

Name: John Doe

Field ID: Cotton

County: Miller

Date: 06/05/2001

Crop: Cotton

Soil: ● Coastal Plain   ○ Piedmont   ○ Deep Sands

Prior Crop: Corn - Irrigated

Irrigated: ☑   Yield Goal: 1000 lbs   Starter N: 0 P_2O_5: 0   Plow Depth: 8 inches
(for lime requirement)

pH: 5.6   Lime Index: 7.50   Target pH: 6   Lime Requirement: 1 tons/Acre

Mehlich-1
Soil Test Values

P	K	Ca	Mg	Zn	Mn
41	112	520	55	5	8
Medium	Medium	Medium	Medium	Sufficient	Sufficient

Application Guidelines

N:	65 lbs/ac
P_2O_5:	70 lbs/ac
K_2O:	70 lbs/ac
Ca:	0 lbs/ac
Mg:	0 lbs/ac
Zn:	0 lbs/ac
Mn:	0 lbs/ac
B:	0.5 lbs/ac
S:	10 lbs/ac

Inputs Screen with Manure Type Selected

Manure Screen

Buildup Screen (4-Yr Buildup)

Buildup Screen with Manure

UGFertex Report

The University of Georgia
College of Agricultural and Environmental Sciences
Cooperative Extension Service

UGFertex-Based Nutrient Application Guidelines

Client:	John Doe		Field ID:	Cotton
County:	Miller		Date:	06/05/2001
Soil Group:	Coastal Plain		Plow Depth:	8 inches
Crop:	Cotton		Previous Crop:	Corn - Irrigated
Yield Goal:	1000 lbs		Irrigated:	Yes

Results

	Phosphorus	Potassium	Calcium	Magnesium	Zinc	Manganese	Soil pH	Lime Index	
Soil Test Index	41 lbs/Acre	112 lbs/Acre	520 lbs/Acre	55 lbs/Acre	5 lbs/Acre	8 lbs/Acre	5.6	7.50	Soil Test Index

Buildup:	Soil P: 20	P_2O_5 Required: 40 lbs/a/year	Years Required	Starter:	N: 0
	Soil K: 20	K_2O Required: 25 lbs/a/year	For Buildup: 4		P_2O_5: 0

Lime and Nutrient Needs and Guidelines

Limestone	Nitrogen (N)	Phosphate (P_2O_5)	Potash (K_2O)	Calcium (Ca)	Magnesium (Mg)	Sulfur (S)	Boron (B)	Manganese (Mn)	Zinc (Zn)
1 tons/Acre	65 lbs/Acre	110 lbs/Acre	90 lbs/Acre	0 lbs/Acre	0 lbs/Acre	10 lbs/Acre	0.5 lbs/Acre	0 lbs/Acre	0 lbs/Acre

Manure Guidelines

Residual Credits lbs N/Acre	Manure Rate tons/Acre	Nutrients Supplied			Nutrient surplus(+) or deficit(-) from manure. Deficit can be met with commercial fertilizer.		
		N	P_2O_5	K_2O			
0	1.6	64	74	72	N	P_2O_5	K_2O
Method of Application: Broadcast - immediate incorporation. Broiler - Litter Ammonium Factor: 95%					-1 lbs/Acre	-36 lbs/Acre	-18 lbs/Acre

Comments

If rank growth has occurred in this field in the past, decrease the N rate by 25 lbs/acre. If the recommended amount of N is not supplied by the manure, apply the remainder as a sidedress application at first square or first bloom.

If vegetative growth has been inadequate in this field in the past, increase the N rate by 20 lbs/acre. Nitrogen in excess of 100 lb/acre may be detrimental if insect control is inadequate.

Avoid spreading manure near streams, wells, ponds, or environmentally sensitive areas.

Use conservation practices which minimize runoff and erosion.

Calibrate application equipment.

PUTTING KNOWLEDGE TO WORK

Appendix B

1. No application guidelines calculated

    Check to make sure that "Crop" and "Prior Crop" have been selected from the pop-up menus. There should also be a value in the "Soil Group" data field. If not, move the cursor to the appropriate data field and select the desired data.

Appendix C

1. Adams, Fred, and C.E. Evans. 1962. A rapid method for measuring lime requirements of Red-Yellow Podzolic soils. *Soil Sci. Soc. Am. Proc.* 26:355-357.

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3. Anonymous. *Stepping up the yield ladder increases plant food needs.* B-279. Potash & Phosphate Institute.

4. Beegle, D. 1996. Personal communication. Penn. State Univ., Coop. Ext. Ser.

5. Cope, J.T. 1983. S*oil-test evaluation experiments at 10 Alabama locations 1977-1982.* Ala. Agr. Exp. Sta. Bull. 550.

6. Plank, C. Owen (ed.). *Soil Test Handbook for Georgia.* 1989. Univ. of GA Coop. Ext. Ser. Handbook.

7. Gilbertson, C.B., et. al. 1979. *Animal waste utilization on cropland and pastureland.* USDA Utilization Research Report No. 6 (EPA-600/2-79-059).

8. Klausner, S.D., A.C. Mathers, and A.L. Sutton. 1984. Managing animal manure as a source of plant nutrients. *National Corn Handbook* NCH-12. Purdue Univ. Coop. Ext. Ser.

9. Marshall, S.B., C.W. Wood, L.C. Braun, M.L. Cabrera, M.D. Mullen, and E.A. Guertal. 1998. Ammonia volatilization from tall fescue pastures and fertilized broiler litter. *J. Environ. Qual*. 27:1125-1129.

10. Segars, W.I. 1986. *Using animal manure as fertilizer.* Univ. of GA Coop. Ext. Serv. Bull 947.

11. Zublena, J.P., J.C. Barker, and T.A. Carter. 1993. *Poultry manure as a fertilizer source*. N.C. State Univ. Coop. Ext. Ser. Fact Sheet, AG-439-5 (Rev.).

12. Zublena, J.P., J.C. Barker, J.W. Parker, and C.M. Stanislaw. 1993. *Swine manure as a fertilizer source.* N.C. State Univ., Coop. Ext. Ser. Fact Sheet, AG-439-4 (Rev.).

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SPECIFIC ERRORS IN THE PROGRAM

SPECIFIC ERRORS IN THE USER'S GUIDE

SUGGESTIONS FOR PROGRAM IMPROVEMENTS

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