PHOSECON
(LOTUS Template Version)

Economics of Phosphorus Fertilizer Management
PROSECON USER'S GUIDE: LOTUS VERSION 1.01

by

Dr. Ardell D. Halvorson
Soil Scientist
USDA-ARS
Akron, Colorado

Dr. Ed H. Vasey
Extension Soil Specialist
North Dakota State University
Fargo, North Dakota

Dr. David L. Watt
Agricultural Economist
North Dakota State University
Fargo, North Dakota

Contribution from USDA-ARS and Cooperative Extension Service and Agricultural Experiment Station at North Dakota State University.

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NDSU Extension Service
P.O. Box 5655,
Fargo, ND 58105

(701)237-7381
INTRODUCTION

Many soils in the northern Great Plains are deficient in plant-available phosphorus. Therefore, wheat and other grain crops often respond to the application of P_2O_5 fertilizer to a phosphorus deficient soil. Today's farm economic situation dictates that crop production inputs be carefully evaluated to assure maximum economic returns are achieved for the dollars invested. The software program PHOSECON was developed to help farmers, lenders, fertilizer dealers, Cooperative Extension Service personnel, and other agribusiness people evaluate the economic consequences of applying different amounts of fertilizer P_2O_5, either as a single broadcast application or as a combination of broadcast plus annual (band) applications, with or without the addition of nitrogen (N) fertilizer each crop year. This software program can be used to help make management decisions as to what method of application and rate of P_2O_5 should be used to achieve the greatest profit potential. This can be accomplished by the program user inputting different cost and price factors and P_2O_5 management strategies and then comparing the resulting output for each run of the program to observe changes in estimated profits.

PHOSECON was developed using crop yield and soil test data from a long-term soil fertility study conducted on a Williams loam soil, a dominant soil in western North Dakota, eastern Montana, and the northern Great Plains. The study was conducted from 1967 to 1983 near Culbertson in northeast Montana (Black, 1982; Halvorson and Black, 1985a, 1985b, 1985c). Halvorson et al. (1986) conducted an economic analysis of the data from this study which served as the basis for developing PHOSECON. PHOSECON, however, allows the user to change input costs, crop prices, money discount rates, and tax rates. PHOSECON also uses information from other sources, including the knowledge and experience of soil scientists, to simulate the effects on spring wheat yields of: (a) banding P_2O_5 fertilizer annually at a user specified rate following an initial broadcast P_2O_5 fertilizer application; (b) banding P_2O_5 fertilizer annually at a user specified rate without an initial broadcast application; and (c) annually banding a computer recommended rate of P_2O_5 fertilizer to achieve near maximum yield potential. Yield data from the long-term Culbertson study are used to calculate projected yields for each of the eleven crop years for the banding simulation. The efficiency of banding versus broadcasting P_2O_5 is taken into account and adjusted as a function of soil test P level similar to that reported by Peterson et al. (1981).

PHOSECON is presented in two parts which are indicated as "One-Time-Broadcast" and "Broadcast-Annual" on the main option menu when the program is running. The "One-Time-Broadcast" option evaluates the long-term economic consequences of applying a single, one-time application of P_2O_5 as influenced by the costs and prices input by the user while assuming crop yields and cropping sequences of the original data base. The "One-Time-Broadcast" option presents the following economic analysis of the data base by presenting data tables and graphs showing:

1) Table of cumulative increase in grain yield above check plot (no N or P_2O_5 added) from crop year 1 through 11.

2) Table of cumulative increase in value of protein premium above check plot with each additional wheat crop year.
3) Table of cumulative gross income plus protein premium above check plot minus fertilizer costs discounted and taxed at user inputted rates.

4) Graphs of cumulative gross income plus protein premium above check plot minus fertilizer costs discounted and taxed at user inputted rates are presented for each of the one-time $P_2O_5$ application rates of 0, 46, 92, 183, and 366 lb $P_2O_5$/acre.

5) Graphs of cumulative gross income plus protein premium above check plot minus fertilizer costs, discounted and taxed at user inputted rates are presented for each of N fertilizer rate of 0, 40, and 80 lb N/acre.

The "Broadcast-Annual" option of PHOSECON simulates the effects of using both broadcast and/or annual band applications of $P_2O_5$ with or without the addition of 40 lb N/acre each crop year. This option allows the user to select and input different $P_2O_5$ rates but not N rates, however, the N fertilizer costs can be changed. The "Broadcast-Annual" option allows the user to also extrapolate the data base to other soils that may have similar yield potentials but a different soil test P level from the data base soil. Responses to $P_2O_5$ fertilization are limited to the yield difference between the check plot and the $P_2O_5$ treatment with the maximum yield each crop year, using the yield data from the long-term study. Cumulative yields and dollar returns above check plot (no N or $P_2O_5$ added) are presented for each of 11 crop years. In addition, two other tables show the change in soil test P levels with the user specified $P_2O_5$ fertilization program (Fert_spec) and with the computer recommended optimum rates (Fert_opt).

For both the "One-Time-Broadcast" and the "Broadcast-Annual" options, the first 6 crops (crops 1-6) simulate spring wheat grown in a wheat-fallow sequence and the last 5 crops (crops 7-11) simulate spring wheat grown annually without a fallow period between crops.

**INSTRUCTIONS FOR USING PHOSECON**

PHOSECON was developed to run on an IBM PC2 or compatible computer using PC.DOS or MS.DOS operating systems and having at least one 5 1/4" disk drive and 512K RAM. This user's manual is intended to be used while running PHOSECON. Turn your computer ON
and boot the system using your LOTUS \(^2\) systems diskette in drive "A". Remove the LOTUS systems diskette from drive "A". Insert the "PHOSECON" diskette in drive "A", depress the / key to activate the LOTUS menu, and select Files and Retrieve from the Lotus menu. When the file name is requested, press the RETURN or ENTER key. If LOTUS is being operated from a hard drive, the user will need to tell the LOTUS program that the PHOSECON worksheet is located in the "A" disk drive. It will take several seconds for the PHOSECON worksheet to load. Watch for the READY sign to appear in the upper right-hand corner of the screen. At this point, the program is ready to run with the display of the first selection menu and a brief introductory screen.

**NOTE:** To obtain a hard copy of a given screen, depress the Shift and Prt Sc keys simultaneously. This option will give you a copy of only those screens you wish to have copied to the printer, excluding graphic screens.

**Screen 1:** Presents a brief description of the worksheet and a listing of PHOSECON authors and programer. This screen presents the main selection menu or branch options of the PHOSECON worksheet.

**DESCRIPTION OF SCREENS FOR THE "ONE-TIME-BROADCAST" MENU OPTION**

**Screen 1:** Displays program default values for fertilizer N and P\(_{2O_5}\) costs; fertilizer application costs; grain price for wheat; protein premium; discount rate (your cost of money above inflation rate); and tax rate. The "Highlighted" values can be changed by selecting the Change menu option. Any or all values can be changed by using arrow keys to select the value to be changed and then inputting the new value. When you have finished changing values, press the ENTER key "twice" to return to the main menu.

**Graphic Screens:** Selecting the Graphs menu option will result in a new menu being displayed. From this menu, you can select any of eight graphs to be displayed: (1) \(P_{2O_5}=0\); (2) \(P_{2O_5}=46\); (3) \(P_{2O_5}=92\); (4) \(P_{2O_5}=183\); (5) \(P_{2O_5}=366\); (6) \(N=50\); (7) \(N=40\); and (8) \(N=80\). Note, numbers to the left of the equal sign represent the \(P_{2O_5}\) or N rate in lb/acre. The second line of the menu provides a brief explanation of the option being selected. Use arrow keys to move the cursor to the desired graph option and press ENTER key. The graph selected should be displayed. Pressing the ENTER key again will bring up a brief explanation of the graph. Selecting Graph from the menu will return you to the last graph that was displayed. Selecting the Continue-Graphs option will bring up the graphics menu from which other graphs can be selected. Selecting the Return option brings up the main menu of the "One-Time-Broadcast" option.

**Table Screens:** Selecting the Tables option from the menu will cause a menu of tables to be displayed. Selecting the Yield Table option will bring up a table showing cumulative grain yield above check plot for each of the N and \(P_{2O_5}\) treatments progressing from crop year 1 to 11. Selecting the Protein Table option will bring up a table showing cumulative value of grain protein premium (wheat crops only) for each of the N and \(P_{2O_5}\) treatments.

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\(^2\) Mention of trade names or manufacturer within the context of this article are used solely to provide specific information and does not constitute a guarantee or endorsement by the U.S. Depart. of Agriculture or North Dakota State University.
progressing from crop year 1 to 11. Selecting the Tax Table option will bring up a table of cumulative gross income plus protein premium minus fertilizer costs discounted and taxed at user specified rates for each N and P<sub>2</sub>O<sub>5</sub> treatment progressing from crop year 1 to 11. Selecting the Quit option will return program control back to the Main menu.

DESCRIPTION OF SCREENS FOR "BROADCAST-&-ANNUAL" MENU OPTION

Selecting the "Broadcast-&-Annual" option of the main menu will bring up a screen displaying default prices for grain, N and P<sub>2</sub>O<sub>5</sub> costs, fertilizer application costs, and protein premium; discount rate on money and income tax rates for crop year 1 and crop years 2-11; and sodium bicarbonate extractable P level of the native soil that has never received any P<sub>2</sub>O<sub>5</sub> fertilizer and current soil test P level in the 0 to 6 inch soil depth in ppm (note: ppm P = [lb P/acre]/2). Any of the default values can be changed by selecting the Change option from the menu. Use arrow keys to move the cursor to the value to be changed, input the new value, then move to the next value to be changed with the arrow key. When all the desired changes have been made, depress the ENTER key once to return to the menu.

The program assumes a sodium bicarbonate extractable P level (Olsen Test) of 18 ppm (36 lb/acre) in the 0 to 6 inch soil depth is needed to achieve optimum yield potential (Halvorson, 1986). The computer program estimates the amount of broadcast and incorporated P<sub>2</sub>O<sub>5</sub> required to raise the soil test level to 18 ppm the first crop year and the amount that needs to be banded each crop year to maintain the soil test level at 18 ppm, similar to the method used by Halvorson and Kresge (1982). The user inputs the amount of P<sub>2</sub>O<sub>5</sub> to be broadcast the first year and the amount to be banded in subsequent years. If the user specifies no (zero) P<sub>2</sub>O<sub>5</sub> is to be broadcast the first year, the program then assumes that P<sub>2</sub>O<sub>5</sub> will be banded the first year at the rate input for the band application. Results are displayed in six tables and one graph and can be viewed by selecting the Tables or Graph options from the menu.

Table Screens: Selecting the Tables option from the menu will bring up a new menu with six table options: (1) Opt-P-ON; (2) Opt-P-40N; (3) Spec-P-ON; (4) Spec-P-40N; (5) Fert_opt; and (6) Fert_spec. The Table options with "Opt-P" in the title refer to P<sub>2</sub>O<sub>5</sub> rates recommended by the computer program as being optimum for maximum wheat yield potential. The Table options with "Spec-P" in the title refer to P<sub>2</sub>O<sub>5</sub> rates specified by the user of this program. The "ON" and "40N" part of the titles simply refer to the lb/acre of fertilizer N applied each crop year. Each table displays cumulative effects, above check plot, of P<sub>2</sub>O<sub>5</sub> fertilization with either no N or 40 lb N/acre applied each crop year on grain yield, fertilizer cost, gross income, protein premium, gross income minus fertilizer cost, gross income plus protein premium minus fertilizer cost, gross income plus protein premium minus fertilizer cost with money discounted at input discount rate, and gross income plus protein premium minus fertilizer cost with money discounted at the input discount rate and with tax credits and debits figured at user inputed tax rate. The Fert_opt and Fert_spec tables display changes in estimated soil test P levels each year as a result of P<sub>2</sub>O<sub>5</sub> applied for the computer optimum and the user specified rates, respectively.

Selecting the Return option from the menu will return you to
the main menu of the "Broadcast-&-
Annual" option. One can now
select any of the listed options
to continue or Quit to end the
program.

Graph Screen: Selecting the Graph
menu option will bring up a graph
showing gross income plus protein
premium minus fertilizer cost with
money discounted at user inputed
discount rate and with tax credits
and debits figured at inputed tax
rates from each of the first four
option Tables (last column of each
table). This graph displays the
results of the selected management
decisions for easy comparison.
Depressing the ENTER key will return
you to the main menu of the
"Broadcast-&-Annual" option.

Selecting the Change menu
option will allow you to input new
prices and fertilizer P rates.
Selecting the Main-Menu option
will send the program back to the
original starting menu of the
worksheet.

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