

SOYBEANPROD

A Soybean Crop Management Computer Model For Undergraduate Agronomy Courses

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Abstract

A soybean crop management computer model was used as an exercise in a sophomore-level crop production class. Students evaluated the exercise. Student backgrounds were recorded. The model is described briefly and student reactions to it are discussed.

Eighty-four percent of the students had farm backgrounds. Student responses to evaluative statements about the model show that 92 percent felt the exercise was worthwhile, 93 percent felt it increased their understanding of soybean production, and 84 percent felt it made other course material more meaningful. There were little differences between farm and non-farm students regarding these evaluations of the model.

Introduction

The results of several questionnaires from students and faculty consistently show a need for increased student experience in field and laboratory exercises in addition to, or in place of, traditional lecture methods of teaching (2, 6, 7). This practical method of teaching is especially beneficial to students with non-farm backgrounds (4, 5, 10).

One way to give students experience with problems and decisions involved in agriculture is through the use of computer simulation models (1, 3, 8, 9). These simulations give the student rapid feedback on the consequences of management decisions without the time and expense involved with actual crops or animals, and repeated experiences are possible.

This paper describes a soybean crop management computer model used in Field Crop Production, a sophomore-level course at the University of Nebraska-Lincoln, and student reactions to it.

Methods and Materials

Agronomy 204, Field Crop Production, is a 3 credit hour course consisting of 3 hours of lecture per week and no laboratory. About midway through the semester the students are required to complete an exercise using SOYBEANPROD, a computer program on the AGNET System. AGNET is a regional computer network headquartered at the University of Nebraska-Lincoln. It utilizes an IBM 370-3031 computer which is accessed us-

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ing terminals connected by phones. Terminals have been placed at several locations on campus for student use.

SOYBEANPROD has been used the last five semesters beginning in the Spring Semester of 1978. The last four semesters, student evaluations of the assignment, and student backgrounds, have been collected by means of a questionnaire given to all students.

How SOYBEANPROD Works

SOYBEANPROD is an interactive program written in FORTRAN language which also utilizes some AGNET subroutines to simplify the interaction between student and computer. Figure 1 shows an abbreviated flow diagram for the program.

After asking whether the student wants a description of the model and the student's first name, the program asks if the student wants to use his or her own soil and weed data. If not, the program will randomly assign a set of soil conditions including soil pH, soil nutrient levels and soil organic matter content, and general groups of weeds present (broadleaf or grasses, or both). The program then asks the student to enter management decisions on fertilizer and lime rates, herbicide selection, rotary hoeing variety, seeding rate and row-spacing, and planting date. It also asks the student to enter the amounts of stored soil water, anticipated growing season moisture, and irrigation water. All interactive requests are accompanied with "help" messages which the student can access by typing "help." These messages further explain what information is needed and the entry format to be used. Limits are placed on all inputs to ensure that student responses are realistic and within the scope of the program. If an entry exceeds the limits, the program gives the limits for that question and asks the student to enter the information again.

After all inputs are received, the program reports the yield and seeding rate and shows the fraction of the possible yield attained from each factor of management (Fn). It then asks if the student wants an economic analysis. If so, the program asks if the student wants to enter his or her own fixed production costs. If not, it sets fixed production costs at \$100/acre. It then asks for the anticipated price of the crop and reports the gross income, expenses, and profit per acre. Input expenses such as herbicide, seed, lime, fertilizer, and irrigation are included.

The program then asks if the student wants to run the problem again. If so, it lists all inputs and asks which entry the student wants to change. After obtaining the new information, it asks if another entry is to be

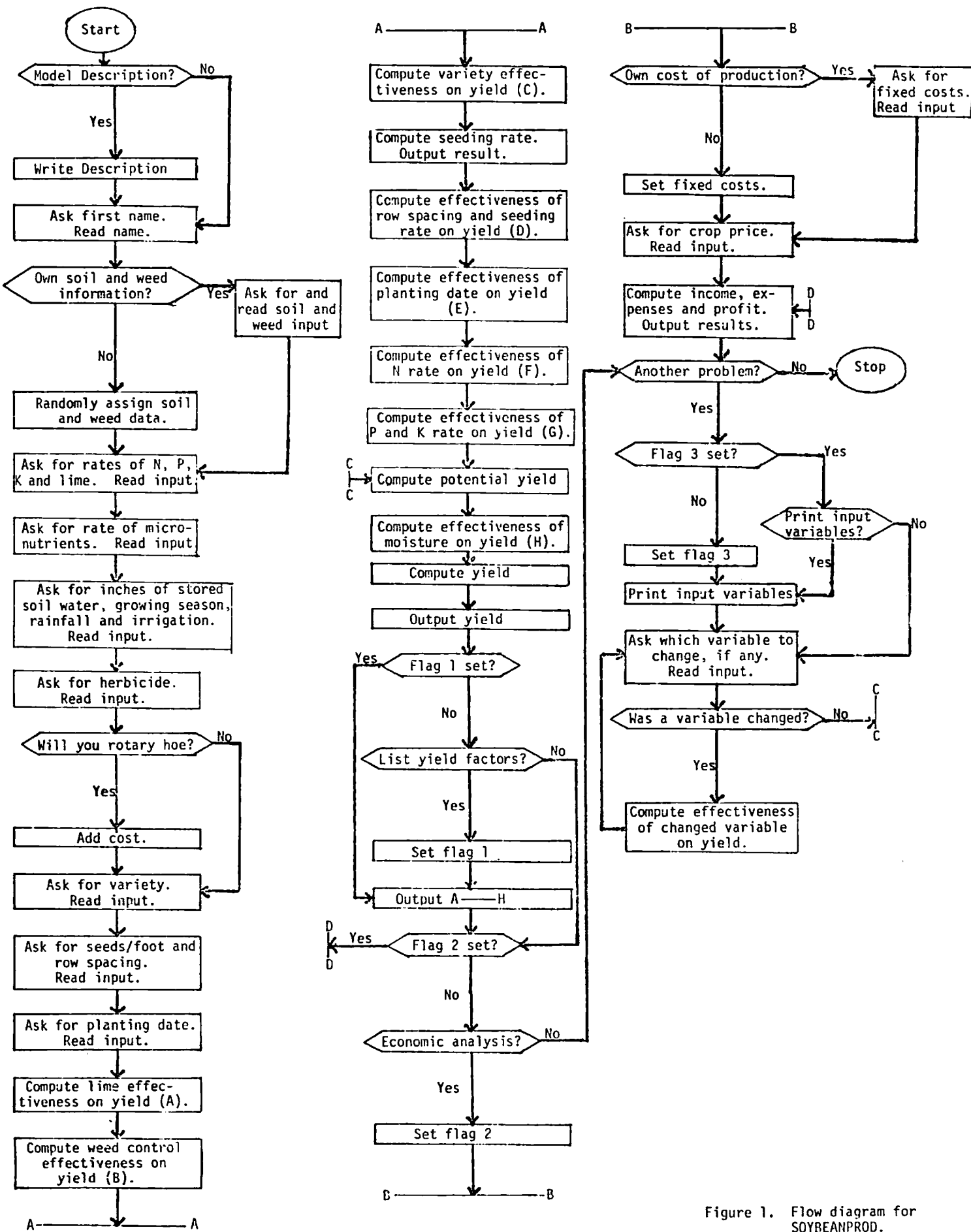


Figure 1. Flow diagram for SOYBEANPROD.

changed. If not, it again reports the yield and other information mentioned previously, and economic data if they were included in the first run. It then asks if the student wants to do another problem. This cycle is continued until the student indicates that he or she does not want to do another problem and the program is terminated.

All calculations of the effect of inputs on yield are based on data obtained in East Central Nebraska. Yield is calculated by assuming that each of the inputs or factors is a function of the yield. If no inputs are limiting, the yield will be 70 bushels per acre. Potential yield Y_{max} = calculated using the following equation:

$$Y_{max} = 70 \times F_1 \times F_2 \dots \times F_9$$

where F_1 through F_9 are herbicide, row spacing, seeding rate, planting date, variety, N rate, P and K rate, micronutrient rate, and lime rate, respectively. Each input (F_n) is calculated as a decimal fraction of the possible attainable yield based on that input. For example, if the herbicide selected by the student decreased yield by 5 percent, $F_1 = 0.95$. Actual yield (Y) is calculated using the following equation:

$$Y = Y_{max} \times F_{10}$$

where F_{10} is the correction for the amount of total water available to the crop.

Each student is required to run the program a minimum of 10 times with one variable changed between each run. A minimum of 5 variables must be changed. Students then write a single paragraph on each run stating which variable was changed, how it affected the yield, and why it affected yield as it did. They also must write a brief one-page summary comparing the effects the different variables had on yield. They also complete a table listing all inputs and outputs from each run to facilitate grading the assignment. They are given three weeks to complete the assignment.

Of the 359 students surveyed, 302 or 84 percent had a farm background. An overwhelming majority of the students (92 percent) felt the assignment was worthwhile (Table 1). The level of satisfaction was slightly higher among farm students.

When asked if using SOYBEANPROD increased their understanding of soybean production, 93 percent of the students agreed (Table 2). There was little difference in percentages of farm and non-farm students responding positively. When asked if the assignment made material used in lecture and the textbook more meaningful, 94 percent agreed (Table 3). In this case, the non-farm students were more positive with almost 90 percent agreeing.

Although only required to run the program 10 times, many students became fascinated with it, running it as many as 50 times in an effort to reach maximum yield. There were also instances where students competed with one another for highest yield. Students who ran the program many times were required to report on a block of only 10 or more runs to fulfill the assignment.

Summary

A computer simulation model can be an effective learning tool, giving students rapid feedback to management decisions, and allowing them to experiment and make mistakes without penalty. Student response to SOYBEANPROD is very positive and all students, whether farm or non-farm, report benefits from its use.

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Table 1. Student responses to "The soybean computer exercise was worthwhile."

	Strongly Agree		Agree		Disagree		Strongly Disagree	
	No.	%	No.	%	No.	%	No.	%
All students	132	36.7	213	55.7	25	7	2	0.6
Farm	127	42.1	157	52	17	5.6	1	0.3
Non-farm	5	8.8	43	75.4	8	14	1	1.8

Table 2. Student responses to "The computer exercise increased your understanding of the factors affecting soybean production."

	Strongly Agree		Agree		Disagree		Strongly Disagree	
	No.	%	No.	%	No.	%	No.	%
All students	108	30.1	224	62.4	24	6.7	3	0.8
Farm	92	30.5	188	62.2	19	6.3	3	1
Non-Farm	16	28	36	63.2	5	8.8	0	0

Table 3. Student responses to "The computer exercise made material presented in lecture and the textbook more meaningful."

	Strongly Agree		Agree		Disagree		Strongly Disagree	
	No.	%	No.	%	No.	%	No.	%
All students	52	14.5	251	69.9	53	14.8	3	0.8
Farm	43	14.2	209	69.2	47	15.6	3	1
Non-Farm	9	15.8	42	73.7	6	10.5	0	0