DAFOSYM for Windows

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Introduction

DAFOSYM is a simulation model of the dairy forage system. The model was developed as a research tool for evaluating and comparing alternative technologies for the dairy farm. The model was first used to evaluate feed production systems and later expanded to include manure handling and tillage systems. By simulating different systems for the same base farm, performance and economic results can be compared to determine the best system. DAFOSYM also provides an excellent teaching aid for use in classrooms and Extension workshops. The model illustrates the complexity of the many interactions among components of the dairy farm. For the experienced user, the model may also provide information useful for strategic planning of dairy farms. Work was undertaken to convert DAFOSYM to a Windows operating system to improve its usefulness to others and to enable further expansion of the model.

Methods

DAFOSYM is a simulation model of crop production and feed use on dairy farms and the return of manure nutrients back to the land. The dairy forage system is simulated over many years of weather to determine long-term performance and economics of alternative technologies and/or management strategies. By modeling several alternatives on the same representative farms, those alternatives which maximize farm production or profit can be determined.

The model is adapted to different locations by changing weather and soil input parameters. The alfalfa growth routine predicts dry matter accumulation and quality changes on a daily basis throughout the growing season. When the crop is ready for harvest, the harvest routine simulates field machinery operations, drying, and rewetting in 3 h increments. Losses and quality changes due to machine operations, plant respiration, and rain damage are accounted to predict the quantity and quality of forage stored. A corn model predicts corn grain and silage yields, and a harvest routine accounts for losses and resource requirements during harvest. Storage losses and associated quality changes are predicted for dry hay, silage and grain stored by different methods. Following storage, feeds are either sold or allocated to a dairy herd. For the dairy herd, balanced diets are fed to each of six animal groups with higher quality forage fed to high producing animals. Supplemental feeds are purchased as needed and extra feeds are sold.

Manure production is modeled as feed dry matter (DM) consumed minus the digestible DM extracted by the animals plus urine DM and any feed DM lost into the manure. The quantity of manure handled is influenced by the type and amount of bedding used and the manure handling method. Nutrients in the fresh manure are determined through a mass balance of the six animal groups. Manure nutrients equal the nutrient intake minus nutrients contained in milk produced and in meat produced through animal growth. Nutrient losses are subtracted to determine that available for plant growth. Crop nutrient requirements are based on the nutrients removed by field crops as a function of yield. These requirements are met with purchased fertilizer minus credits from crop rotation carryover and manure.

Moisture near the soil surface is tracked through time to predict days suitable for field work. Soil moisture is increased by rainfall and decreased through evapotranspiration and moisture flow to lower soil layers. Field operations are allowed only on days when the moisture is below a critical level. Up to six sequential operations are used for estab-lishment of each crop. On any given parcel of land, the operations must occur in a sequence. Tillage follows manure handling in the sequence of spring and fall operations. A delay in planting due to un-timely operations results in a decrease in corn yield.

An economic analysis includes all costs associated with growing, harvesting, storing and feeding of crops to the milking herd and young stock and the collection, storage, and application of manure back to the crop land. Total feed and manure costs are determined as the sum of all costs associated with these processes. Additional costs for animal housing, milking, herd health, and herd maintenance are then included to estimate the total production costs and the net return to management or farm profit. All production costs and the net return over these costs are determined for each simulated year

of weather conditions. The distribution of annual values obtained can be used to assess the risk involved in alternative technologies or strategies as weather conditions vary.

Results and Discussion

DAFOSYM for Windows is primarily intended for use as a teaching tool. This tool can be used in university courses in Bio-Systems Engineering, Agronomy, and Dairy Science. Students can use DAFOSYM to learn more about the complexity of interactions that occur within a dairy production system. The model can also be used in Extension type workshops. With some training, Extension field staff, private consultants, and producers can use the model to study the impacts of various technology changes on farms in their area.

The user interface functions like other well designed Windows based programs. Icons are used to direct the user through major model functions. Menus are used to view or modify model parameters. Files are supplied with the model that provides default values for all parameters of example farms. Parameters are changed by reentering values in an entry box, selecting the appropriate option from a list box, or setting the desired value through a scroll box. Either metric or English units of measurement can be used.

DAFOSYM for Windows functions on any computer that uses Microsoft Windows version 3.1 or later, but it works best on computers using a 486 DX or Pentium processor with at least 4 MB of RAM. About 5 MB of disk space is required to store the program and its associated data files. A Windows type help system assists the user in preparing a simulation and interpreting the results. DAFOSYM is published and distributed by the USDA's Agricultural Research Service. The model and associated files are available without charge through the World Wide Web from the home page of the U.S. Dairy Forage Research Center (http://www.dfrc.wisc.edu).

Conclusion

DAFOSYM for Windows is available through the home page of the Dairy Forage Research Center. It is provided as a teaching aid that illustrates the complexity and interaction of the many components of the dairy farm.