DSSAT
Decision Support System for Agrotechnology Transfer

Introduction

The Decision Support System for Agrotechnology Transfer (DSSAT) Version 4.6 is a software application program that comprises crop simulation models for over 28 crops. For DSSAT v4.6 to be functional it is supported by data base management programs for soil, weather, and crop management and experimental data, and by utilities and application programs. The crop simulation models simulate growth, development and yield as a function of the soil-plant-atmosphere dynamics. DSSAT and its crop simulation models have been used for many applications ranging from on-farm and precision management to regional assessments of the impact of climate variability and climate change. It has been in use for more than 20 years by researchers, educators, consultants, extension agents, growers, and policy and decision makers in over 100 countries worldwide.

The crop models require daily weather data, soil surface and profile information, and detailed crop management as input. Crop genetic information is defined in a crop species file that is provided by DSSAT and cultivar or variety information that should be provided by the user. Simulations are initiated either at planting or prior to planting through the simulation of a bare fallow period. These simulations are conducted at a daily step and, in some cases, at an hourly time step depending on the process and the crop model. At the end of the day the plant and soil water, nitrogen and carbon balances are updated, as well as the crop's vegetative and reproductive development stage.

For applications, DSSAT combines crop, soil, and weather data bases with crop models and application programs to simulate multi-year outcomes of crop management strategies. DSSAT integrates the effects of soil, crop phenotype, weather and management options, and allows users to ask "what if" questions by conducting virtual simulation experiments on a desktop computer in minutes which would consume a significant part of an agronomist's career if conducted as real experiments.

DSSAT also provides for evaluation of crop model outputs with experimental data, thus allowing users to compare simulated outcomes with observed results. This is critical prior to any application of a crop model, especially if real-world decisions or recommendations are based on modeled results. Crop model evaluation is accomplished by inputting the user's minimum data, running the model, and comparing outputs with observed data. By simulating probable outcomes of crop management strategies, DSSAT offers users information with which to rapidly appraise new crops, products, and practices for adoption.

The release of DSSAT v4.6 incorporates changes to both the structure of the crop models and the interface to the models and associated analysis and utility programs. The DSSAT package incorporates models of 28 different crops with new tools that facilitate the creation and management of experimental, soil, and weather data files. DSSAT v4.6 includes improved application programs for seasonal, spatial, sequence and crop rotation analyses that assess the economic risks and environmental impacts associated with irrigation, fertilizer and nutrient management, climate variability, climate change, soil carbon sequestration, and precision management.

Minimum Data

The minimum data set (MDS) refers to a minimum set of data required to run the crop models and evaluate crop model simulation and outputs. Evaluation requires:

1. Site weather data for the duration of the growing season
2. Site soil profile and soil surface data
3. Crop management data from the experiment
4. Observed experimental data from the experiment

Weather Data

The minimum required weather data includes:

- Latitude and longitude of the weather station,
- Daily values of incoming solar radiation (MJ/m²-day),
- Maximum and minimum daily air temperature (ºC), and
- Daily total rainfall (mm).

You may also include dry and wet bulb temperatures and wind speed as optional data. The length of weather records for evaluation must, at minimum, cover the duration of the experiment and preferably should begin a few weeks before planting and continue a few weeks after harvest so that "what-if" type analyses may be performed.

Soil Data

Desired soil data includes soil classification (SCS), surface slope, color, permeability, and drainage class. Soil profile data by soil horizons include:

- upper and lower horizon depths (cm),
- percentage sand, silt, and clay centent,
- 1/3 bar bulk density,
- organic carbon,
- pH in water,
- aluminum saturation, and
- root abundance information.

Management and Experiment Data

Management data includes information on planting date, dates when soil conditions were measured prior to planting, planting density, row spacing, planting depth, crop variety, irrigation, and fertilizer practices. These data are needed for both model evaluation and strategy analysis.

In addition to site, soil, and weather data, experimental data include crop growth data, soil water and fertility measurements. These are the observed data that are needed for model evaluation.

Product Information

Components

The Cropping System Model (CSM) released with DSSAT v4.6 represents a major departure from DSSAT v3.5 and earlier released versions of DSSAT. This does not refer to the function but more to design. The computer source code for the model has been restructured into a modular format in which components separate along scientific discipline lines and are structured to allow easy replacement or addition of modules. CSM now incorporates all crops as modules using a single soil model and a single weather module. The new cropping system model now contains models of 28 crops derived from the old DSSAT CROPGRO and CERES crop growth models.

The major modules are:

- **Land Module**
- **Management Module**
- **Soil module** - A soil water balance sub-module and two soil nitrogen / organic matter modules.
- **Weather module** - Reads or generates daily weather data
- **Soil-Plant-Atmosphere module** - Deals with competition for light and water among the soil, plants, and atmosphere
- **CROPGRO plant growth module**

    - Grain Legumes - Soybean, peanut, dry bean, chickpea, cowpea, velvet bean, and faba bean
    - Vegetables – Tomato, bell pepper, cabbage and green bean
    - Forages – Bahia, brachiaria
    - Fiber crops - Cotton
- **CERES-Maize Plant Growth Module**
    - Grain Cereals – Maize
- **CERES-Sweetcorn**
    - Vegetables – Sweet Corn
- **CERES-Rice Plant Growth Module**
    - Grain Cereals - Rice
- **CERES-Sorghum Plant Growth Module**
    - Grain Cereals - Sorghum
- **CERES-Millet Plant Growth Module**
    - Grain Cereals – Millet
- **CSCERES-Wheat Plant Growth Module**
    - Grain Cereals – Wheat, barley
- **IXIM Plant Growth Module**
    - Grain Cereals - Maize
- **SUBSTOR Plant Growth Module**
    - Root Crops - Potato
- **AROID Plant Growth Module**
    - Root Crops - Taro
    - Root Crops – Tanier
- **CROPSIM Plant Growth Module**
    - Root Crops – Cassava
    - Grain Cereals – Wheat, barley
- **CANEGRO Plant Growth Module**
    - Sugar/Energy Crops - Sugarcane
- **CASUPRO Plant Growth Module**
    - Sugar/Energy Crops – Sugarcane

References

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