Development and Implementation of a Software for Eucalyptus Plantations Forest Irrigation in Initial Months of Growth

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ABSTRACT

During the initial months of a eucalyptus forest is necessary irrigation to ensure survival of the plant. In large areas with thousands of plots, the daily check in place the availability of water in each plot planted in recent months is a very difficult task. The work would be simplified if there was a prior estimate, reducing the number of plots to be checked and better planning in the displacement of personnel and equipment for irrigation. The objective of this work was to develop a warning system for the availability of soil water for irrigation management during the initial months planting in eucalyptus forests. The calculation of water availability in soil was based on the model of Rietche. The system allows you to set ranges of soil water for alerts. Indicating whether to irrigate, needs attention or is ok. Was incorporated into the database all company plots allowing the system run from the dates of initial planting and the last irrigation.

Keywords: Eucalyptus, irrigation, ritchie model, Brazil

1. INTRODUCTION

In the early stages of growth eucalyptus may be need to be irrigated to prevent that plant die. This practice is justified by the high cost of replanting, either for labor and the value of seedlings. Another aspect to be considered is the loss of uniformity, vegetative canopy that creates uniformity and competition between trees, resulting in a fall in global production of wood. In large areas with thousands of plots, the daily check in place the availability of water in each plot planted in recent months is a very difficult task. The work would be simplified if there was a prior estimate, reducing the number of plots to be checked and better planning in the displacement of personnel and equipment for irrigation.

The use of a simulation system to estimate the volume of water in the soil for each plot planted in the last months is very useful for large companies, especially those who acquire land in different city.

The objective of this work was to develop a warning system for the availability of soil water for irrigation management during the initial months planting in eucalyptus forests.

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2. MATERIALS AND METHODS

The system was developed in C ++ and uses a embedded database, the Firebird. In the database are registered all the plots of the company, the weather station and meteorological observations. When a new planting is carried out at time of planting should be updated in the table plot. The system use a meteorological station choice for the user for run the model.

The evapotranspiration model used was proposed by Ritchie. In 1972 Ritchie proposed a method to estimate the evaporation of the soil in rows of plants, where the soil is not completely covered (Blad, 1983). By this method, the soil evaporation is estimated in two stages or phases: one in a constant humidity and other moisture-rate decreasing. In the first phase, the volume of soil is sufficiently wet and the flow of water to the soil surface layer is maintained at appropriate level to meet the rate of potential evaporation. In this condition, the available energy is the only factor that limits the evaporation of soil.

After a certain time interval dependent on environmental conditions that govern the change of phase of water (wind speed, solar radiation and humidity and air temperature), there is a sharp decrease in the rate of transfer from water to air (Phase 2). This is because the drying of the soil promotes the reduction in hydraulic conductivity. Furthermore, if the rain is not sufficient to saturate the ground, and observed a partial wetting, the model calculates the recovery of stored soil water by calculating the balance of water, or a return in the stage two or the stage of a drying.

The hydraulic properties of soil determine the supply of water to the soil surface and are the main factor to determine when the rate begins and ends in the declining stage. Pereira et al., (1997), argue that the method of Ritchie is an alternative to introduce the concept of coefficient of culture and allow the determination of ETc, with an estimated separately culture and transpiration (Ep) using the equation:

$$ET = Es + Ep \quad (1)$$

The ETc and the potential evapotranspiration (ET_o) or reference to a grass surface, differ with respect to agricultural crops, with the characteristics of soil cover, and canopy morphology of aerodynamic resistance

The method proposed by Ritchie to estimate the evaporation of the fraction of bare soil is expressed by (Blad, 1983):

$$Es = \left(\frac{m}{m+\gamma}\right) Rns \cdot e^{-0.4 IAF} \quad (2)$$

Where: Rns = net radiation at the soil surface, m = slope of the curve of the saturation vapor pressure; γ = psychrometric constant and IAF = leaf area index.

The intensity of the estimated from the equation (2), depends on the environmental characteristics of the hydraulic characteristics of the soil and monitoring of leaf development through the IAF over the cycle the crop season. During the drying of the soil, are more of soil hydraulic properties and is less dependent on the availability of energy Blad (1983).

Formulation of the method RITCHIE.

$$E_{max} = \left(\frac{\Delta}{\Delta + \gamma}\right) \frac{Rn}{\lambda}$$

$$E_{s1} = E_{max} \ldots \text{[illegible]}$$

$$E_{s1} = \frac{E\,T_{max}}{\ldots} \ldots \text{[illegible]}$$

$$E_{s2} = \alpha t^{0,5} - \alpha (t-1)$$

$$\sum E_{s2} = \alpha t^{0,5}$$

$$E = E_{max} \ldots \text{[illegible]}$$

$$E_p = E\,T_{max} \ldots \text{[illegible]}$$

3. RESULTS AND DISCUSSION

In the initial screen (figure 1), we can see at ,the bottom, a large area for output results and at the top bellow the menu buttons for import meteorological data, register plots, register meteorological station and see and change meteorological data. Below this two tabs for run the model in differ ways (figure 1 and 2) one take the meteorological from the embedded database and another from a file.

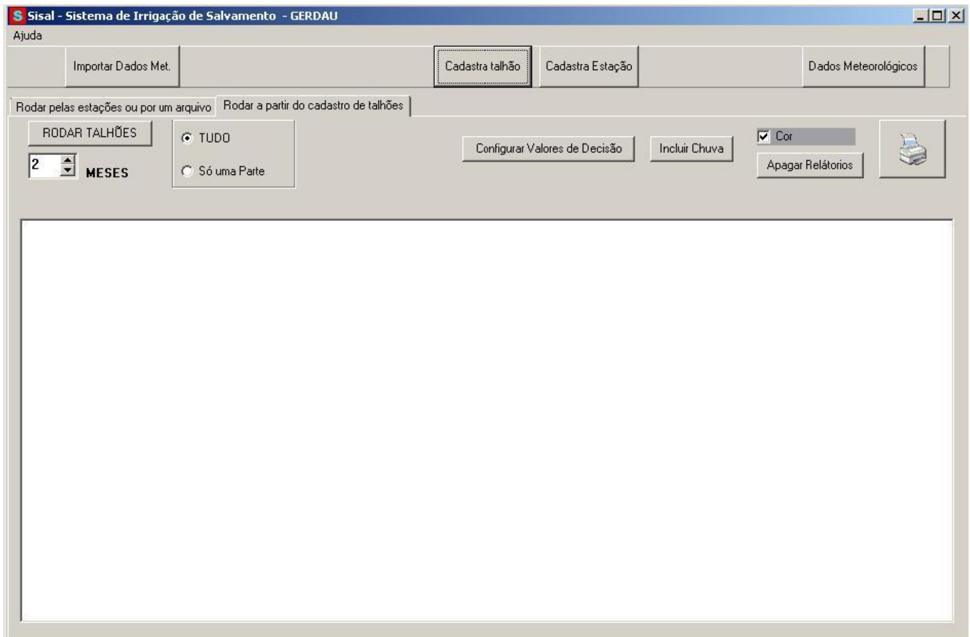

Figure 1. Program initial screen.

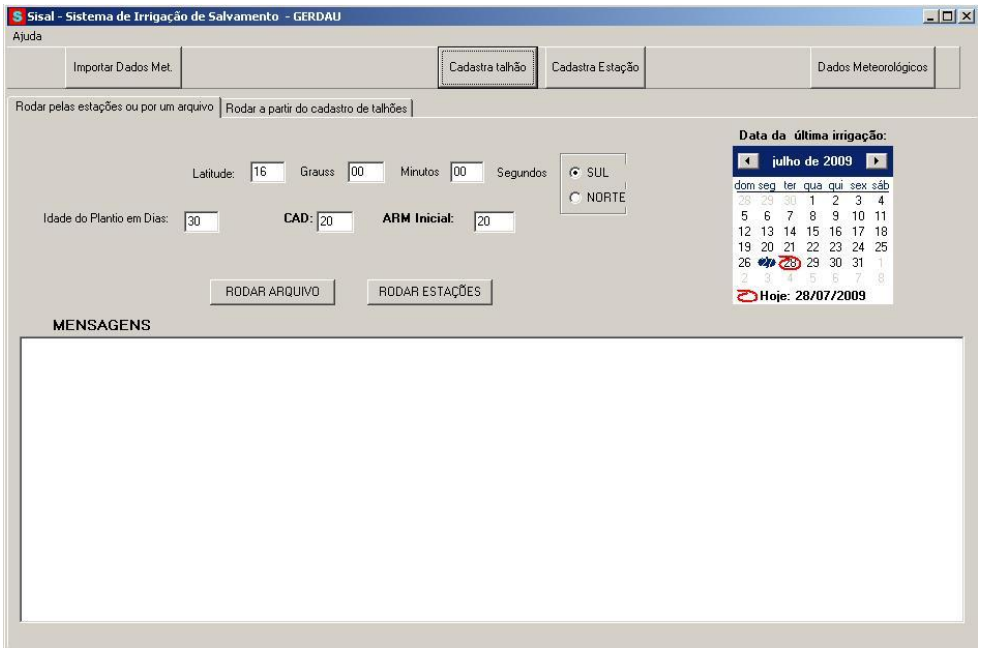

Figure 2. Second tab.

The database have all company's plots, they can to be import from a .csv file generate in a worksheet (figure 3). Original all data about the plots was in worksheet files.
When the system runs, the date of planting is checked and if the planting was a period less than the chosen the irrigation model will run for the plot. According to climatic conditions and the period of year the monitoring for irrigation can vary from 2 to 6 months. You can restrict the plots by a region or farm (company organization of plots).
If we run the model in the second tab, its necessarily create before a text file with meteorological data, one line for it day, the model, in this situation, run for all file and use the configuration that was typing in the fields at the tab, nothing from the database will be use.
The model produce a report that can be print, the are options for color or black and write reports.

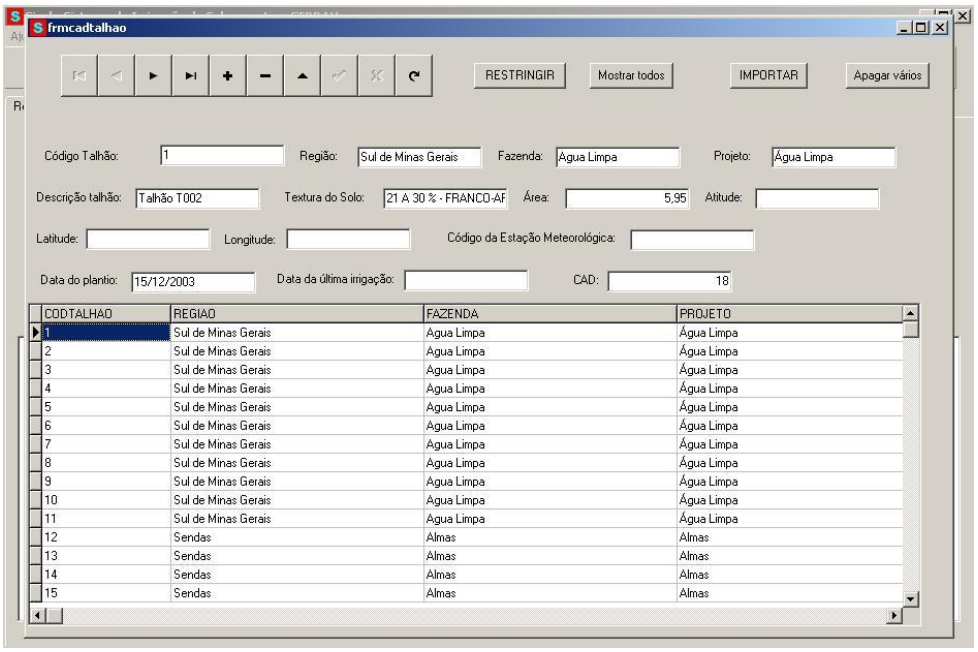

Figure 3. Register of plots.

The are three levels of decision in the system: nothing to do, attention and irrigation. You can configure them (figure 4).

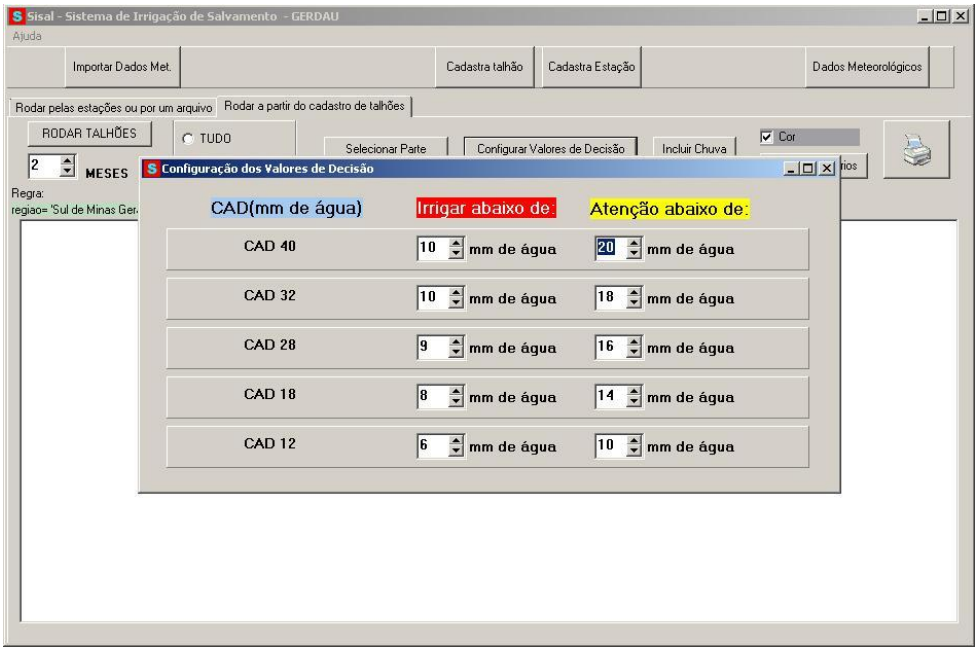

Figure 4. Window for configure the values for decision.

Attention mean that is necessary check on site if you must irrigate. The model is not the fact there are errors in the estimate, as in any model, there is a track which is not possible to say exactly whether it is necessary to irrigate. The configure options are divided by capacity of available water in soil.

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