COMPUTER-AIDED MAPPING IRRIGATION SCHEDULING FOR ARAB REPUBLIC OF EGYPT

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Irrigation is a method of lessening the risk of crop yields being reduced by adverse climatic conditions. It is particularly beneficial on soils of low water holding capacity liable of water deficit. Water management issues are particularly sensitive in the arid and semi-arid regions of Mediterranean countries, where agricultural water use may easily reach 80% of the total developed supply. Improving water management in irrigated agricultural area can not attain sustained optimum land productivity conditions unless a proper soil – crop – water relation are used. This phase can be achieved through the use of reliable irrigation scheduling scheme in order to increase the water use efficiency in such arid and semi-arid zones.

Irrigation scheduling is aimed principally at applying the right amount of water at the right time to achieve maximum crop production. Irrigation scheduling saves water, minimizes stress on crop, controls Salinization, prevents losses by deep percolation and optimizes the use of energy. Decisions for scheduling must be based on knowledge of the climate, the availability of soil water, the needs of the plant and the capacity of the irrigation system. The complexity of crop – soil – water inter-relationships makes it difficult for the farmer to develop his own irrigation scheduling plan, but the availability of low cost personal computers now offers scope for the wide application of soundly based scheduling programs.

Modeling for irrigation scheduling attempts to answer two basic questions posed by irrigators; when to irrigate and how much water to apply. These two decisions require a through understanding of the complex behavior of climatic, soil and plant factors which independently determine irrigation frequency and water quantity for crops.

The estimate of water consumption may be improved by inclusion of factors related to soil, plant and even water resources especially when water becomes a limiting factor and /or water delivery costs increases.

Real time irrigation scheduling is an art to manipulate weather – crop – soil – water data to achieve the maximum possible benefits of an irrigated area. The idea of mapping has been recognized in recent years since the Information Technology (IT) as well as the Geographic Information System (GIS) has offered scope to help mangers analyze the water use information gathered for optimal water usage.

A friendly user computer program was developed to schedule irrigation for different locations positioned geographically on the Egyptian map. This computer program was named "Computer-Aided Mapping Irrigation Scheduling Model"; CAMISM. This computer program is a deterministic dynamic one. The advantages of this program may be summarized as follows :

1- It calculates the real time irrigation scheduling for 36 mapped Egyptian zones. Users may add whatever numbers of new locations upon clicking the Egyptian map window and add up the global positioning of the site (i.e. latitude, longitude and altitude).

2- To give this program the characteristic of wide use application; four methods of reference crop evapotranspiration calculations were introduced; Blaney-Criddle, solar radiation, modified FAO Penman-Monteith and Pan evaporation. Users may choose amongst these methods according to availability of weather data and/or the basis that justify the use of each method on a specific location.

3- The crop module data base included seven crop categories representing 65 crop types and species to calculate the crop evapotranspiration according to three crop development stages.

4- The soil module data base added up to 13 different soil textures to cover almost all soil types. This module also makes use of the progressive effective rooting rooting depth to calculate the available water for different crops grown on different soil types.

5-The leaching requirements module was included to add the amount of water required to control salinization. CAMISM data base took into consideration the right level of crop tolerance to salinity according to electrical conductivity of irrigation water and/or soil solute.

6-The irrigation system module contained four types; surface, improved surface, sprinkle and drip to quantify that extra amount of water accounted for the application deficiency.

The necessary models required for each module were developed using appropriate regression and correlation analysis. The coefficients of determination for these models were statistically calculated. The precision of the relationships were highly significant at 1% level. Then the CAMISM computer program was written using visual basic software (Version 6) to include all modules to calculate the irrigation amount required for an area and the likely time of irrigation application.

To evaluate and verify the CAMISM predictions; all necessary steps required to develop such models were followed with proper justification. On real application three different locations were chosen to represent study cases to validate the CAMISM output results. Toshka, Maruot, Sakha (Kafer Al-Sheekh) were considered in this respect. Verification proved that CAMISM predictions are either above or below and/or at the perfect line of agreement according to suitability of ETo method for the chosen location as well as availability of weather data. Nevertheless, in all cases the CAMISM predictions were highly significantly correlated with the ETo values obtained from the Central Laboratory of Agricultural Climatic "CLAC", Desert Research Institute and Sakha Station. The modified FAO Penman-Monteith method for ETo calculations has given the best verification ever proving once more the fact of its wide application.

The amount of water saved by CAMISM has reached a total of 102.2, 128 and 143.3 million m^3 for con crop in Toshka, groundnut in Maruot and wheat in Sakha regions respectively.