

## Software for monitoring the nutrient and irrigation levels in oil palm

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### Abstract

Oil palm requires adequate irrigation and demands a balanced and adequate supply of nutrients for its growth and yield. Under irrigated conditions, studies were undertaken to standardize fertilizer and irrigation dose through fertigation and micro irrigation to improve nutrient and water-use efficiency, respectively. For these studies, the palm-wise data needs to be compiled and analysed to know the performance of various treatments. Software requirement analysis was done to identify the input and output characteristics of the experiments and related data management. Database modules were designed and developed in MS Access using the Visual Basic for Applications to record the palm-wise data on different characters and to retrieve information in the form of various reports for the selected period like day, month and year. User friendly screens were designed for this purpose. The software enables to retrieve the data on treatment means for various parameters and export it to Excel format for further analysis using any statistical software. The software was tested for its function and is implemented.

**Key words:** Oil palm, software, database, irrigation, module, yield

### Introduction

Oil palm is cultivated in India under assured irrigated conditions. The major factors influencing the growth and yield of oil palm under irrigated conditions are water and fertilizer application. Insufficient irrigation affects the photosynthetic activity of palm thereby impairing the growth and yield of the crop. It is also a heavy feeder and demands a balanced and adequate supply of macro, secondary and micro - nutrients for its growth and yield.

Manual processing of palm wise data on various parameters is not only cumbersome but also time taking. Though the data can be stored in an Excel file, it is cumbersome to handle the data collected over a period of time as data retrieval for various specific tasks becomes difficult. Software modules / applications were developed to cater the needs of irrigation and nutrient management experiments. There is a need to store and retrieve database information in both convenient and efficient manner by allowing users to create, edit and update data in database files. Hence, the DBMS software was required to store the data in a structured manner thereby minimizing redundancy, easy retrieval and analysis. This paper describes the design and development of software modules for the experiments on irrigation management and nutrient studies.

### Materials and methods

Experiments laid out at the Indian Institute of Oil Palm Research, Pedavegi, Andhra Pradesh to standardize the level of irrigation using micro irrigation and fertilizer dosage using fertigation to improve water and nutrient use efficiency in oil palm were considered while developing the software.

The software modules for irrigation and nutrient management studies were developed following the Waterfall model of Software Life Cycle. Requirement analysis was done to study the manual process and existing module in MS Access to identify

the input / output parameters of the experiments. The layout of the experiments was incorporated into the database by linking the palm numbers to the treatment and replication details. The relational database was designed in MS Access considering the aspects of normalization. Two different modules were developed in MS Access for irrigation management and nutrient uptake studies, respectively. Tables were created with different attributes which were linked to one another by mapping the primary and foreign key. Data entry forms and reports were designed in MS Access with coding in Visual Basic for Applications (VBA). Macros, queries and reports designed in MS Access were used in the process of retrieving information and generating reports. Dynamic reports were created based on number of harvests during the selected period for retrieving information on various parameters. The software's were tested for their reliability by comparing with manual calculation. The software modules were implemented and are being used in the experiments.

### Results and discussion

Softwares developed for irrigation and nutrient studies. Created database tables, designed and developed user friendly screens for data entry and retrieval of information. The software modules were mainly categorized into Data Management and Reports. The Data Management enables the user to enter the data of various characteristics using the user friendly screens in a row and column format similar to MS Excel. The data once entered could be modified using the respective correction screens. The correction screens enable the user to select the observation date, palm number and character from the drop down lists and retrieves the data which can be modified and stored in the database.

Programming was done to analyse the data and view in the form of various reports *viz.*, treatment-wise means, date-wise, month-wise and year-wise provided under Reports function. The report on treatment means displays in a replicated table form for the

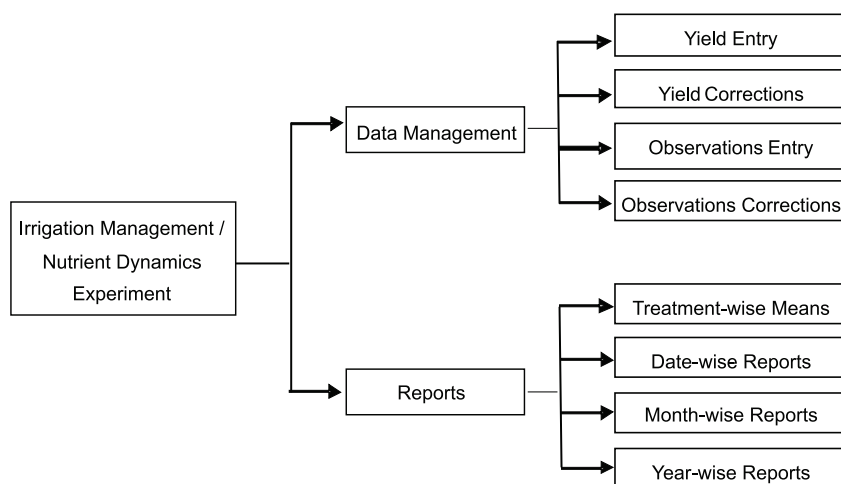


Fig. 1. Functions of Irrigation Management and Nutrient Dynamics software modules

selected period of the specified character (*e.g.* bunches, yield, height). Provision has been made in the software to exclude dead, replanted and sterile palms in the calculation of means. This gives scope of using varying number of palms in a treatment while analyzing the data.

The displayed report could be printed and also exported into Excel format in a tabular as well as columnar form with the treatment and replication values. Thus exporting the data into Excel format enables the user to use the contents for statistical analysis.

The date-wise reports of the selected character displays the palm-wise entries for the selected duration. At the end of each date, the maximum, minimum and sum total values of the selected character are also displayed. The reports also display treatment and replication-wise data for the selected date. The screen for retrieving date-wise information with an option to choose between harvesting data and other characteristics. Selection can also be made for Financial and Calendar year. By choosing the option Harvesting Details, provides further options for number of bunches and weight of bunches. Similarly, by choosing the option Observations, it displays the list of various observations *viz.*, height, girth, number of leaves, inflorescence *etc.* Based on selection of the character and year, all the years for which the data is available in the database, are listed in the drop down box. By selecting the required year, the palm-wise data is displayed in the form of report for every date of recording of observations. This helps in viewing and verifying the trend of each palm over the years.

The month-wise reports display the palm-wise data for the selected year (Financial / Calendar) and character for both harvesting and other characteristics. The year-wise reports display the palm-wise data on a year to year basis for the selected duration of years. The data is displayed in the form of report for the criteria selected. The month-wise and year-wise reports on harvesting details includes both the characters, *i.e.* number of bunches and weight of bunches in a single report. For other observations, the data is displayed for the character selected *viz.*, height, girth *etc.*

Using this software, one can store palm-wise data on various characters for entire life span of the palm. The large database on various characters also help in retrieving the information on specific character for the specified period. Provision has been made in the software to include additional characteristics. As per the user requirements, various reports could be designed using database to retrieve more information regarding the performance of the palms.

The softwares developed for data management in plantation crops is having many advantages as it is user friendly like Excel for data entry, easy data retrieval in the required format as in Access, dynamic representation of information in the form of reports *etc.* Though the software modules mainly cater the needs of research personnel, it can also be customized for use by the farmers to store the palm-wise data of their crop. Customization of these software modules will help the farmers to retrieve information on performance of palms on various characteristics over a period of time. *i.e.*, month-wise, year-wise information. The software modules are available at IOPR, Pedavegi, as executable files and can be installed in any desktop or laptop system having a windows operating system and MS Office 2007.

The major factors influencing the growth and yield of oil palm, under irrigated conditions are water and fertilizer application. User friendly database management software was designed and developed in MS Access with VBA code for recording and retrieving the data on experiments of irrigation management and nutrient management. The Data Management and Reports options enabled the user to enter the data of various characters and retrieve and view the information in the form of various reports *viz.* Treatment-wise Means, Date-wise, Month-wise and year-wise reports. The reports on treatment-wise data of the experiments can be exported to Excel format for further statistical analysis. These software modules helped in handling large data of the experiments more effectively and efficiently. These modules can be customized for use by the farmers to know the performance of their crop.

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