A Decision Support System for Determining the Effect of Seeding Rate on Crop Yield

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Abstract

The rapidly growing demand for the application of information technology have induced managers, farmers and policy makers to question the performance of the systems when no use of the computer software and information systems applications versus applying the information technology techniques. In Sudan the information systems application started to grow in the last few years, specially systems designed to automate payroll, accounts payable, inventories control and other old ideas in the domain of international computer software application, but the agricultural and environmental information technology applications and decision support systems is suffering very much from stagnancy. Moreover, it was found that the agricultural, environmental and resource management researchers suffer more from the insufficiency of information technology applications and computer software support during the period of research preparation and results calculation. All the mentioned causes waste a lot of time and effort after designing the experiment, collect the row data and during the stage of decision creation, which depend on data manipulation that is done manually. So the degree of accuracy, reliability and promptness achieved from these calculations, will not satisfy the desired conviction. This study constructs a DSS to support agronomists, stands on their ideas and helps them in determining the better level of one parameter out of two parameters applied in the field. The objectives of this study are to: accurate and simplify the data entry versus that done manually; organise and simplify the process of data showing during entering and after entering; calculate the vertical and horizontal totals and means and then represent tables as it is on the researcher papers; give consecutive steps and information that help computer-ignorant researchers to execute its stages until they achieves the last results and to give the last decision about the best seeding rate that is suitable at the specified circumstances of the field.

\textit{Keywords: Agricultural information systems, DSS Model, split-plot design.}

2 Objectives of the Study

The main objective of this study is to design a decision support system (DSS) to help researchers to determine the best seeding rate out of many seeding rates those applied in the field depending on the productivity.

Specific objectives include:

- To accurate and simplify the data entry versus that done by the calculator.
- To organize and simplify the process of data showing during and after entering.
3. To calculate the vertical and horizontal totals and means and then represent tables as it is on the researcher papers.
4. To give consecutive steps and information that help the computer “ignorant” researchers to execute its stages until he achieve the final results.
5. To give the last decision about the best seeding rate.

3 Materials and Methods

The practical fieldwork and the experiment design have been done by Abdel-Rahman (2003) with four seeding rates, two cultivars, and four replications (see figure 1). Consequently the number of treatments is eight (cultivars number multiplied by seeding rates).

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Figure 1: The layout of the field experiment.
Source: Modified from Abdel-Rahman (2003)

3.1 Split-plot Design

The split-plot design is experimental design that specifically suits for a two factors experiment with many treatments. One of the factors is assigned to the main plot and called the main plot factor. The main plot is divided into subplots to which the second factor (called the subplot factor) is assigned. Thus, each main plot becomes a block for the subplot treatments (Gomez & Gomez, 1984). Also the analysis of variance of a split-plot design is divided into the main plot analysis and the subplot analysis.

3.2 The Theory of the DSS Model:

According to the idea of the split-plot design, the DSS model computes the analysis of variance as follows:
Step 1. Constructing the template of the analysis of variance.
Step 2. Totals and means calculation.
Step 3. The correction factor (C.F.) computation.
Step 4. Creating the main plot analysis totals table.
Step 5. The computation of sums of squares for the main plot analysis.
Step 6. The computation of sums of squares for the subplot analysis.
Step 7. The computation of F value for each effect that needs to be tested by dividing each mean of square by its corresponding error term.
Step 8. Obtaining the corresponding tabular F value and check the significance for each effect whose computed F value is not less than ‘one’ (note: this step is still done manually).

3.3 The DSS Algorithmic Model

The model is composed of a serialized algorithms (figure 2) ordered like:

1. Data: The data collected by the researcher from the field (crop yield).
2. Data entry: The user enters the data in the DSS software.
3. BFDP: Calculation of the number of treatments according to the entered data.
4. GT: Calculation of the grand total (used to determine the correction factor).
5. CF: Calculation of the correction factor (used to calculate the square sums and means).
6. SMC: Calculation of the vertical and horizontal totals and means of the field data matrix.
7. SUM OF SQUARES: The aggregation of the field data matrices square for the two factors.
8. MEAN OF SQUARES: The calculation of the field data matrices means of squares for the two factors.
10. FT: Tabulated F value.
11. EVALUATOR: An expert whose revise and check the accuracy of the results in any step.

Figure 2 .The Decision Support System Model
4 Results:

A DSS model has been built. It consists of three important components: the first is the database, which gathered consecutively from the field by the researcher and ordered in a matrix form (figure 1); the second component is the algorithmic model, which explains the modules of DSS model and shows the general structure of the work (figure 2). The third component is the software that translates the DSS model into a computer-based model to create the last decision using C++ programming language. The software is now functioning very well determining the best seeding rate depending on the entered data. But we plan to rebuild it in another visual software in order to achieve more effectiveness (For free copy from the DSS software, contact the first author).

References


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