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Application of Hierarchical Visualization Techniques in Meta-Analysis Data

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ABSTRACT

The meta-analysis is a probabilistic technique that groups the results of several studies, approaches the same subject and produces a result that summarizes the whole. The results that are displayed in graphical form neither offer interactivity with the user, nor a user-friendly interface and easy comprehension. In order to obtain a visual exploratory analysis with more satisfactory results, there are information visualization techniques applied to map the data in graphical form to broaden the user cognition. This article performs the execution of the meta-analysis, through R software, in order to determine the efficiency of fungicide fluquinconazole when combating Asian soy rust and applies the Technique for the Visualization of Hierarchical Information Structure; the Bifocal Tree, to improve the results displayed by the R through the forest plot graphic.

KEYWORDS

Bifocal Tree, Dynamic Visualization, Fluquinconazole, Information Visualization, Meta-Analysis, R Software, Soybean Rust

INTRODUCTION

The scientific research is currently applied in several areas of study, and it is possible to find numerous results about the same content through existing media (Madden & Paul, 2011). Meta-analysis is a probabilistic technique that uses the merger of results obtained in different studies and produces results that summarize the whole. This technique can be applied in a fixed or random effect model by using existing software, as an example, the free R Software (Ziegelmann, 2013).

In the field of agriculture, MA is used to perform empirical estimates of efficiency for the development of productivity and economic research of agriculture (Thiam et al., 2001).

R Software, used to perform the meta-analysis, operates through command lines previously known by the user and displays its results by means of statistical graphs, without providing repetition or offering a user-friendly interface that is easy to understand and operate (Sutton et al., 2000).

The graphics generated by the software neither offer interactivity with the user, nor a user-friendly interface and easy comprehension. In order to obtain a visual exploratory analysis with more satisfactory results, there are information visualization techniques applied to map the data in graphical form to broaden the user cognition (Thiam et al., 2001).

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The Information visualization is a computer graphics method used to assist in the process of examining a set of data through manipulable graphical representations. These representations not only present the results, but provide mechanisms that allow the user to interact with information, by visually examining it (Valiati et al., 2008).

This article aims to analyze and improve the Forest Plot graphic generated by R Software through the implementation of meta-analysis to determine the effectiveness of the use of the fungicide Fluquinconazole on soybean seed, used to minimize the impact caused by rust disease on productivity of Asian culture. The results will be displayed using the information visualization, so that the user can obtain greater interaction with the data and better exploitation of achieving results.

META-ANALYSIS

The meta-analysis uses grouping statistical techniques by combining and analyzing the results of several studies from an area in order to obtain more specific or even definitive results. Regardless the literature reviews that performs a descriptive work (Patel, 1989). The most important prerequisite of meta-analysis is that the various individual studies approach the same research topic or examine different aspects of a broader issue. The goals of a meta-analysis can be defined by Patel (1989):

- Get an ideal central estimate of a series of quantitative estimates.
- Improve the accuracy with which a quantity is estimated.
- Resolve an uncertain matter when a series of studies differ in their conclusions.
- Give answers to questions that are not treated in any individual study, which can be examined in subgroups of systematic studies in different settings.

Although some authors (Feuer, 1989; Delahaye et al., 1991) only approach quantitative estimates, resulting from several studies statistical calculations, Delahayne et al. (1991) explain that both the quantitative and the qualitative approaches are possible in the meta-analysis. Methodological analysis identifies studies which have scientific validity and provides the original research with a qualitative answer (Venables, 2001). The steps of a qualitative approach carried out through meta-analysis are (Delahaye et al., 1991):

- Formulating the research question
- Carrying out bibliographical research
- Defining criteria to judge scientific validity
- Applying these criteria to each study

The quality of the statistical accuracy obtained from meta-analysis depends on the comprehensiveness of bibliographical research, i.e., It is proportional to the number of samples found.

To combine the studies found in a meta-analysis, it is necessary to determine the measure of effect (ME) and calculate it for each study, thus the studies are grouped by the measure taken. The choice of ME depends on the research in matter, the type of the variable involved and the number of compared groups. The most commonly used measure of effects on meta-analysis of experiments are: relative risk (RR), odds ratio and mean difference (Ziegelmann, 2013). When the measure of effect is set, it is elementary to determine the presence, or not, of heterogeneity between the studies classified (Ziegelmann, 2013).