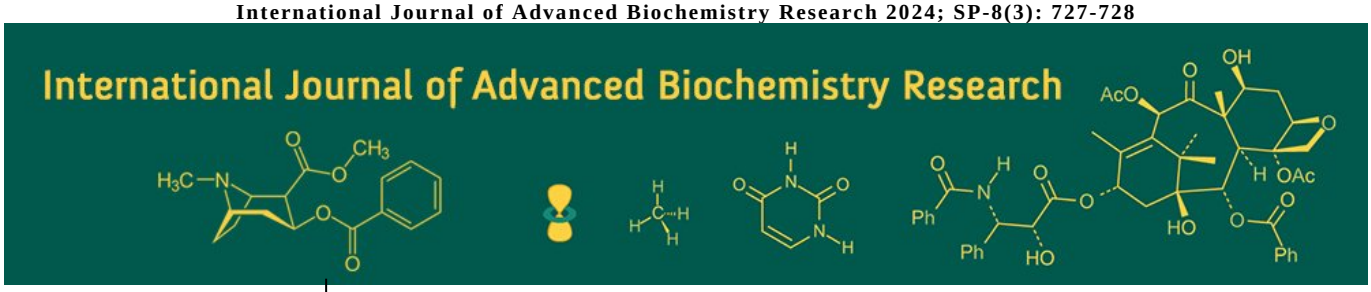

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Comparative analysis of statistical software usage in agricultural research: A review

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Abstract
Statistical software plays a crucial role in analyzing data and drawing meaningful conclusions in agricultural research. This paper aims to provide a comprehensive review of the usage of different statistical software packages in agricultural studies. The review covers the advantages, limitations, and applications of popular statistical software such as R, SAS, SPSS, MATLAB, Python and STATA in agricultural research. Additionally, it discusses emerging trends and future prospects in statistical software usage within the agricultural domain.

Keywords: Statistical software, agricultural research, R, SAS, SPSS, STATA, MATLAB, python

Introduction
Agricultural research involves the collection, analysis, and interpretation of data to address various challenges in crop production, livestock management, environmental sustainability, and food security. Statistical analysis is essential for making informed decisions based on experimental results and observational data. In recent years, numerous statistical software packages have been developed to facilitate data analysis in agricultural research. This review aims to compare the features, capabilities, and suitability of different statistical software for agricultural applications.

Review literature with Methodology
R: R is an open-source statistical software widely used in agricultural research due to its flexibility, extensive statistical capabilities, and active user community. It offers a vast repository of packages for various statistical analyses, including regression analysis, spatial statistics, time-series analysis, and multivariate analysis. Moreover, R allows for seamless integration with other data manipulation and visualization tools, making it a preferred choice for many agricultural researchers (González *et al*., 2019) [1].

SAS: SAS (Statistical Analysis System) is a proprietary software suite known for its robustness, reliability, and scalability. It offers a comprehensive range of statistical procedures and data management tools tailored for agricultural research applications. SAS is particularly favored in large-scale agricultural studies and industry-sponsored research projects due to its extensive documentation, technical support, and regulatory compliance (Jung *et al*., 2018) [4].

SPSS: SPSS (Statistical Package for the Social Sciences) is a user-friendly statistical software widely adopted in agricultural research for its intuitive interface and ease of use. Although originally developed for social science research, SPSS offers a wide array of statistical tests suitable for analyzing agricultural data, including ANOVA, regression analysis, and factor analysis. Its graphical user interface (GUI) makes it accessible to researchers with limited programming skills (Sahle *et al*., 2017) [7] and IBM Corp. (2020) [3].

STATA: STATA is a statistical software package known for its efficiency, data management capabilities, and advanced econometric methods. While originally developed for economics research, STATA has gained popularity in agricultural studies for its robustness in handling large datasets and complex statistical models.

It offers a comprehensive suite of commands for data manipulation, regression analysis, survival analysis, and panel data analysis, making it suitable for diverse agricultural research applications (Kawuki *et al*., 2019) [5].

MATLAB: A high-level programming language and environment for numerical computation, data analysis, and visualization by Math Works. (2021) [6].

Python: A versatile programming language with libraries such as NumPy, Pandas, and SciPy for statistical analysis and machine learning used by VanderPlas, J. (2016) [10].
The evaluation criteria include: Ease of use and learning curve, Availability of agricultural-specific packages and functions, Flexibility and customization options, Computational efficiency, Visualization capabilities, Technical support and community resources.

Emerging Trends and Future Directions
With advancements in technology and computational methods, the landscape of statistical software in agricultural research is continually evolving. Emerging trends include the integration of machine learning algorithms, cloud-based computing, and reproducible research practices into statistical software platforms. Furthermore, there is a growing emphasis on open science principles, collaborative research networks, and data sharing initiatives to enhance transparency and reproducibility in agricultural research (Gómez *et al*., 2020) [2].

Conclusion
In conclusion, the choice of statistical software in agricultural research depends on various factors, including the nature of the research questions, available computational resources, level of technical expertise, and preferences of the researchers. While each statistical software package has its strengths and limitations, researchers should carefully evaluate their requirements and select the most appropriate tool for their specific research needs. Future developments in statistical software are likely to enhance data analysis capabilities and foster interdisciplinary collaborations in agricultural research.

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