

Evaluating the efficiency and accuracy of SuDoKu experimental designs used in an ornamental breeding company

Good experimental design is one building block of efficient phenotyping pipelines in plant breeding programs. Selecta one has recently introduced efficient experimental designs in several of its programs for ornamental species. One particular kind of design that has been used recently involves three blocking factors, i.e. rows, columns and superblocks, imposed on a rectangular grid of experimental units (plots) in the greenhouse or field. These kind of designs have been denoted as SuDoKu designs (Vo-Thanh and Piepho, 2020) and were generated using a package developed to fit practical requirements, available at (<https://github.com/janattig/SudokuPlantDesign.jl>). A total of 25 datasets from such experiments, from which several include data from multi-environment trials, have been identified that will be used to evaluate the efficiency of the used designs in comparison to alternatives, including randomized complete block designs, augmented designs, and row-column generated designs using alternative packages, such as the OPTEx procedure of SAS (Piepho, 2015) or the CycDesigN package (vsni; Piepho et al., 2021). Contending designs including the 25 empirical datasets will be evaluated and compared based on post-blocking analysis for alternative blocking structures and spatial modelling with the package SpATs (Rodriguez-Alvarez et al., 2018). In detail, computation of efficiency measures such as A- and D-efficiency (John and Williams, 1995) and evaluation of differences in ranking of genotypes will be included.

Reference

- John, J. A., & Williams, E. R. (1995). *Cyclic and computer generated designs*, (2nd ed.). Chapman and Hall.
- Piepho, H.P. (2015): Generating efficient designs for comparative experiments using the SAS procedure OPTEx. *Communications in Biometry and Crop Science* **10**, 96-114.
- Piepho, H.P., Williams, E.R., Michel, V. (2021): Generating row-column field experimental designs with good neighbour balance and even distribution of treatment replications. *Journal of Agronomy and Crop Science* **207**, 745-753.
- Rodriguez-Alvarez, Maria Xose, et al.: Correcting for spatial heterogeneity in plant breeding experiments with P-splines." *Spatial Statistics* 23 (2018): 52-71.
- Vo-Thanh, N., Piepho, H.P. (2020): Augmented quasi-sudoku designs in field trials. *Computational Statistics and Data Analysis* **150**, 106988.

Interested? Get in touch with

Prof. Dr. Hans-Peter Piepho
Biostatistics Unit (340c)
phone 0711-459-22386
piepho@uni-hohenheim.de