

Field trends, design and analysis

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Signe M. Jensen & David Redek
PLEN, KU
smj@plen.ku.dk

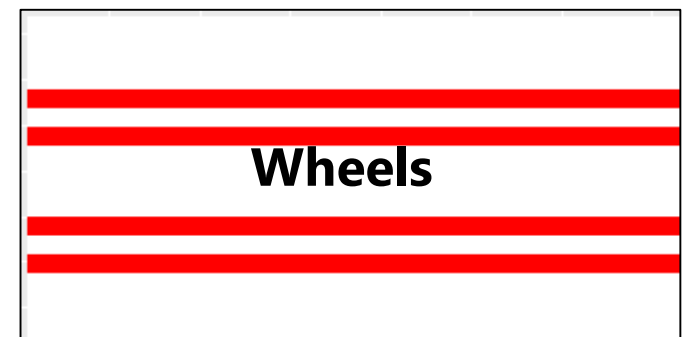
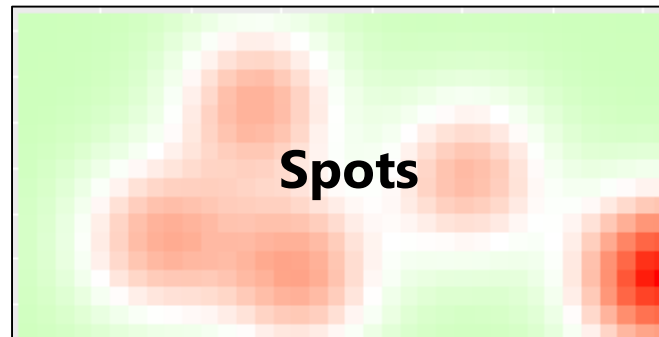
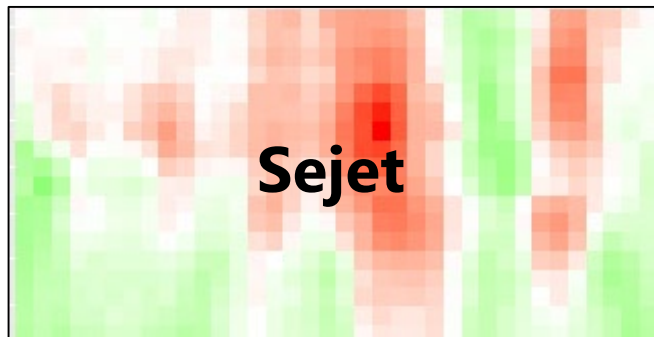
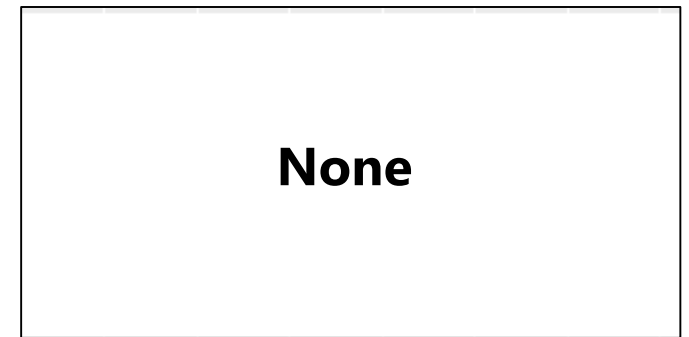
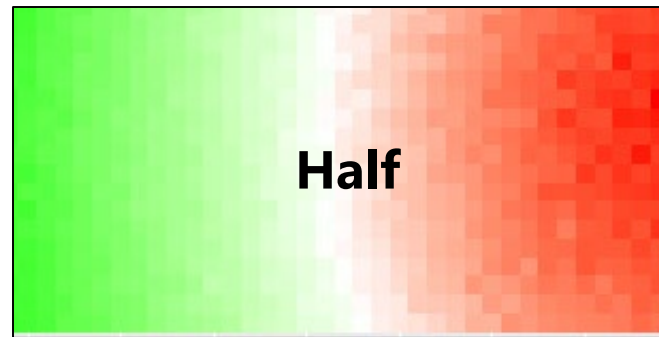
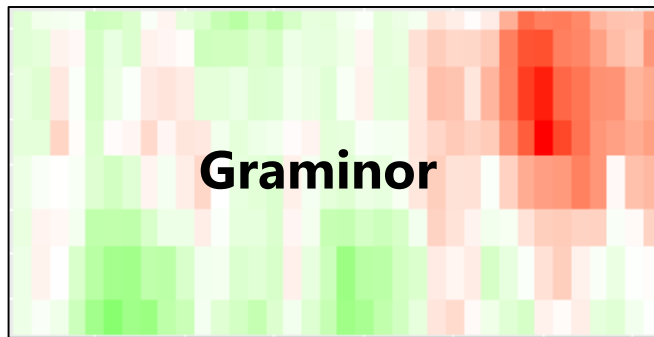
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Background

- Good treatment estimation relies on effective control of the field variation
- Field variation is commonly addressed by
 - Experimental design
 - Statistical analysis
- Designs
 - **RCBD**, well-known and simple
 - **Alpha designs**, typically recommended due to the large number of genotypes
 - **Row-column designs** have shown to be more efficient for rectangular fields
 - **Augmented designs** have shown good performance
- Analysis strategies
 - Different strategies to adjust for the design
 - Different strategies to adjust for the spatial trend

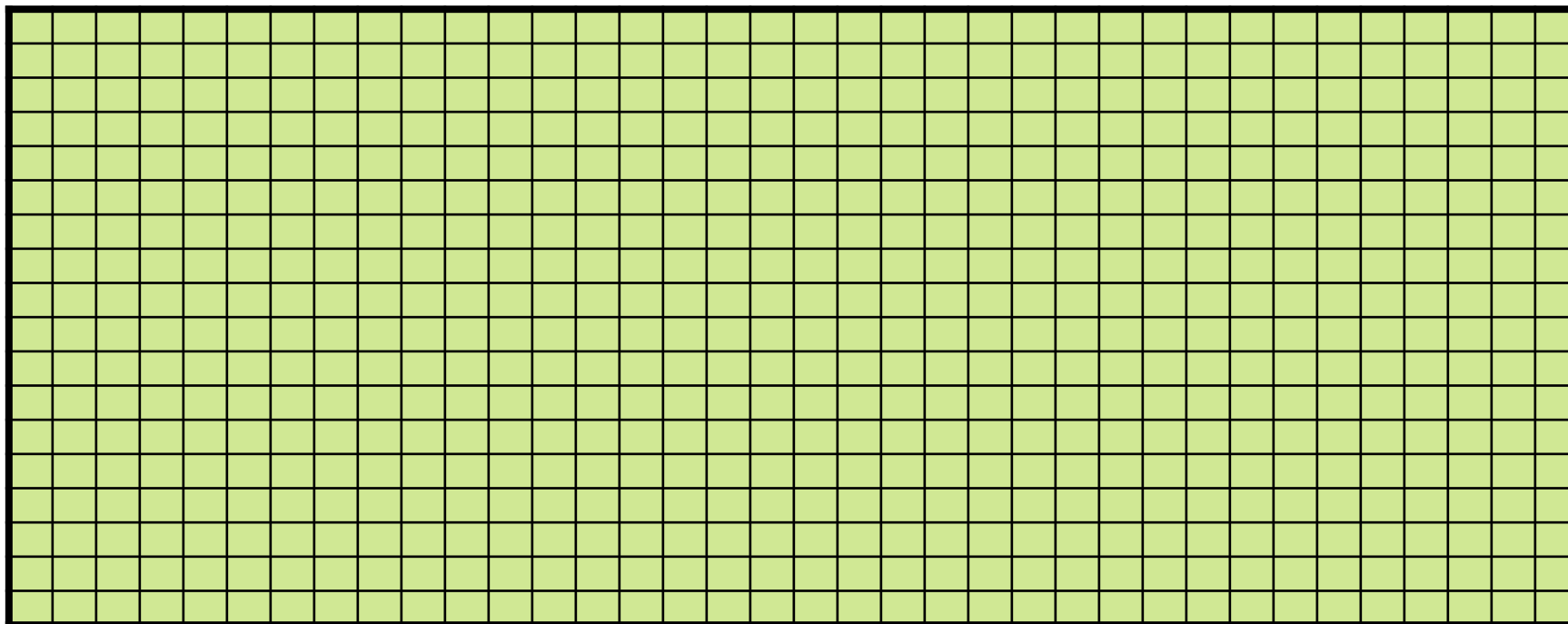
Field trends



Field layout

36 columns

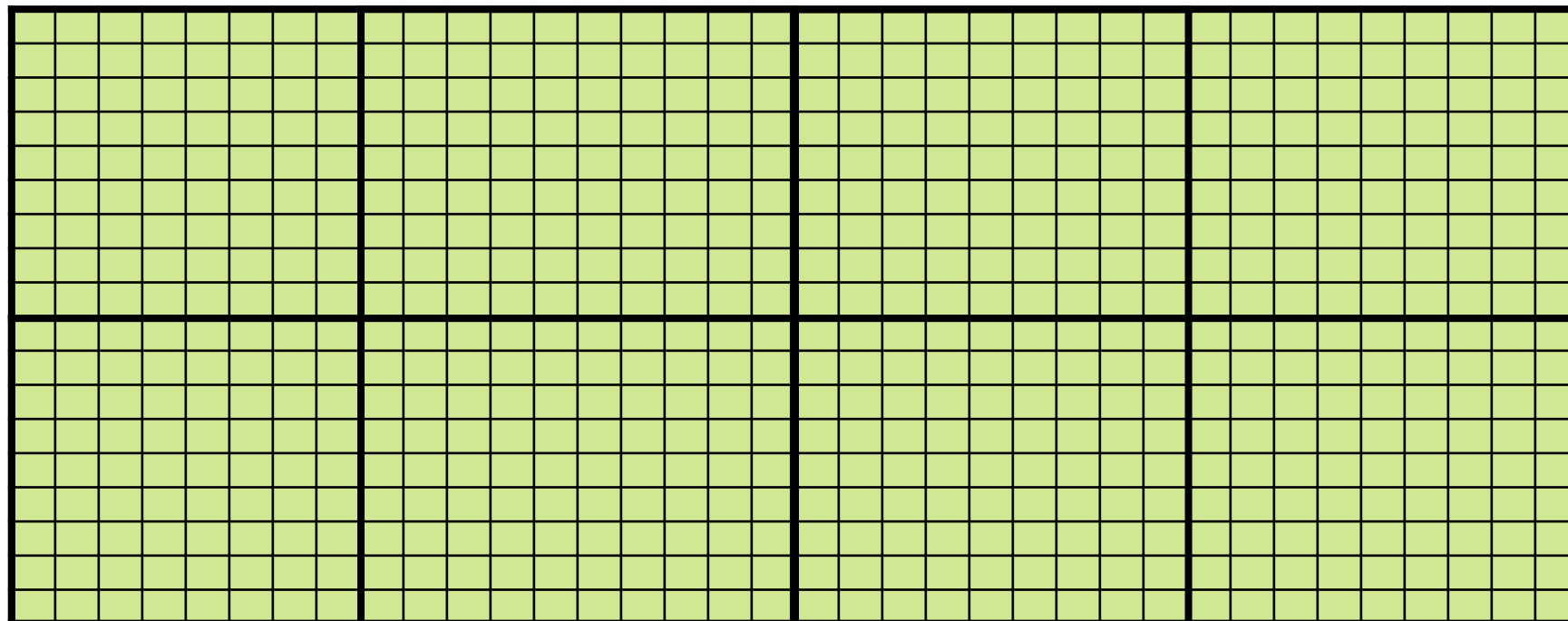
18 rows



Field layout

36 columns

18 rows



Designs

Design	Experiments	Replicates test lines	Replicates check lines	Check lines	Test lines
Alpha	6	2	12	3,4,5	306, 300, 294
	4	3	12	3,4,5	204, 200, 196
RCBD	18	2	36	3,4,5	270, 252, 234
	12	3	36	3,4,5	180, 168, 156
Row-col	18	2	36	3,4,5	270, 252, 234
	12	3	36	3,4,5	180, 168, 156
Augmented	1	1	36	3,4,5	540, 504, 468
	1	1	54	3,4,5	486, 432, 378

Analysis strategies

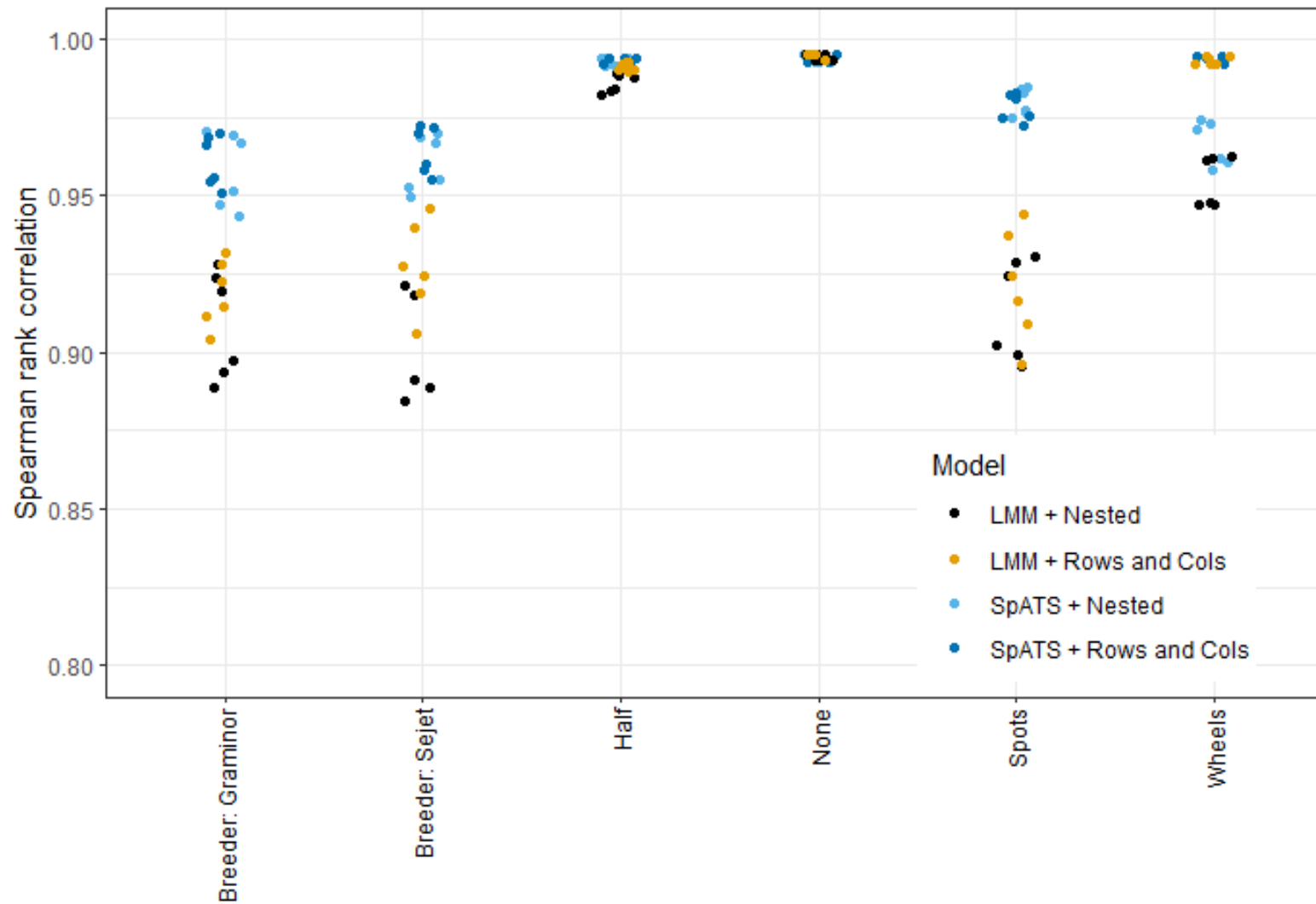
Linear mixed models ("Classic")

- Accounting for design effects (Sub-experiments, blocks, mini-blocks)
- Accounting for row and column effects

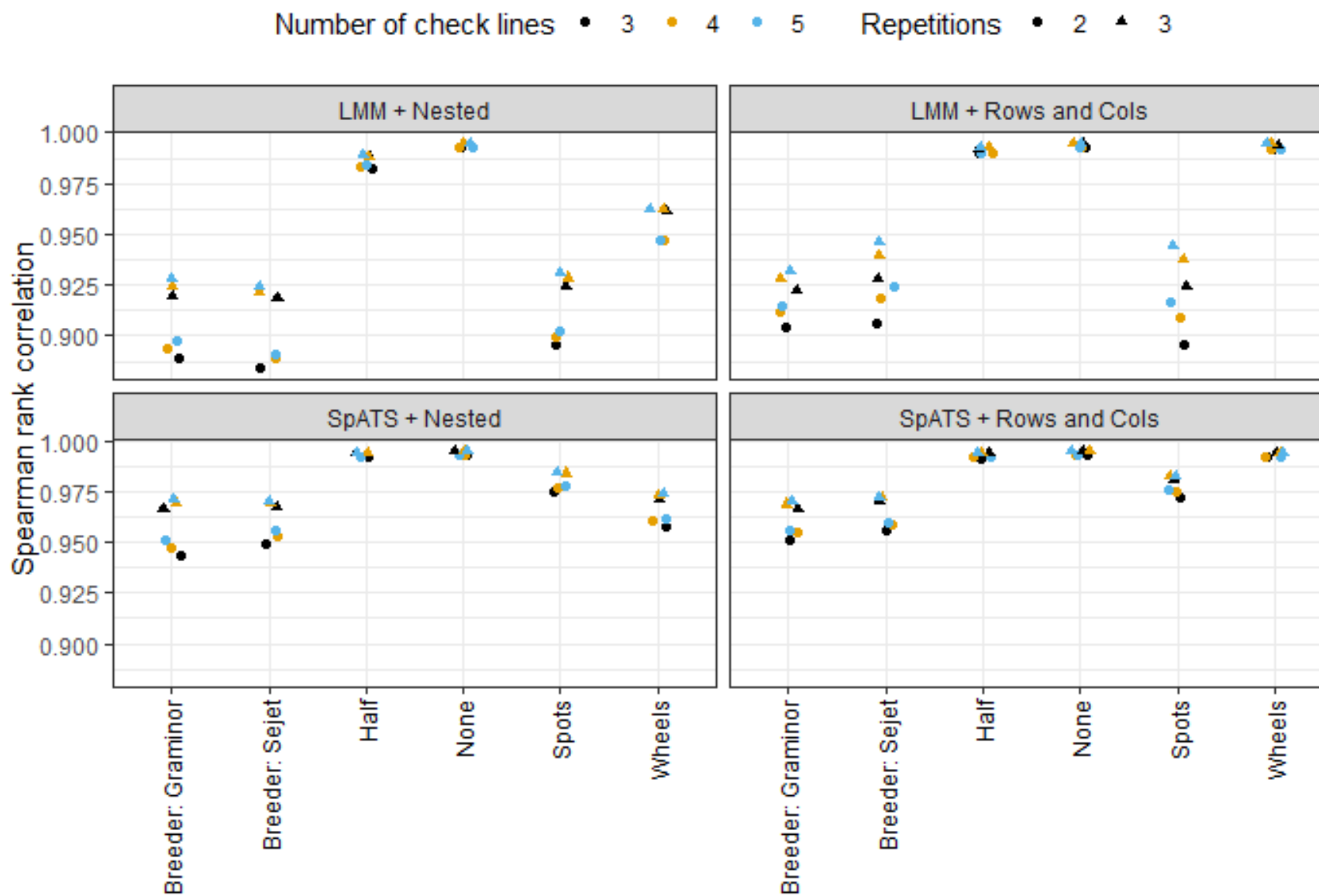
SpATS (Spatial Analysis of Field Trials with Splines)

- Accounting for design effects + splines-based bivariate smooth surface modelling the spatial effects
- Accounting for row column effects + splines based bivariate smooth surface modelling the spatial effects

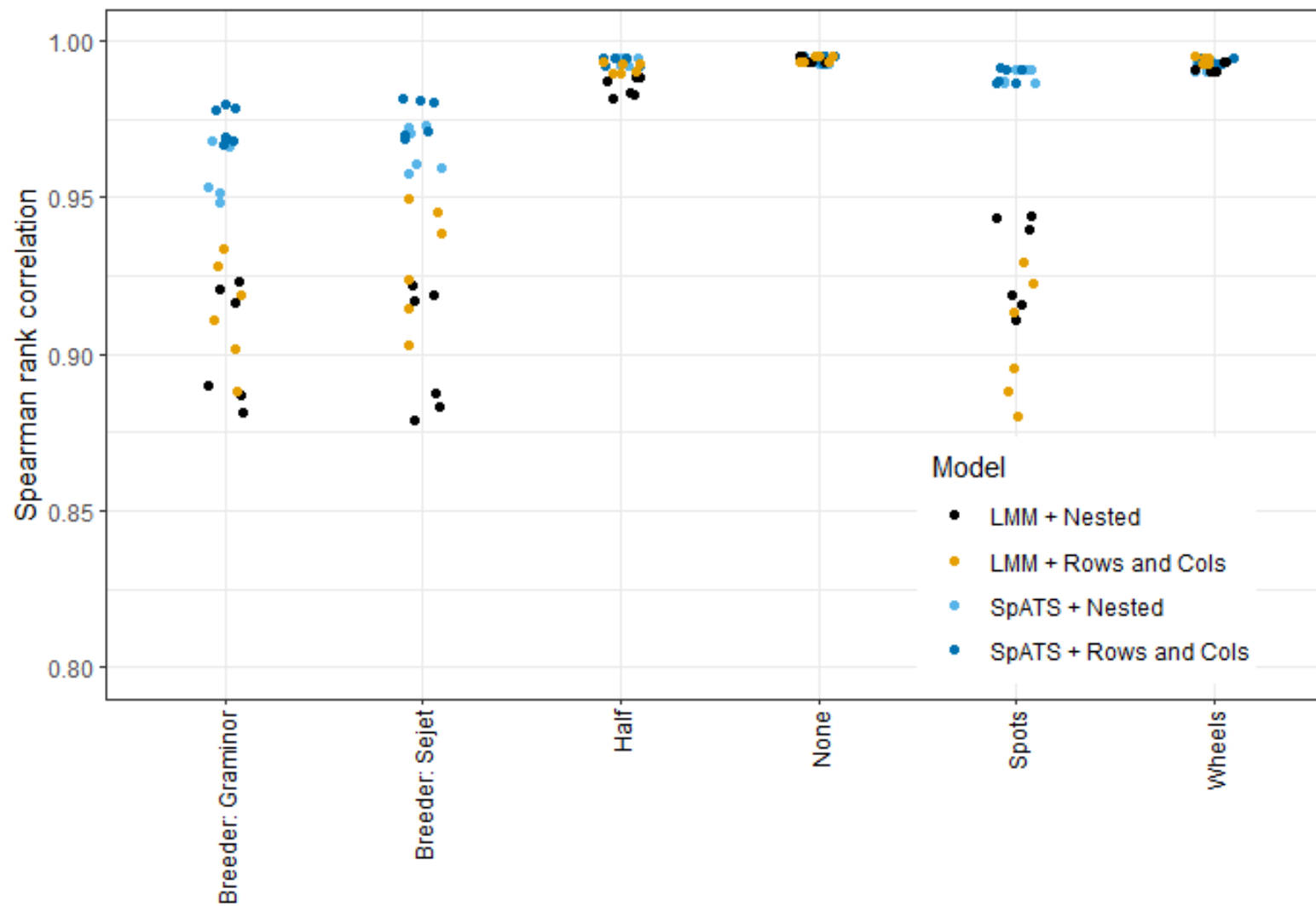
RCBD design – Choice of model



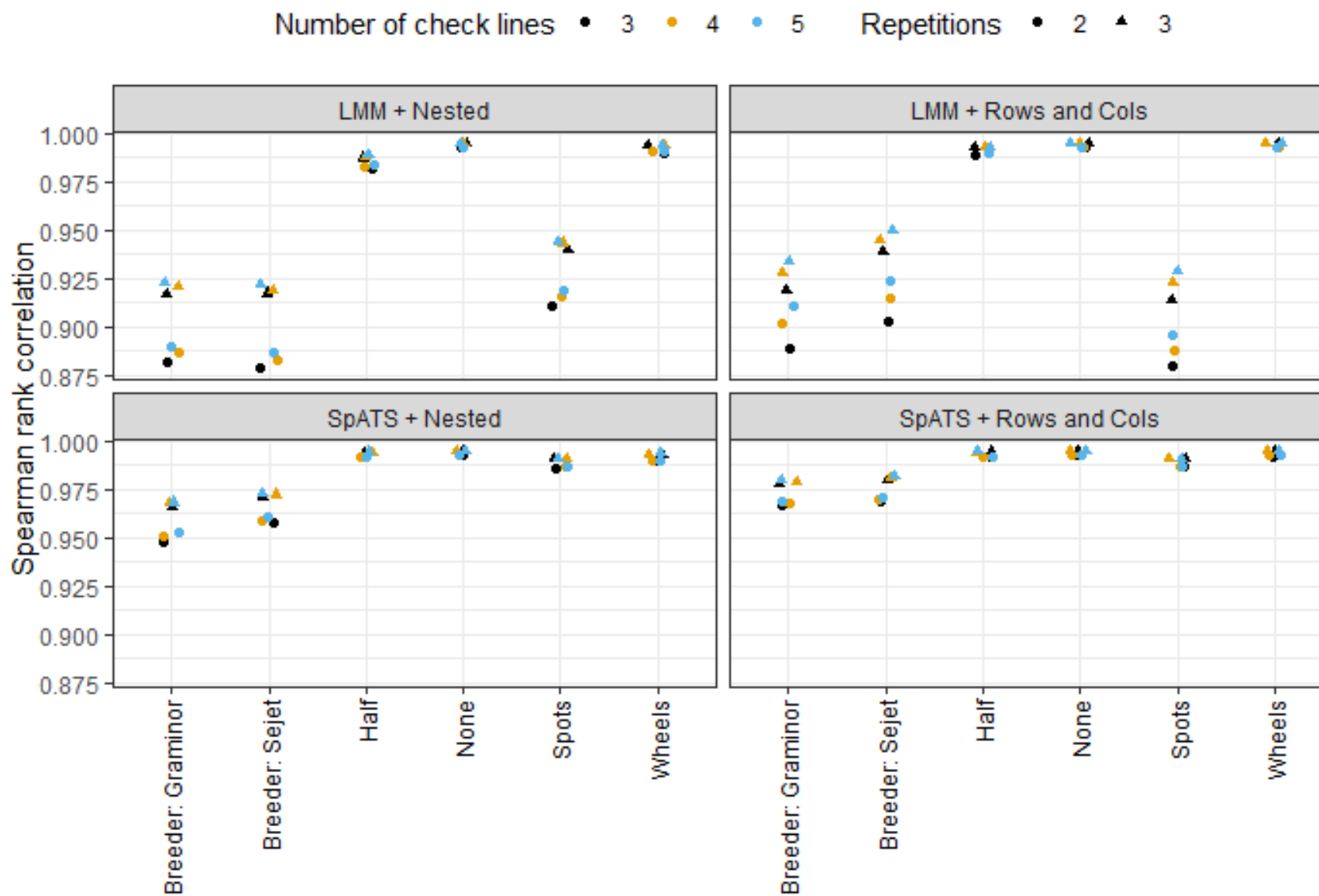
RCBD – Check lines and replicates



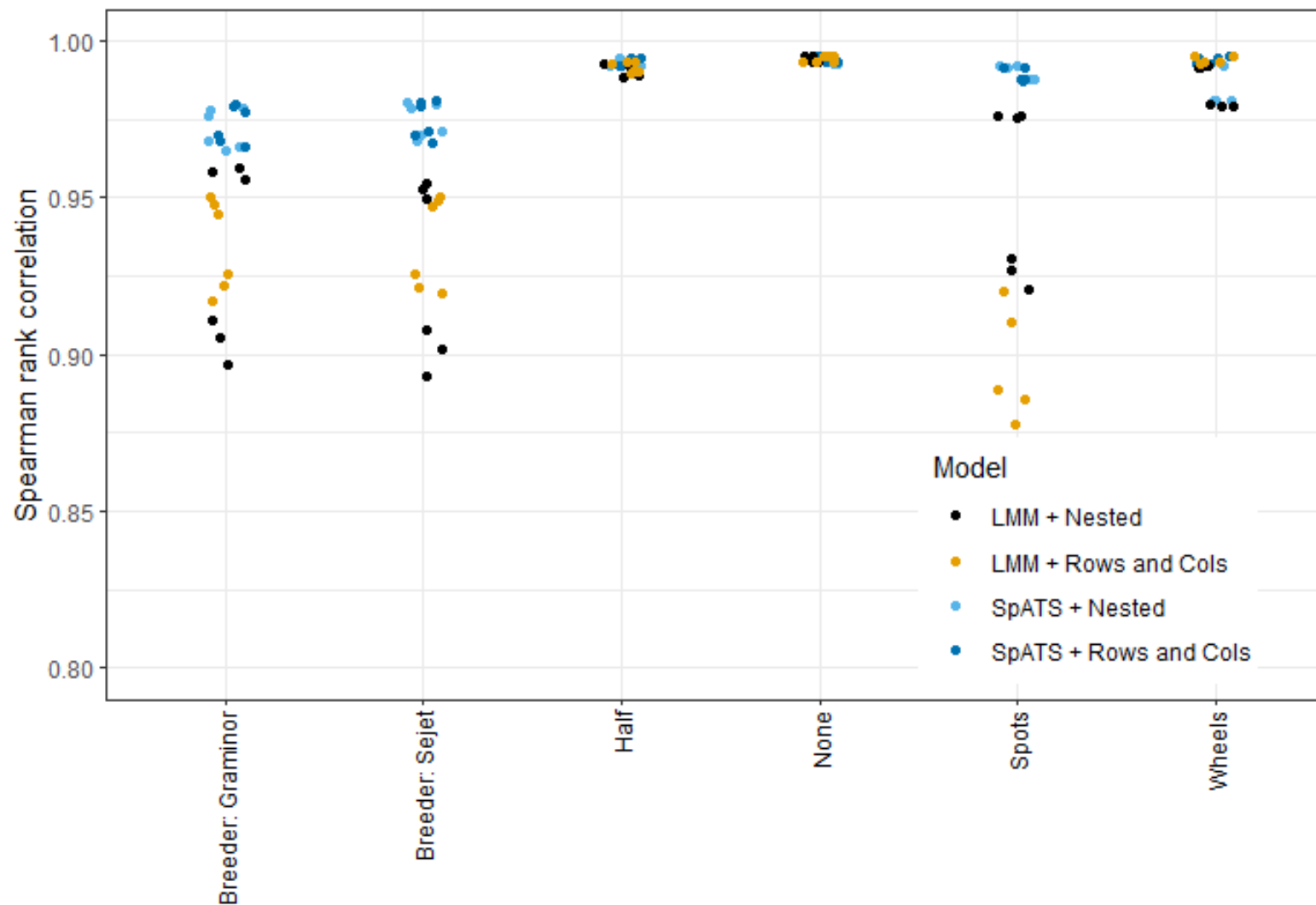
Alpha design – Choice of model



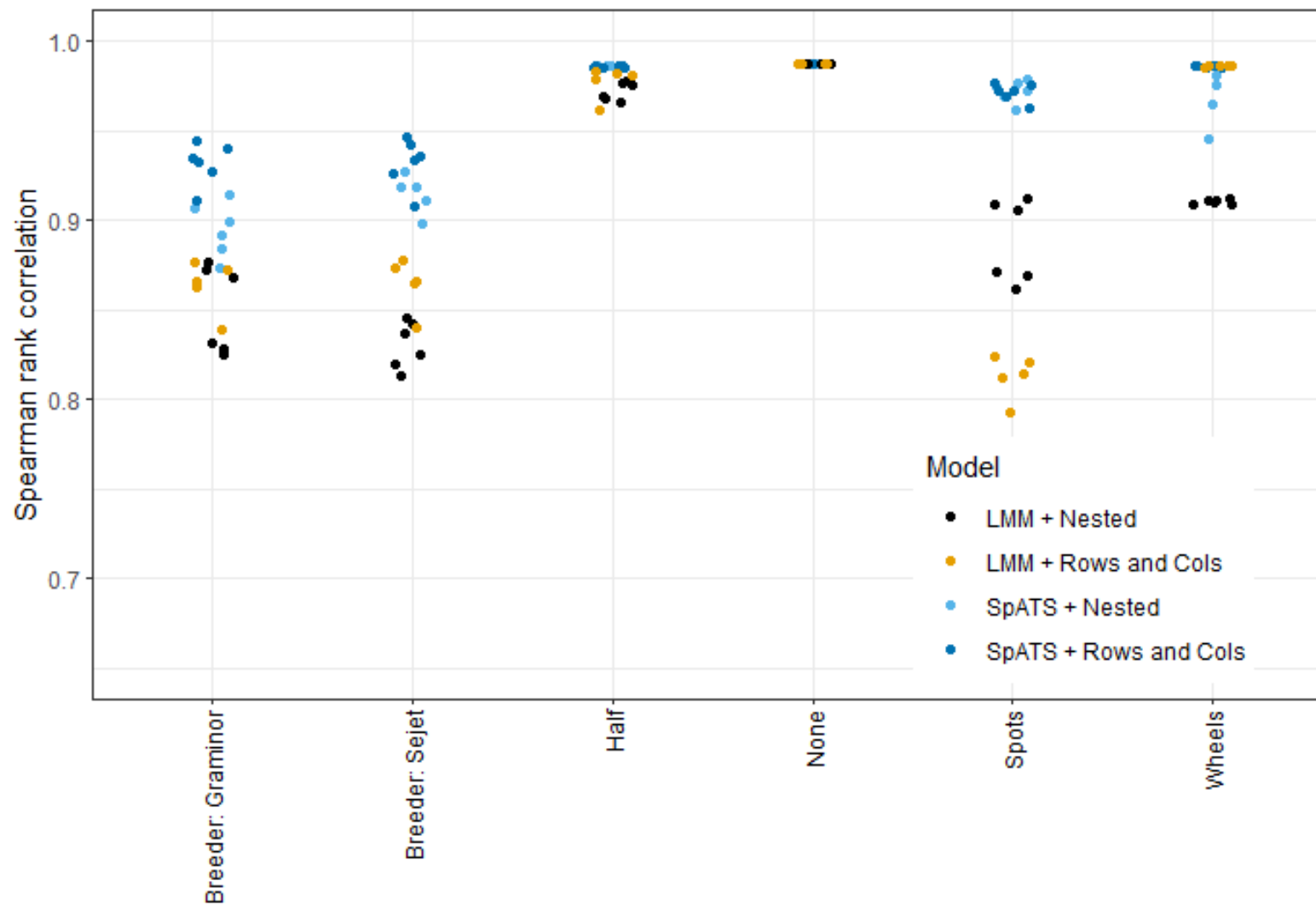
Alpha design – Check lines and replicates



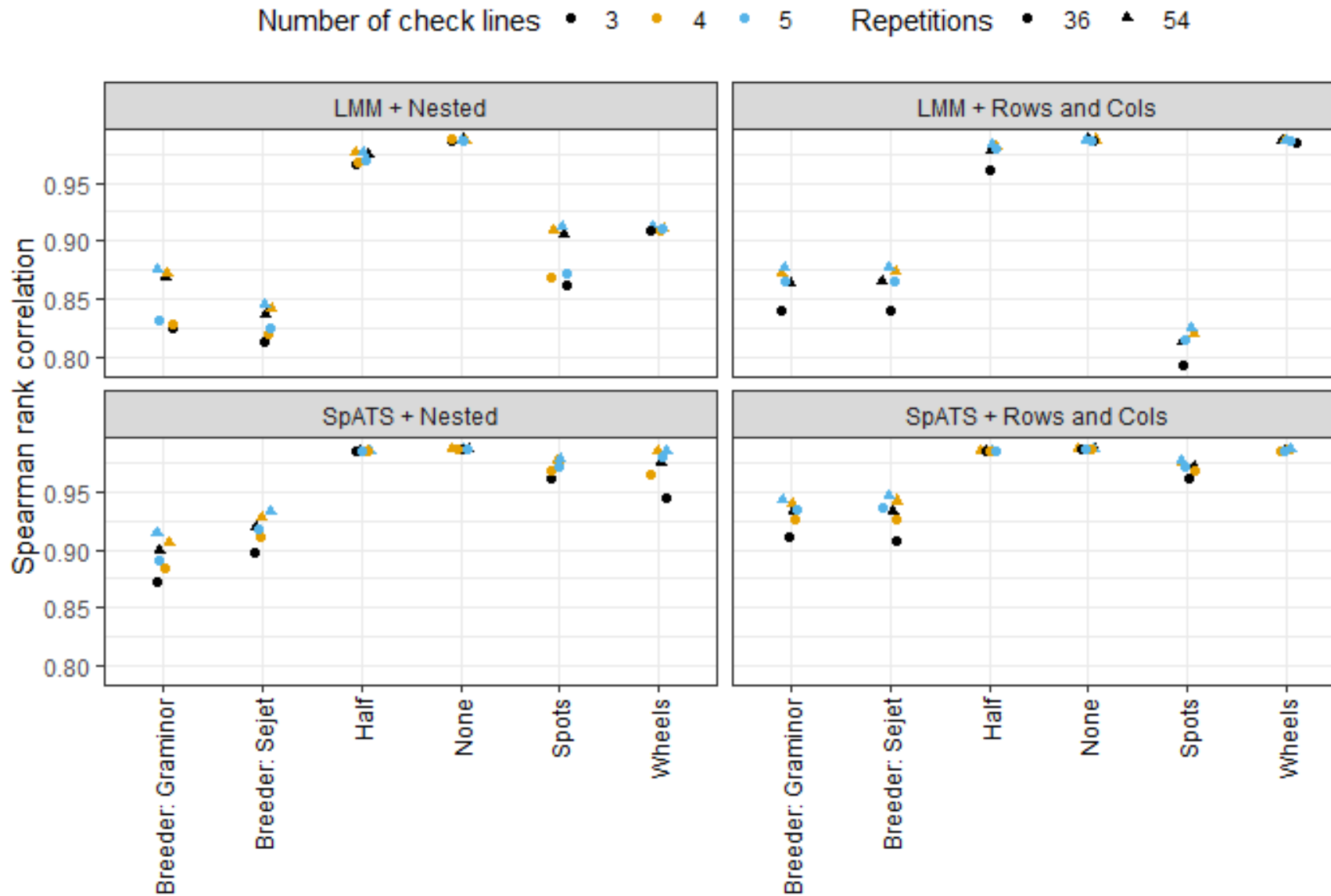
Row-column design – Choice of model



Augmented design – Choice of model



Augmented design – Check lines and replicates



Conclusions

- No effect of design when fields are homogeneous and well described by blocks
- A heterogeneous field is best handled by alpha or row-column designs
- Clear advantage of adjusting for a spatial trend in the statistical model
- Number of check lines included mainly has an effect for the LMM models with row-column adjustment
- Increasing number of replicates mainly an advantage for LMM

References

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- Mao, X., Dutta, S., Wong, R. K. W., & Nettleton, D. (2020). Adjusting for Spatial Effects in Genomic Prediction. *Journal of Agricultural, Biological, and Environmental Statistics*, 25(4), 699–718.
- Piepho, H. P., & Williams, E. R. (2006). A comparison of experimental designs for selection in breeding trials with nested treatment structure. *Theoretical and Applied Genetics*, 113(8), 1505–1513.
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