

Statistics in Field Trials

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Johannes Forkman, SLU Fältforsk

Single-location trials

Single-location trials

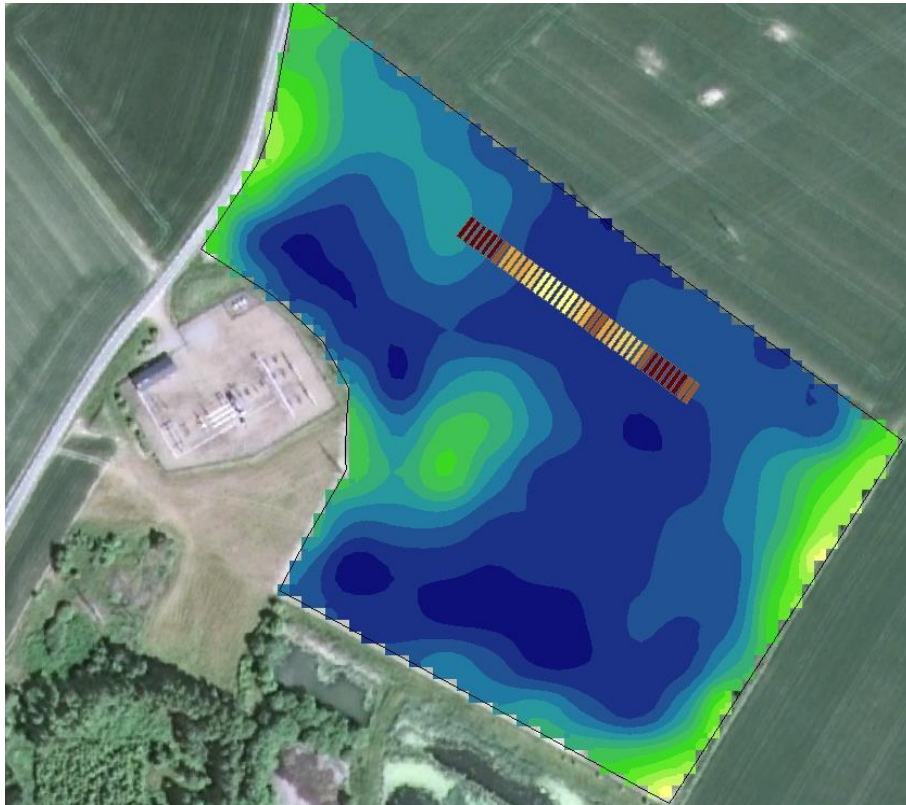
Aim:

Compare the experimental treatments

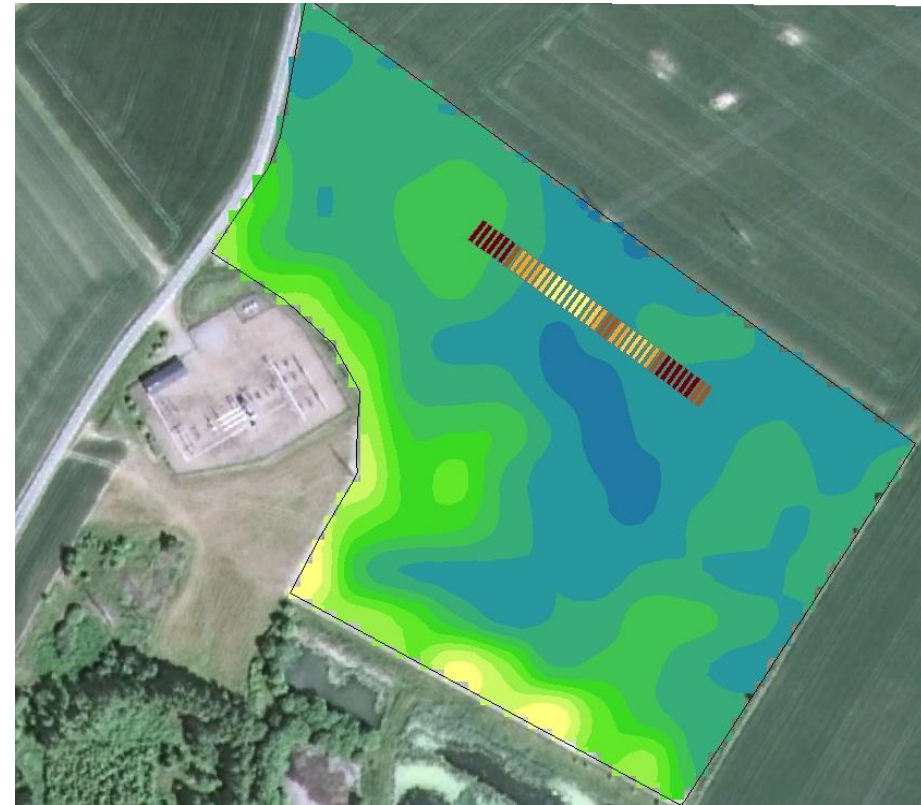


Field heterogeneity

2009



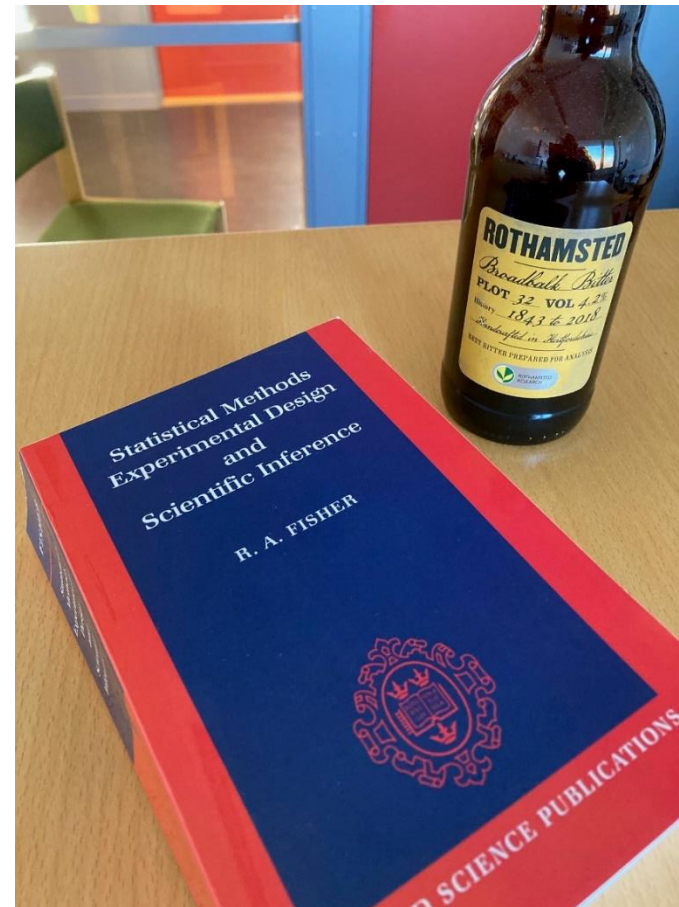
2010



Piikki et al. (2012). Variation i marken inom fältförsök. Precisionsodling Sverige, Rapport nr 25

Basic ideas

- Randomization
- Blocking
- Replication

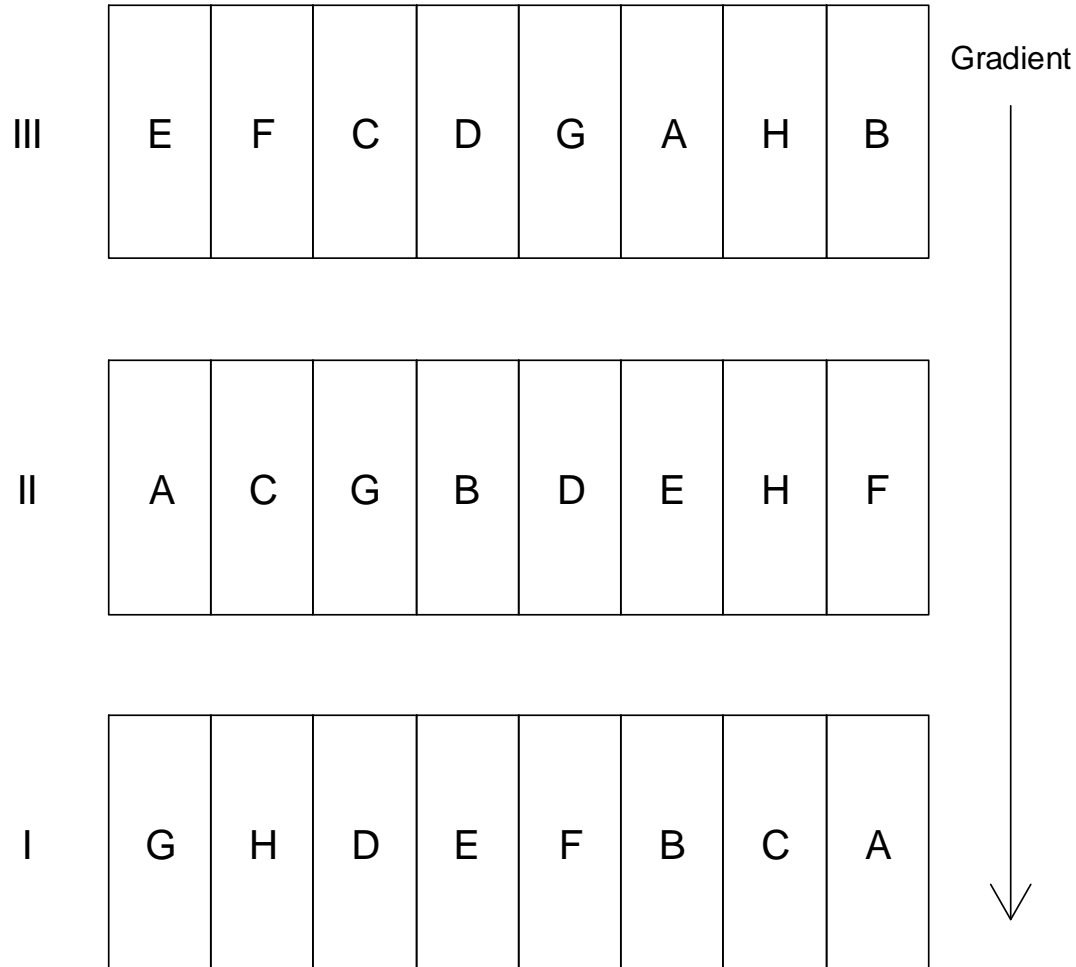


Randomization

Randomization

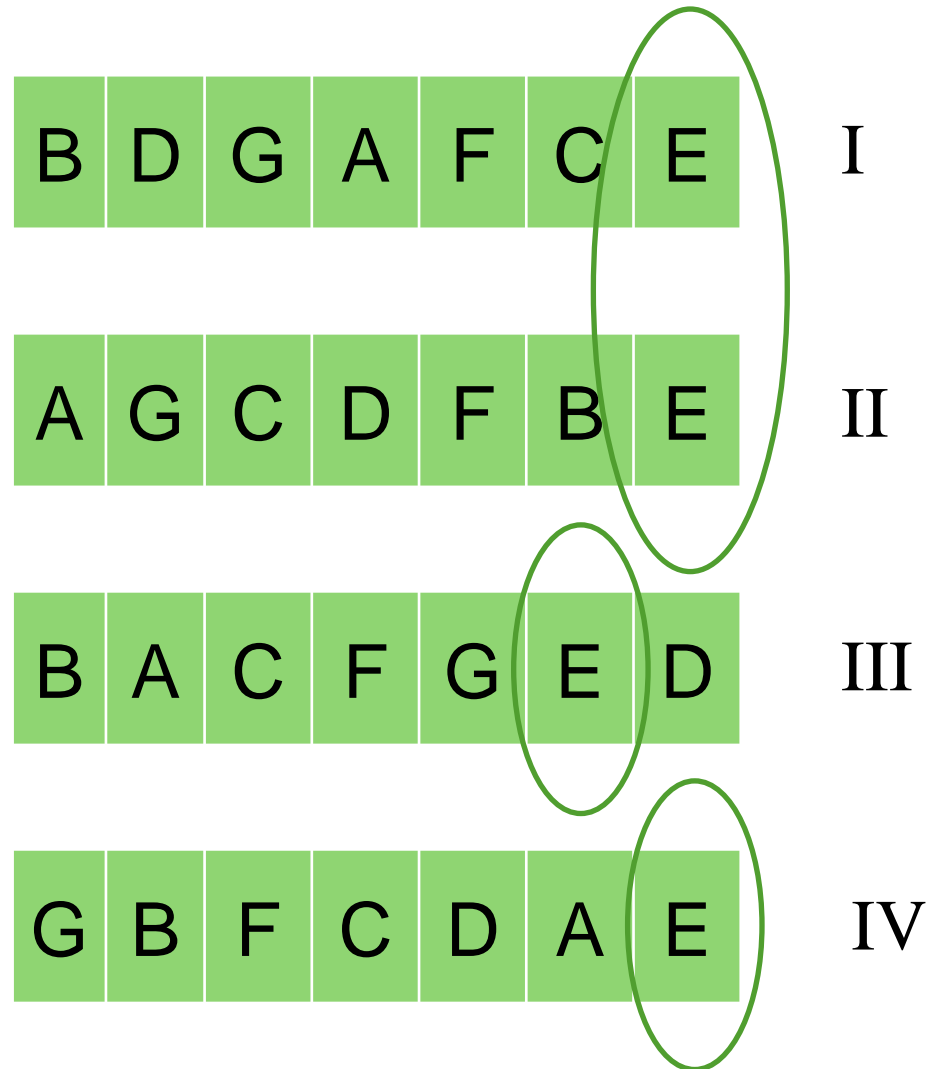
- transforms systematic errors into random errors,
- introduces randomness without using sampling, and
- enables the use of statistical methods.

Blocking



Within blocks, plots should be as similar as possible

Randomized complete block design



Row-column design

C	A	D	E	F	B	G	I
F	D	G	A	B	E	C	II
G	E	A	B	C	F	D	III
A	F	B	C	D	G	E	IV



Replication

	I			II			III		
Year	A	B		B	A		B	A	
2020	2 1 3	1 2 3	3	2 3 1	2 3 1	1	3 2 1	2 1 3	
2021	2 1 3	1 2 3	3	2 3 1	2 3 1	1	3 2 1	2 1 3	
2022	2 1 3	1 2 3	3	2 3 1	2 3 1	1	3 2 1	2 1 3	

Replication

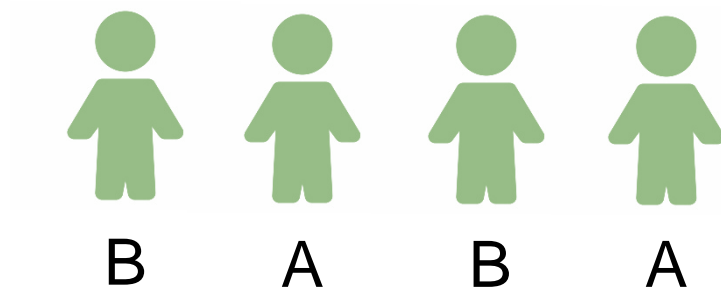
Type 3 Tests of Fixed Effects				
Effect	Num DF	Den DF	F	p-value
year	2	4	41.71	0.002
treatment	1	2	2.27	0.271
subtreat	2	8	1.67	0.248
year*treatment	2	4	0.27	0.775
year*subtreat	4	20	5.26	0.005
treatment*subtreat	2	8	0.11	0.898

Replication

There are 3 blocks with 2 main plots per treatment.

Source	DF
Block	2
Treatment	1
Error	2
Total	5

Replication



Source	DF
Treatment	1
Error	2
Total	3

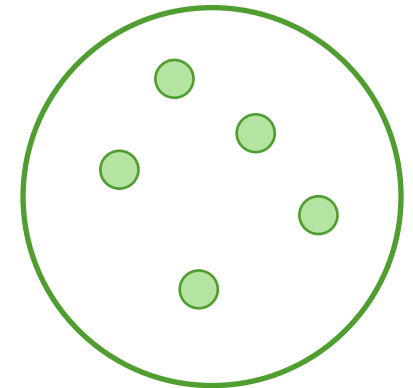
Multi-location trials

Multi-location trials

Aim:

To investigate either

- treatment differences averaged over locations,
- treatment-by-location interaction, or
- treatment-by-environment interaction.



An environment
with five locations

Aim: Treatment differences

- Analysis of means
- No treatment-by-location interaction
- Trials act as blocks

Aim: Treatment-by-location interaction

- Analysis of plot observations
- Fixed effects of treatments, locations and treatment-by-location interaction

Aim: Treatment-by-environment interaction

- Analysis of means
- Treatment-by-environment interaction.
- Fixed effects of treatments, environments and treatment-by-environment interaction, and random effects of trials.

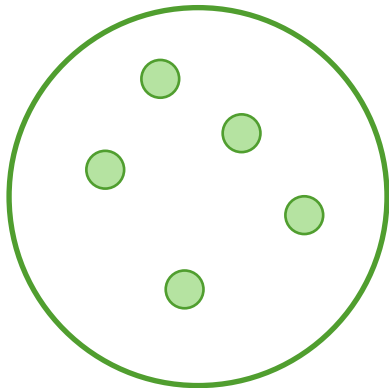
 Requires many trials

Treatment-by-environment interaction

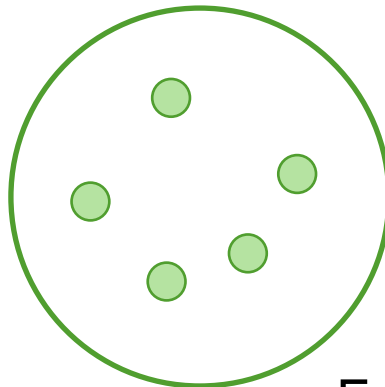
How do treatments interact with soil type?

How do treatments interact with climate or weather?

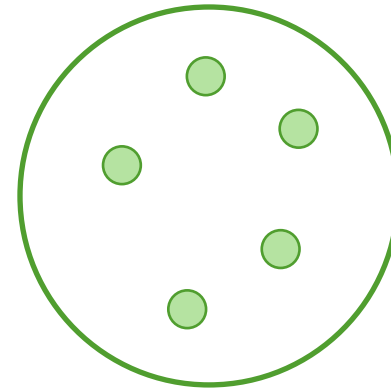
How do treatments interact with farmers' practice?



Environment 1



Environment 2



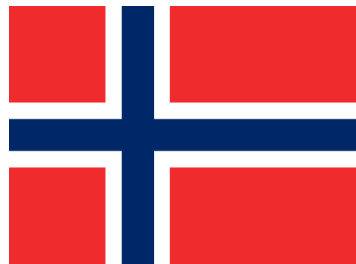
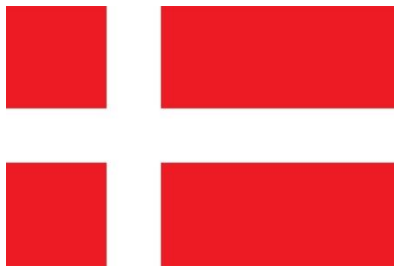
Environment 3

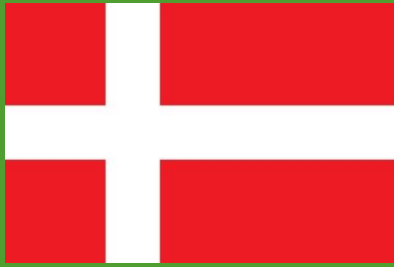
Treatment-by-environment interaction

How do treatments interact with soil type?

How do treatments interact with climate or weather?

How do treatments interact with farmers' practice?





Summary

- Randomization, blocking and replication are fundamental concepts.
- The statistical model for a multi-location trial depends on the aim.
- Nordic collaboration can make possible study of treatment-by-environment interaction.