JUSTUS-LIEBIG-
UNIVERSITÄT
GIESSEN

Giessen **Plant Breeding**
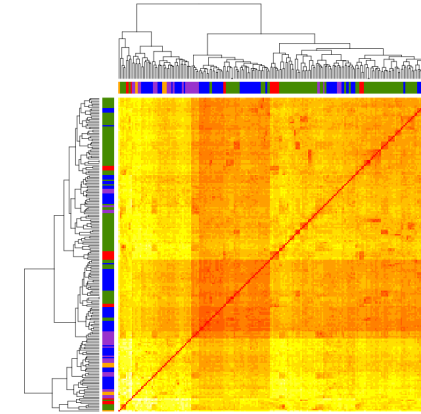
JKi

3D Point clouds for high throughput Phenotyping in canola

Part of: Increase of N-efficiency through extension of genetic diversity

Sven Weber
Brisbane
15.11.2022

Hypothesis in the project

1) The **extension of genetic diversity** could be useful to enrich variation for NUE in breeding pools.

2) Incorporation of **plant architectural traits** that are in an relationship with **NUE and Seed yield** and have a **higher heritability** than the primary traits could **help in the selection** process.

3) The **digital assessment of plant architecture** can be a useful tool in research and industry for high throughput phenotyping.

Selection of test hybrid fathers

Genetic diverse founder lines

Shared crossing partners

NAM-Population

Elite mothers

Collection of test hybrids
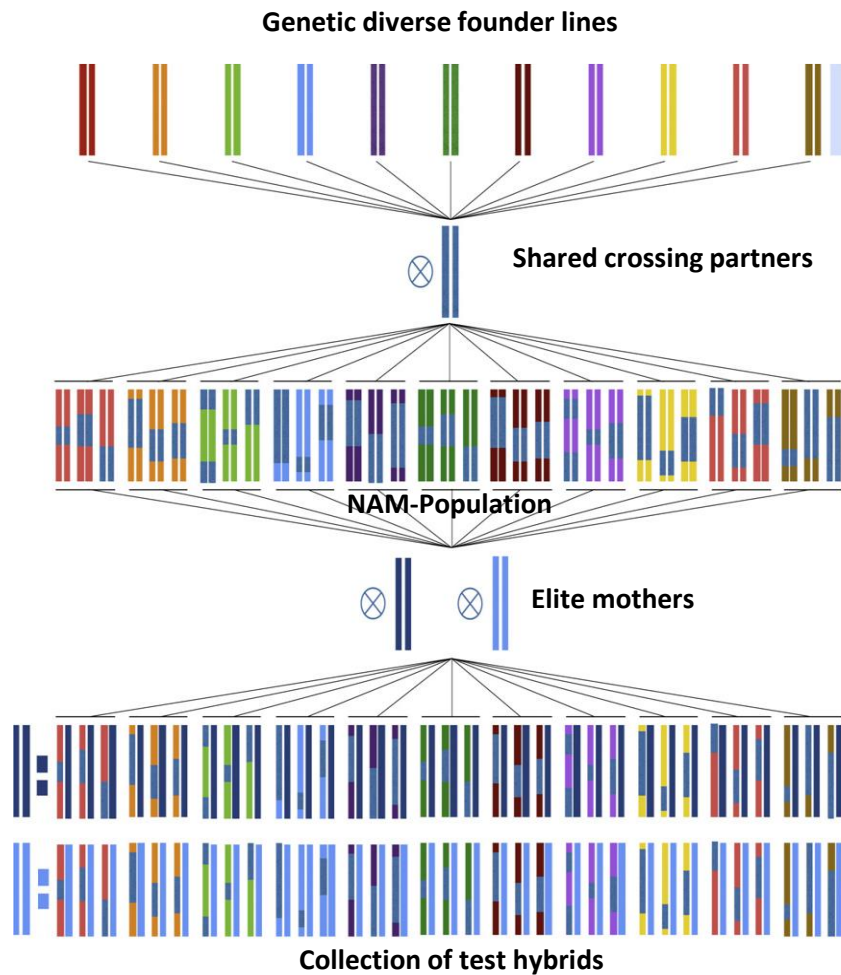
Screening of first test hybrids
with one mother at 12 sites

n=968

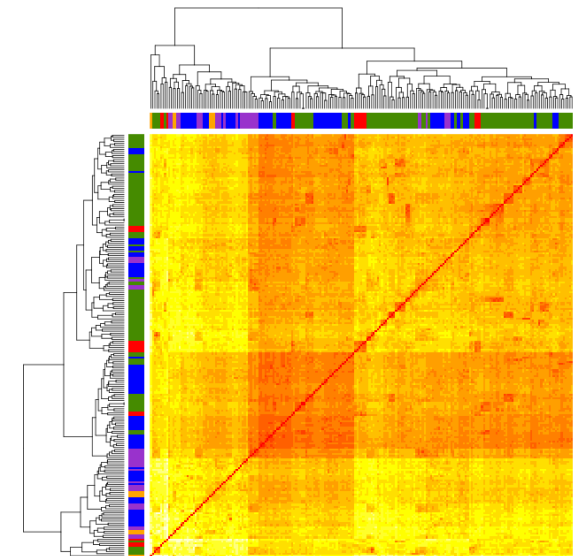>48,9 dt/ha of DH-Populations (2014)
>46,2 dt/ha of SSD-Populations (2015)

n=262

28 409 SNP-marker based genetic
distance
(Rodger´s Distances)

n=207

n=ca. 160

Test hybrids with two mothers

Field trials

7 locations in 2 years (2020 & 2021)

one level of N-fertilization: 125 kg N ha^{-1}

400 plots in p-rep design:

> **350 genotypes:**
>
> **50 plots for repetitions**

Mixed linear model for entry mean adjustment
- <u>fixed:</u> Genotype
- <u>random:</u> Env, Env:Row, Env:Col, Env:Rep
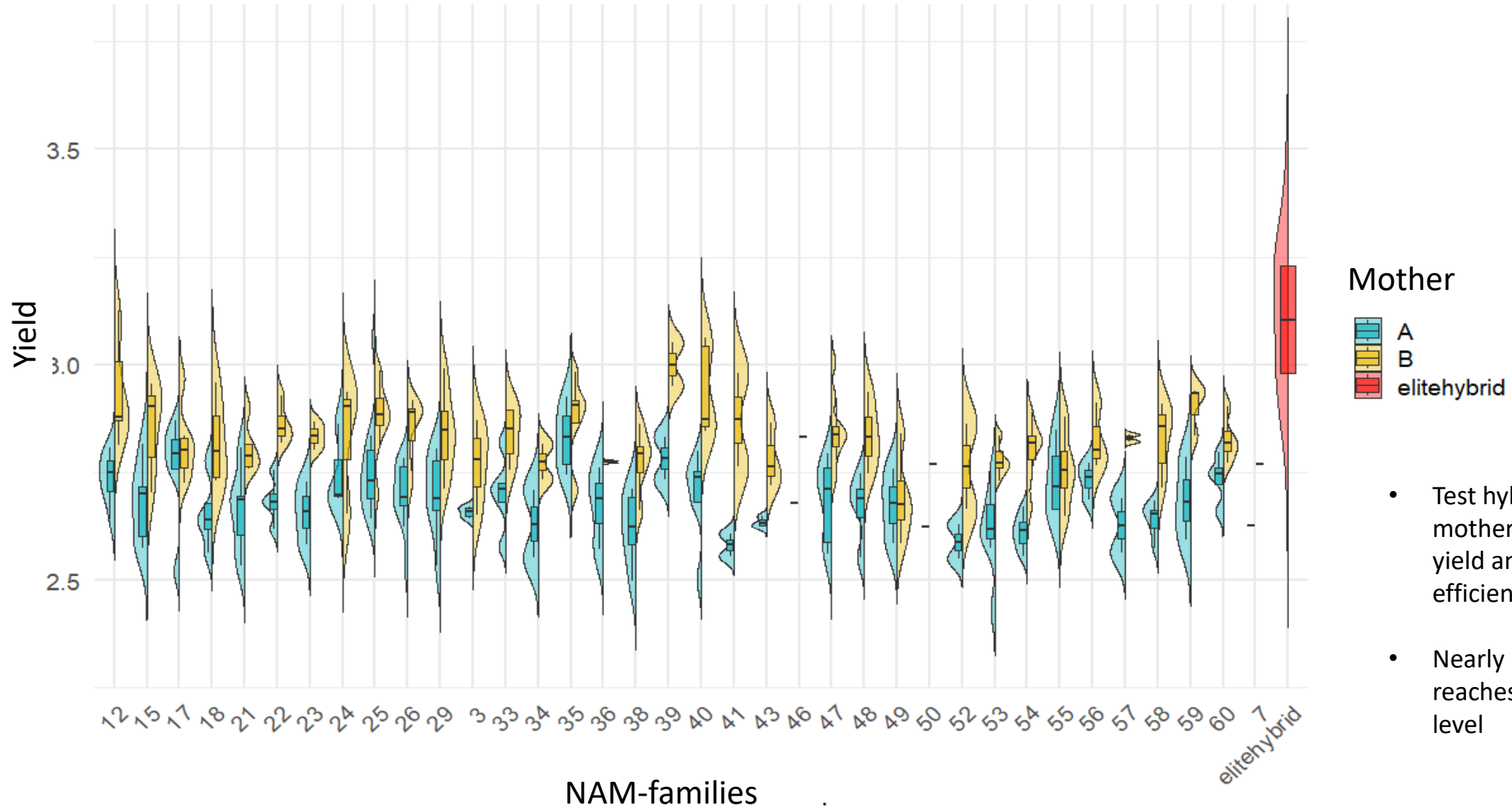
Assessment of plant architecture

Adj. means for yield from 14 environments
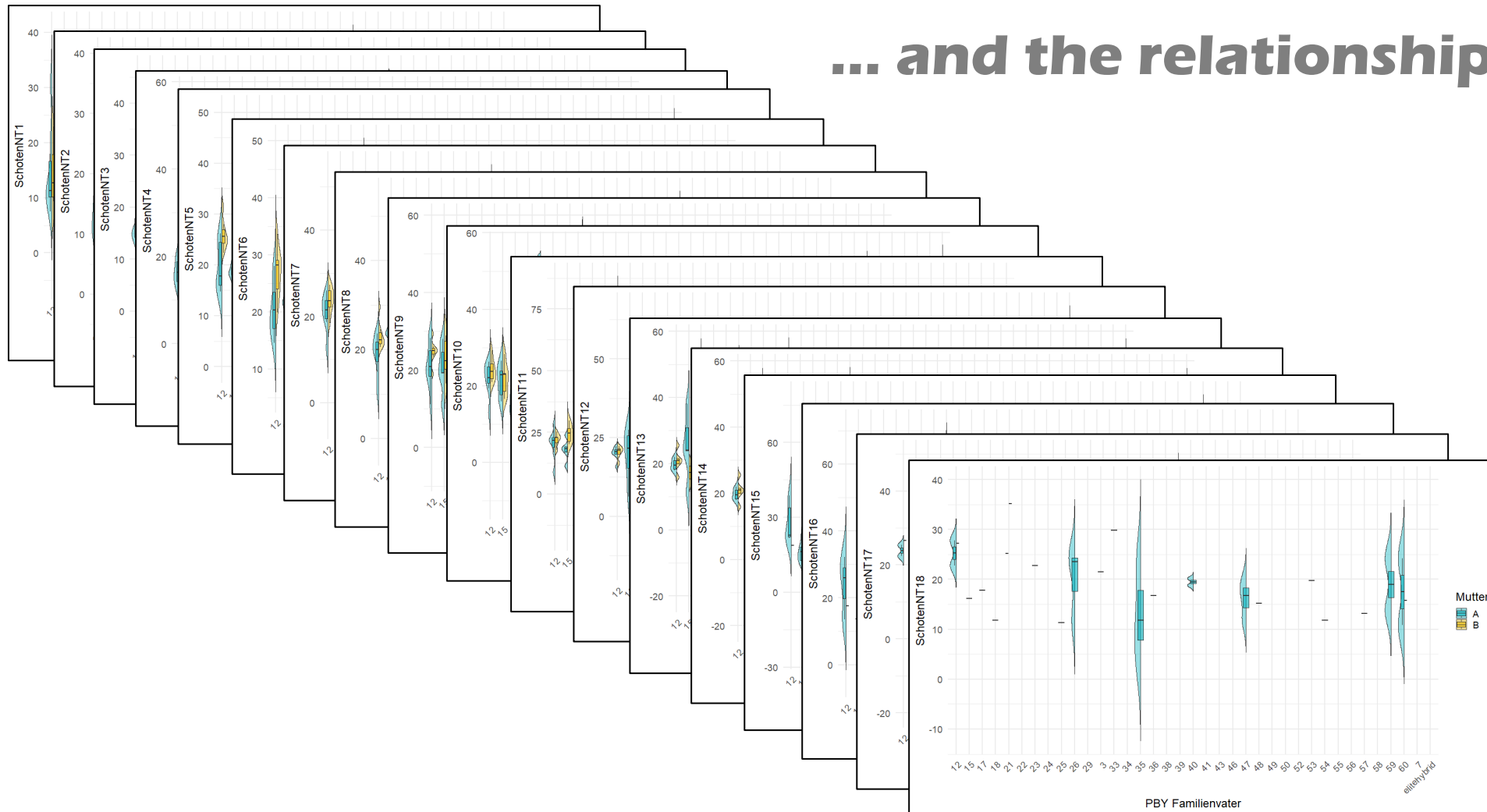

Mother
- A
- B
- elitehybrid

- Test hybrids from mother B have a higher yield and hence more efficient

- Nearly non family reaches elite material level
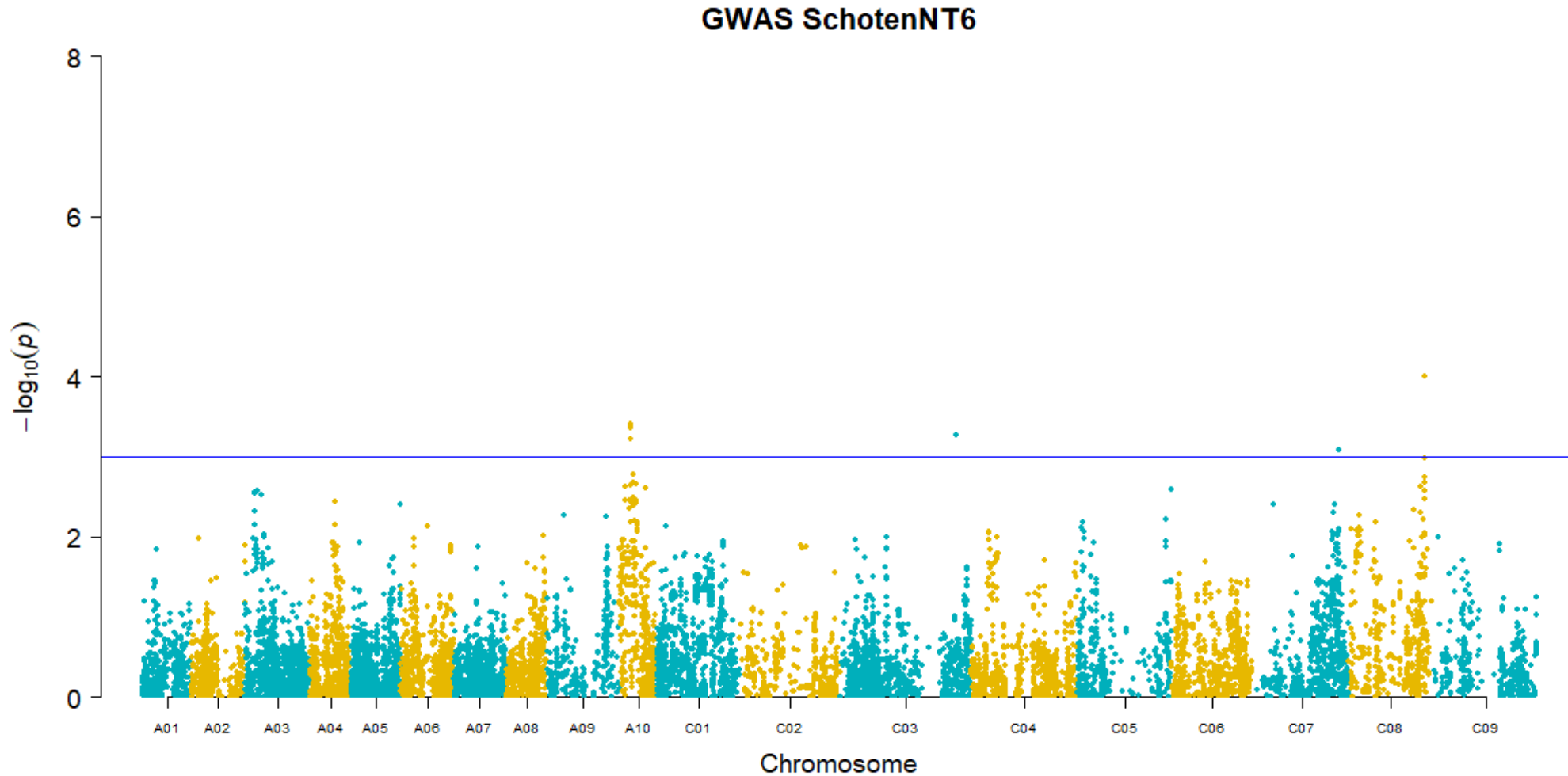
Pods per side branch
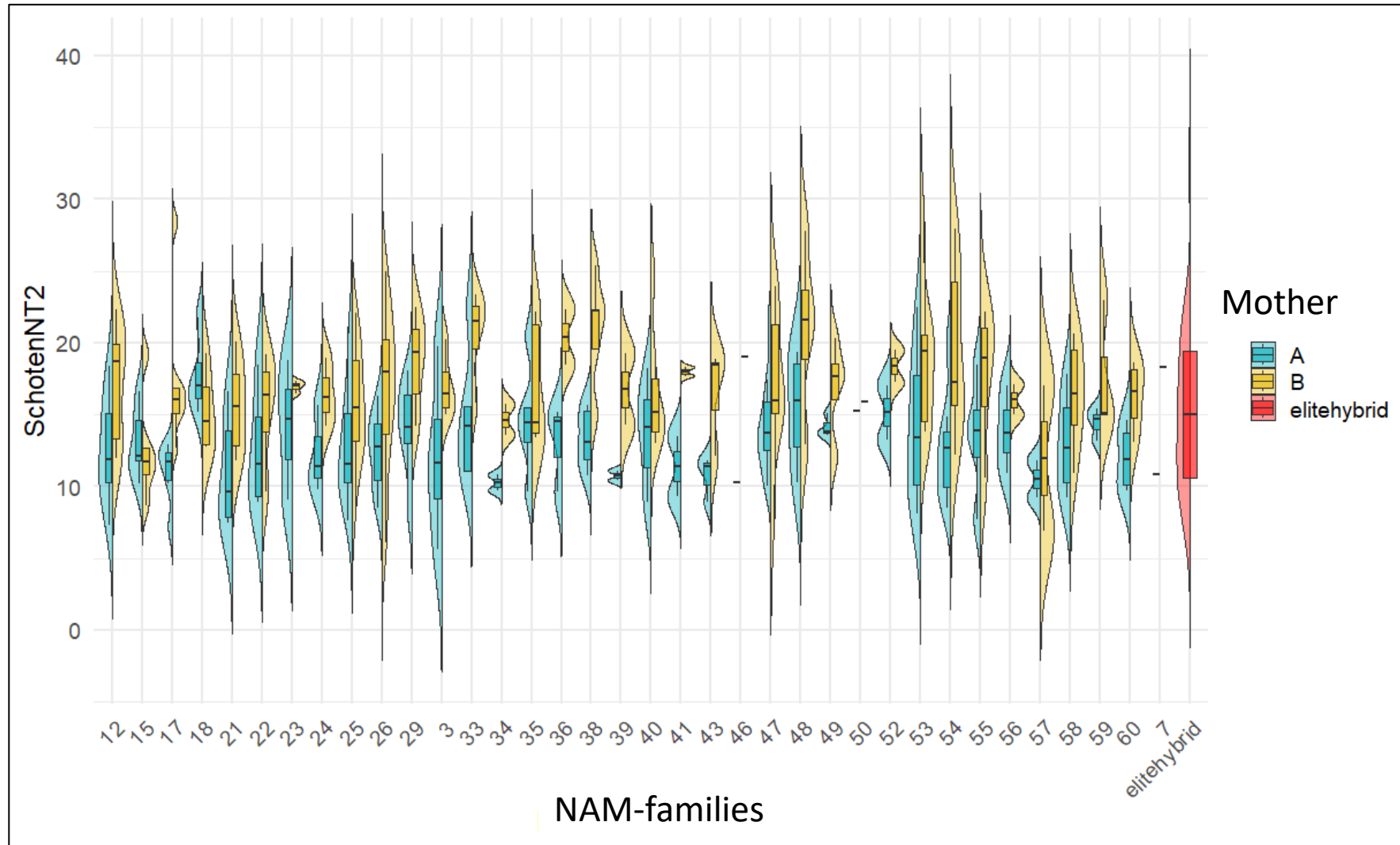
Pods per side branch

... and the relationship to seed yield

	r (to yield)
SchotenNT1	0.084
SchotenNT2	0.123
SchotenNT3	0.221
SchotenNT4	0.297
SchotenNT5	0.307
SchotenNT6	0.377
SchotenNT7	0.317
SchotenNT8	0.260
SchotenNT9	0.218
SchotenNT10	0.212
SchotenNT11	0.247
SchotenNT12	0.178
SchotenNT13	0.242
SchotenNT14	0.242
SchotenNT15	0.223
SchotenNT16	0.047
SchotenNT17	0.173
SchotenNT18	0.069

GWAS pods on 6th side branch

GWAS SchotenNT6

Assessment of plant architecture

Digital assessment of plant architecture

From point cloud to phenotype

	X	Y	Z
P1	10	5	6
P5	23	17	8
P3	12	22	9
P4	4	1	3
P2	66	55	18
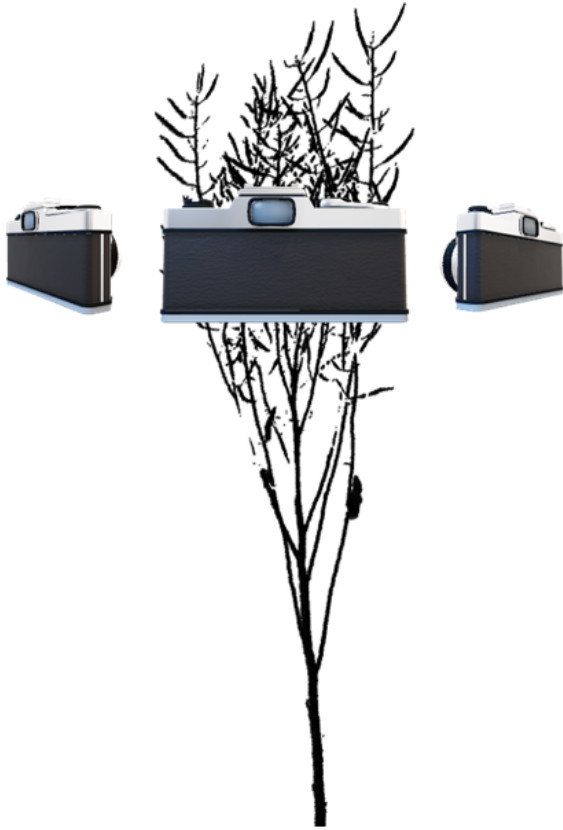
CNN to predict architecture based on point clouds

CNN to predict architecture based on point clouds
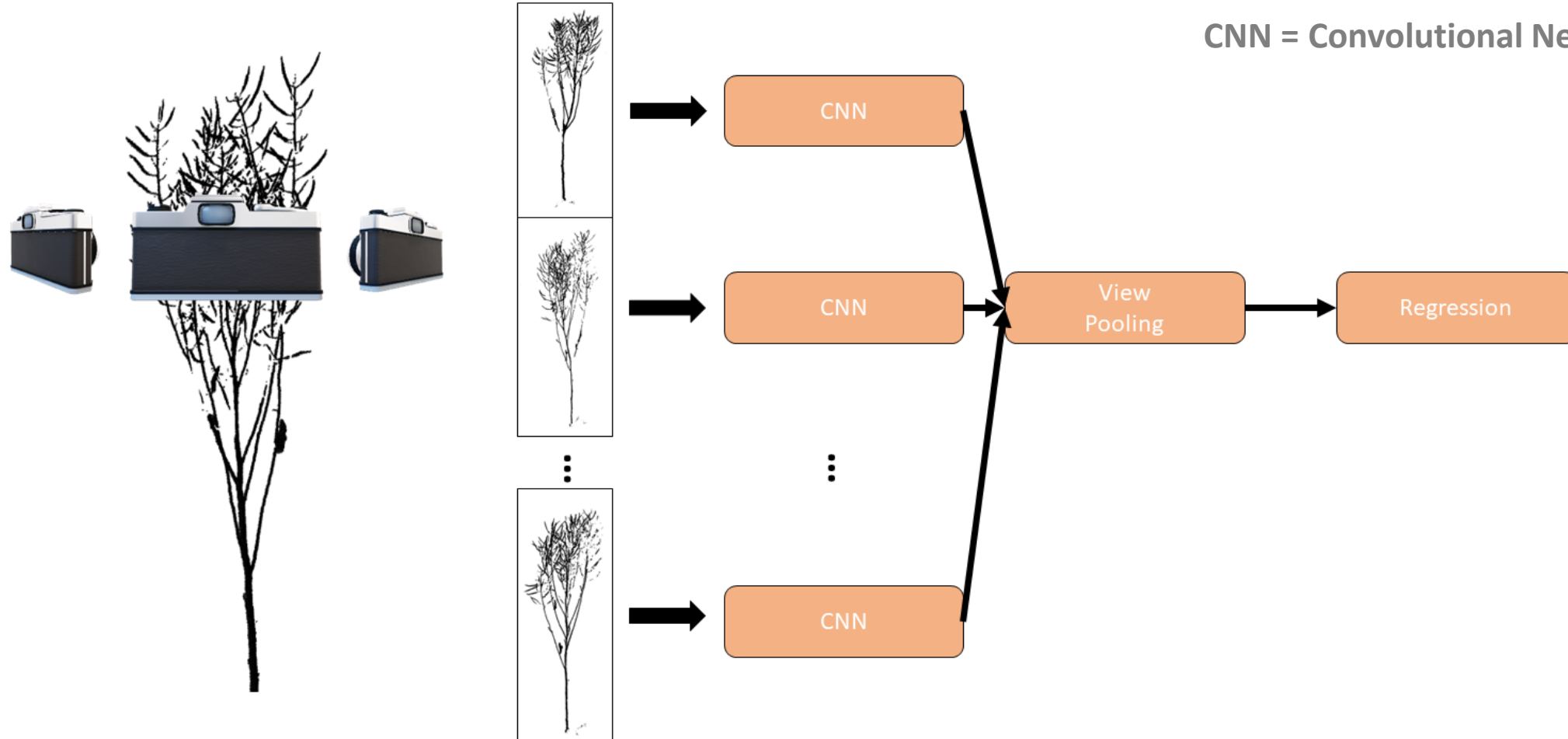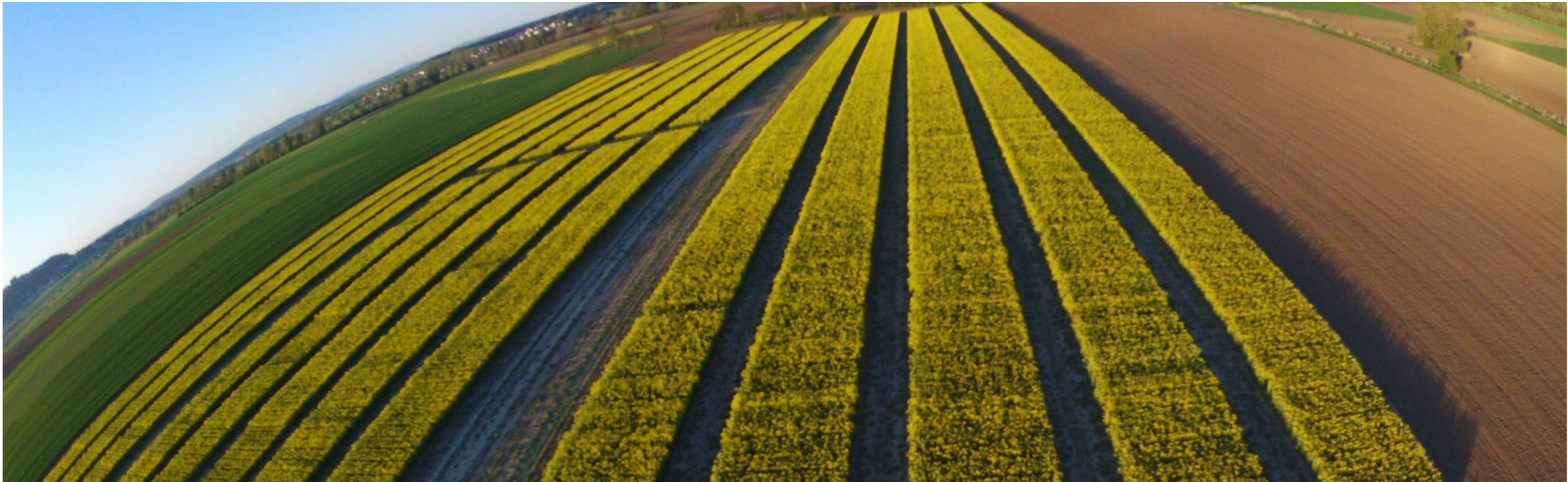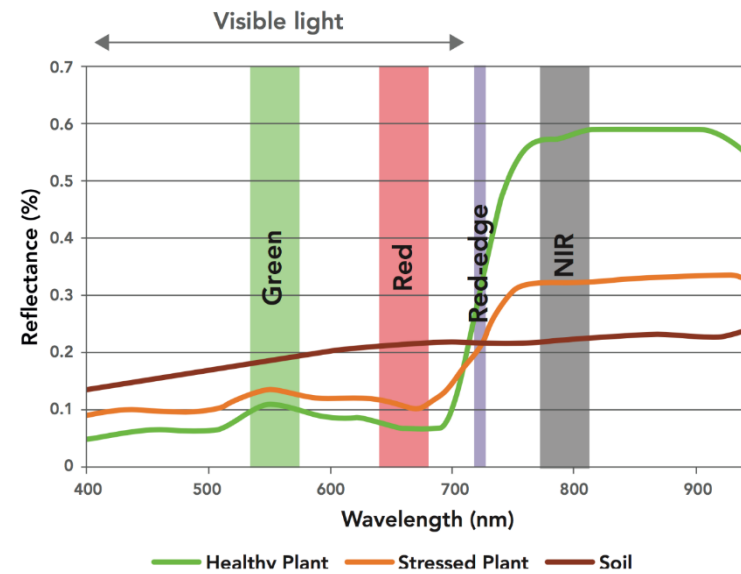

CNN = Convolutional Neural Network

CNN to predict architecture based on point clouds
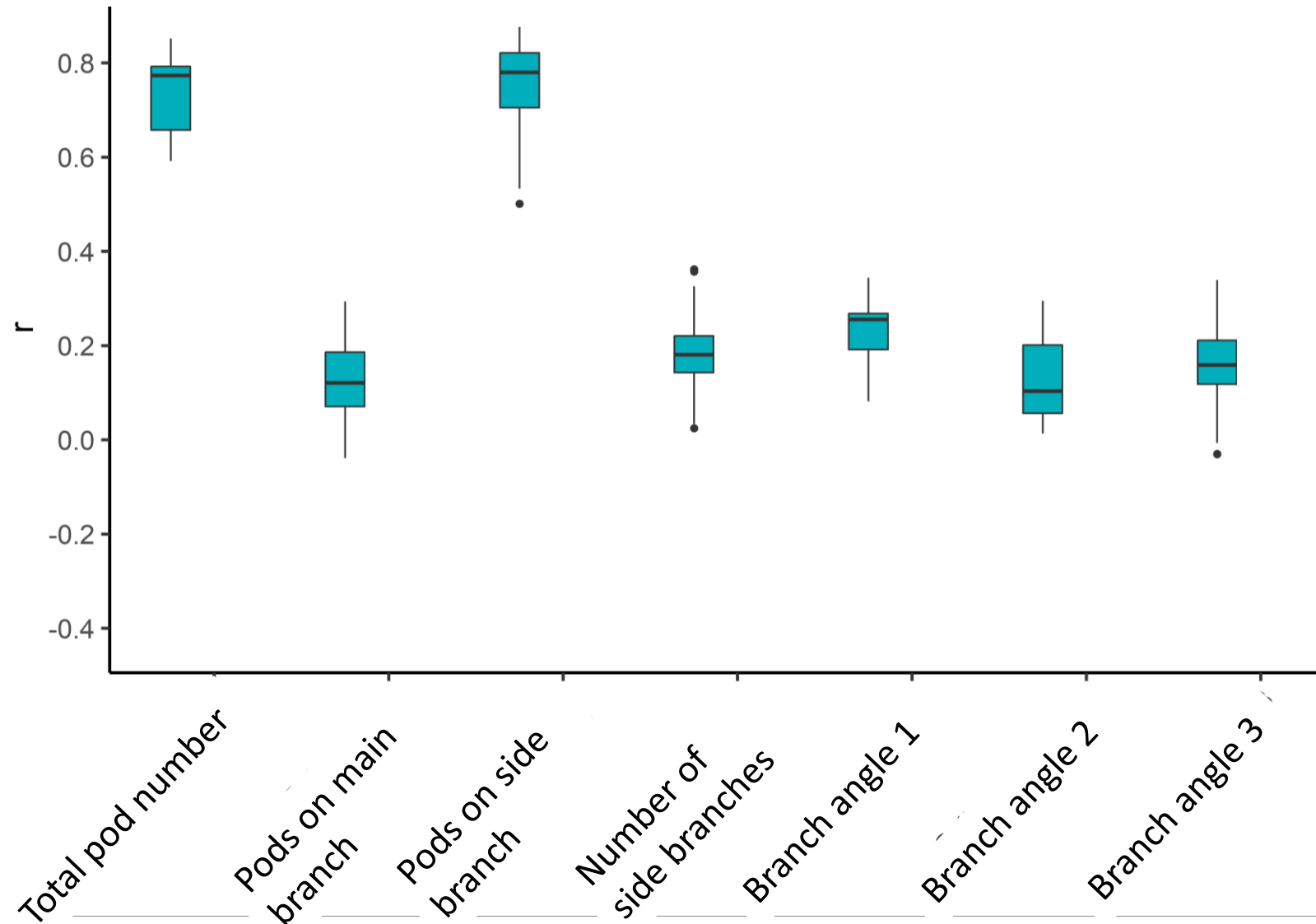
CNN = Convolutional Neural Network

Vegetation indices

NDVI = (NIR – red) / (NIR + red)

GNDVI = (NIR-GREEN) /(NDVI+GREEN)

NDRE = (NIR – RED EDGE) / (NIR + RED EDGE)

https://www.sensefly.com/fileadmin/user_upload/sensefly/documents/brochures/Sequoia_Specifications_2016_sensefly.pdf http://sensefly.geosolutions.sk/drony/ (27.04.2017)

Normalized Difference Red Edge
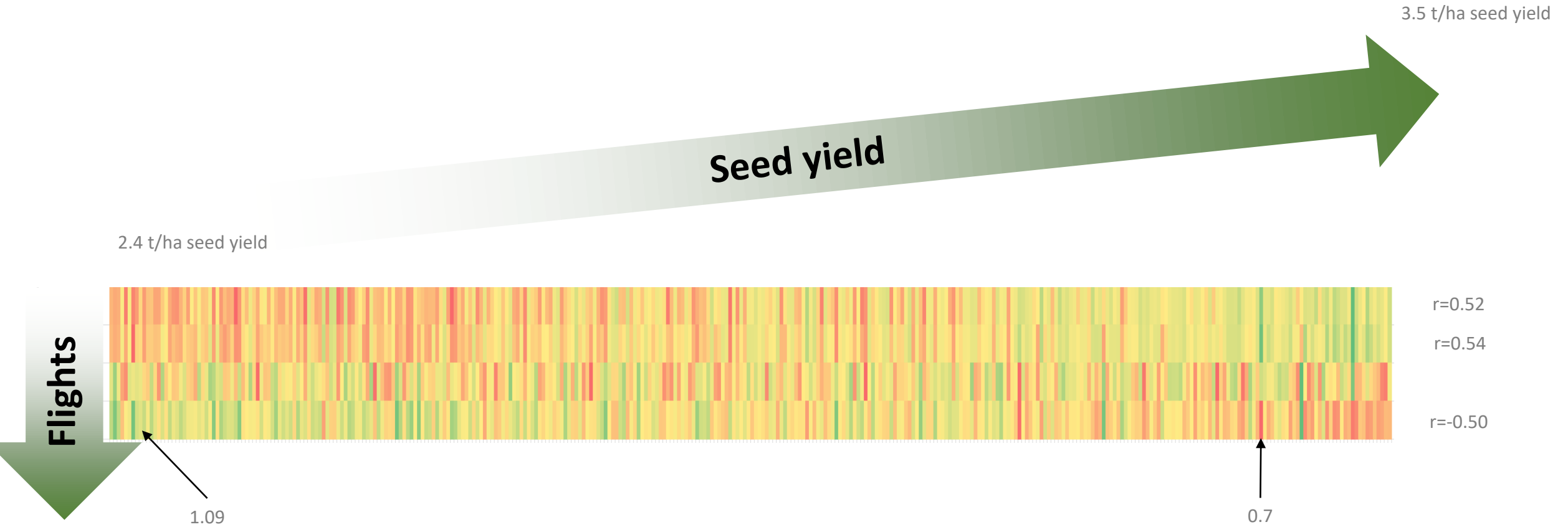
3.5 t/ha seed yield

Seed yield

2.4 t/ha seed yield

Flights

r=0.52

r=0.54

r=-0.50

1.09

0.7

CNN to predict architecture based on point clouds and UAV pictures

CNN = Convolutional Neural Network
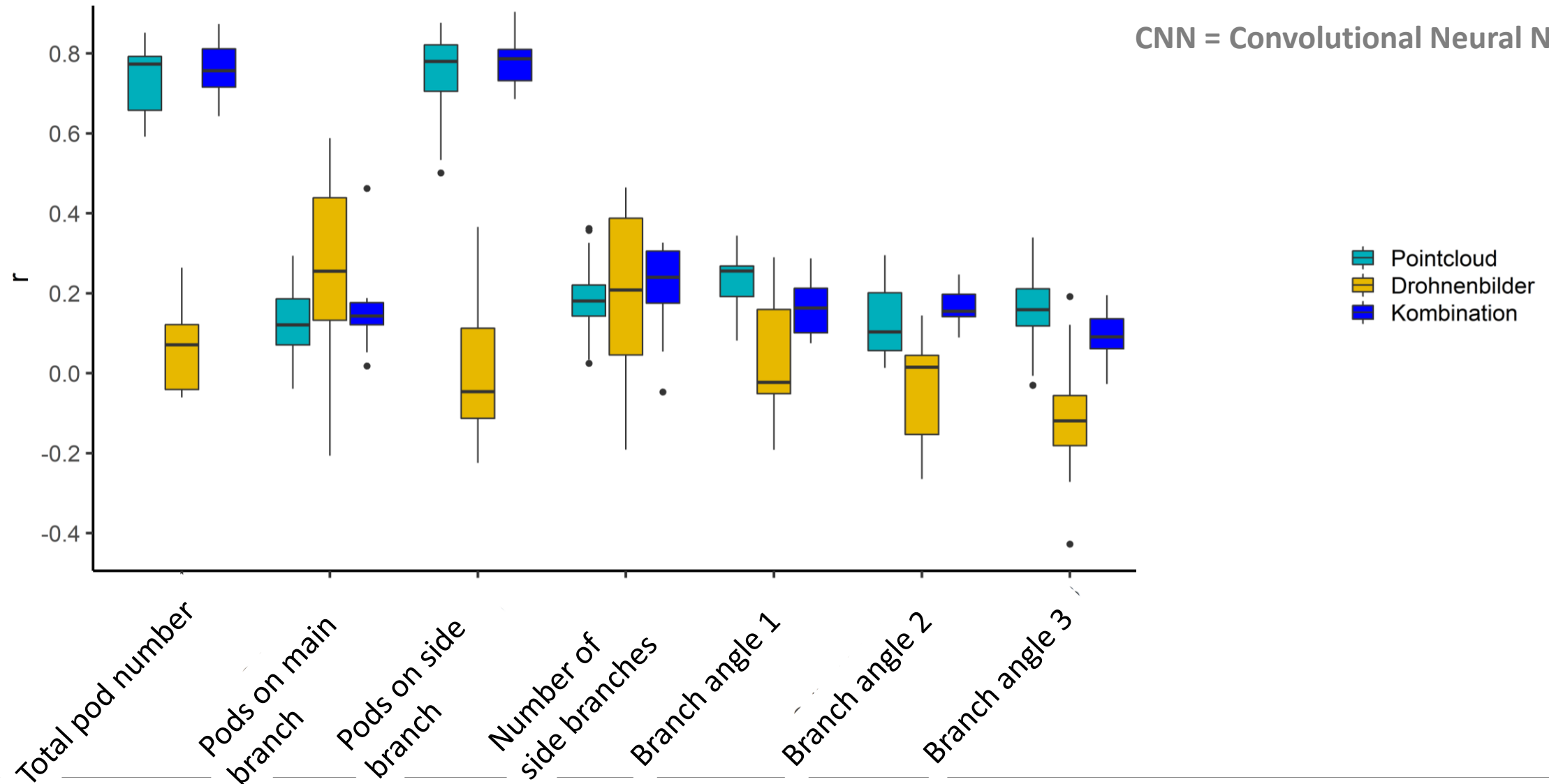
CNN to predict architecture based on point clouds and UAV pictures
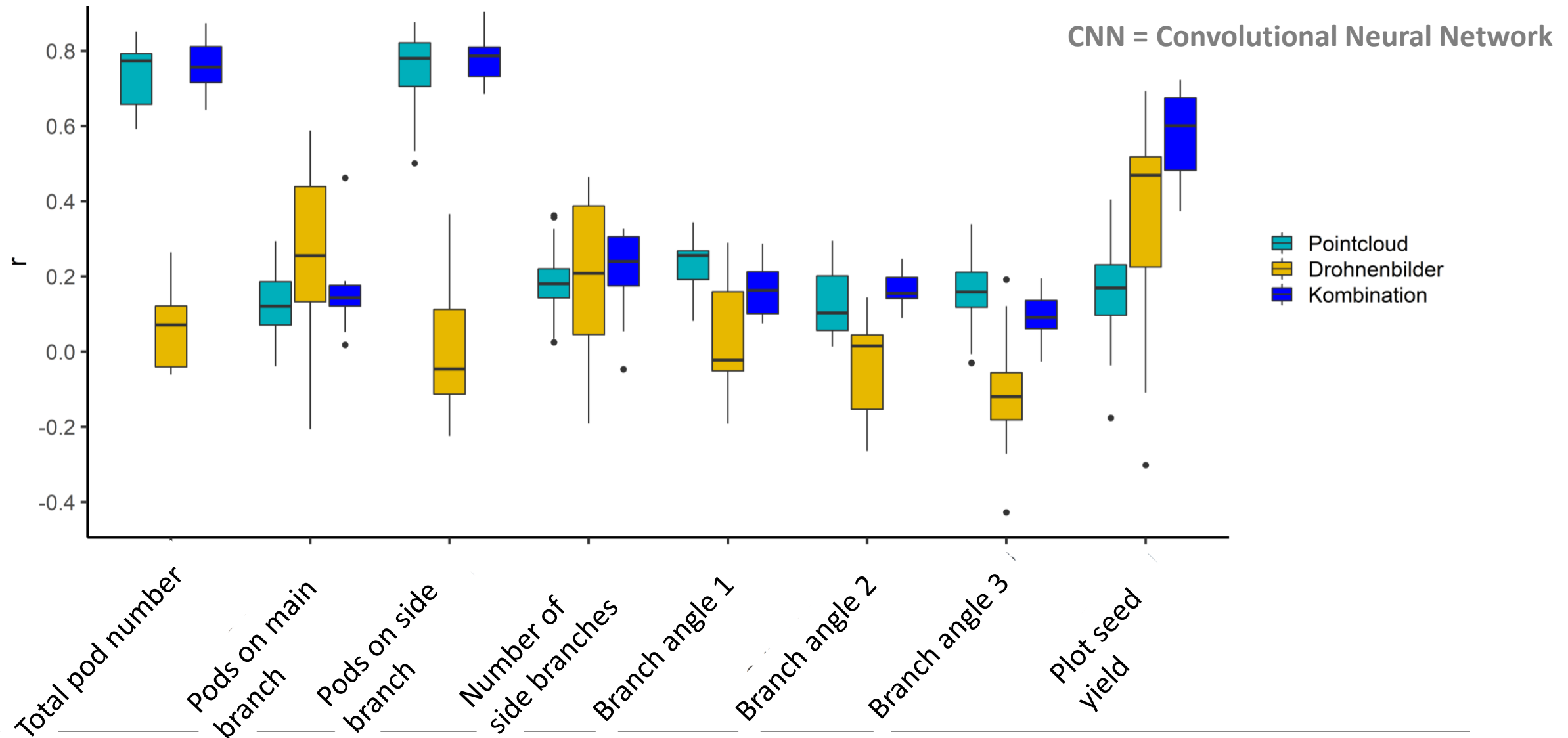
Thanks for your attention!

Any questions?

- **Prof. Dr. Andreas Stahl (JKI)**
- Andreas Eckert (PhD-student)

- **Prof. Dr. Rod Snowdon**
- Dr. Benjamin Wittkop

- Stjepan Vukasovic
- Anna Langstroff
- Lennard Ehrig
- Lennart Scheer
- Lukas Förter (Master)