



**HAL**  
open science

## Maize plasticity characterization through in-field 3D phenotyping

Mario Serouart, Raul Lopez Lozano, Maeva Beaumont, Brigitte Escale,  
Benoit de Solan, Frederic Baret

► **To cite this version:**

Mario Serouart, Raul Lopez Lozano, Maeva Beaumont, Brigitte Escale, Benoit de Solan, et al.. Maize plasticity characterization through in-field 3D phenotyping. 7th International Plant Phenotyping Symposium 2022, Sep 2022, Wageningen, Netherlands. . hal-03784065

**HAL Id: hal-03784065**

**<https://hal.inrae.fr/hal-03784065>**

Submitted on 22 Sep 2022

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

# Maize plasticity characterization through in-field 3D phenotyping



Mario SEROUART<sup>1,2</sup>, Raul LOPEZ LOZANO<sup>1</sup>, Maëva BEAUMONT<sup>3</sup>, Brigitte ESCALE<sup>3</sup>, Benoit DE SOLAN<sup>2</sup> and Frederic BARET<sup>1</sup>

<sup>1</sup> INRAE, UMR EMMAH, UMT CAPTE, 228, route de l'aérodrome | CS 40509, 84914 Avignon Cedex 9, France

<sup>2</sup> Arvalis, 228, route de l'aérodrome | CS 40509, 84914 Avignon Cedex 9, France

<sup>3</sup> Arvalis, Physiology and Plant Protection, 21 Chemin de Pau | 64121 Montardon, France

7th International Plant Phenotyping Symposium 2022 | Wageningen

## BACKGROUND & AIM

### Identifying architectural traits linked to intra-specific competition.

Plant density and sowing pattern play a key role in light interception and a number of processes that are downstream (canopy photosynthesis, evapotranspiration...). Understanding how maize genotypes can cope with intra-specific competition adapting their architecture to maximize light interception is essential to evaluate the impact of intra-specific competition in biomass production and yield. The objective of this study is to analyse the architectural plasticity of several maize hybrids using indirect high-throughput phenotyping (HTP).

## METHODS

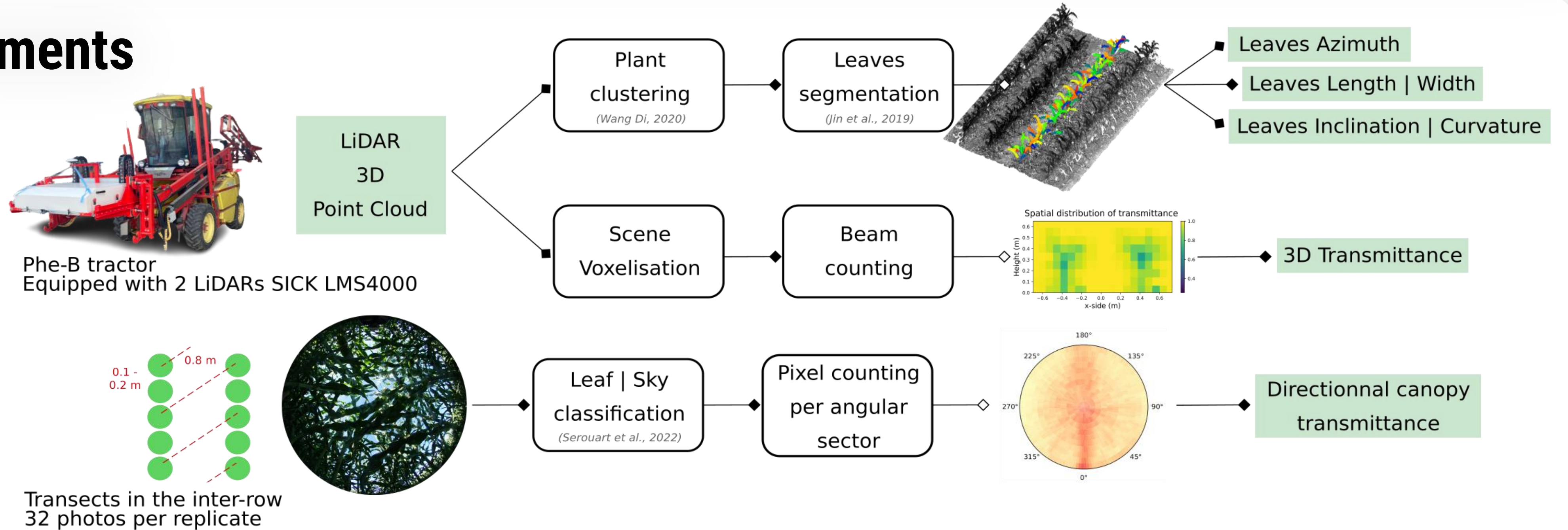
### Experiment

A field experiment was conducted in Montardon, France. Five commercial maize hybrids were sown at two plant density (6 and 12 plants.m<sup>-2</sup>) at 0.8 m rows spacing with three replicates.

### HTP Measurements

I – Ground-based LiDAR at 409 and 642 GDD

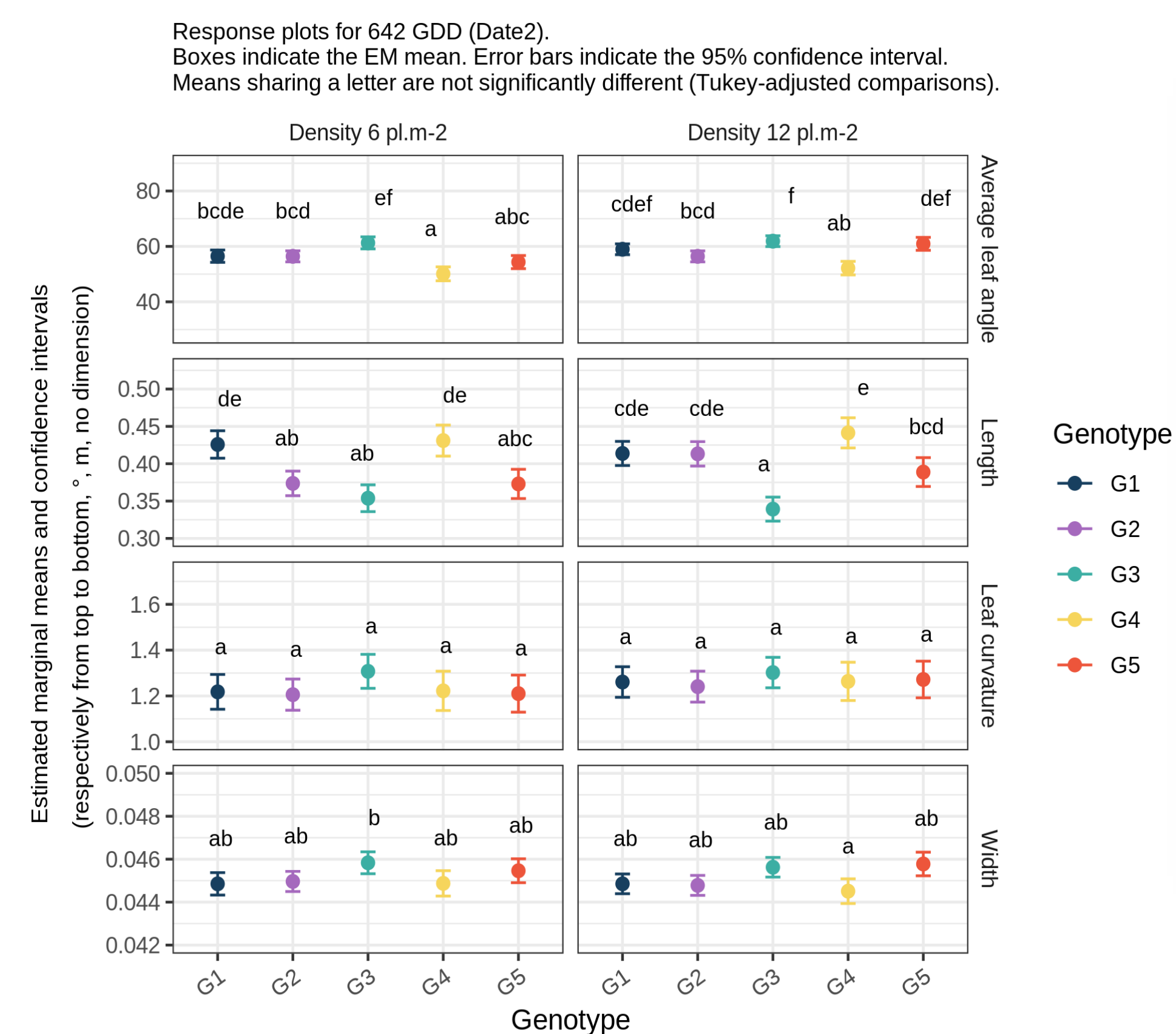
II – Hemispherical photographs at flowering (700 GDD)



## RESULTS

### Genotypic differences in maize plant architecture

#### Leaves dimensions and inclination



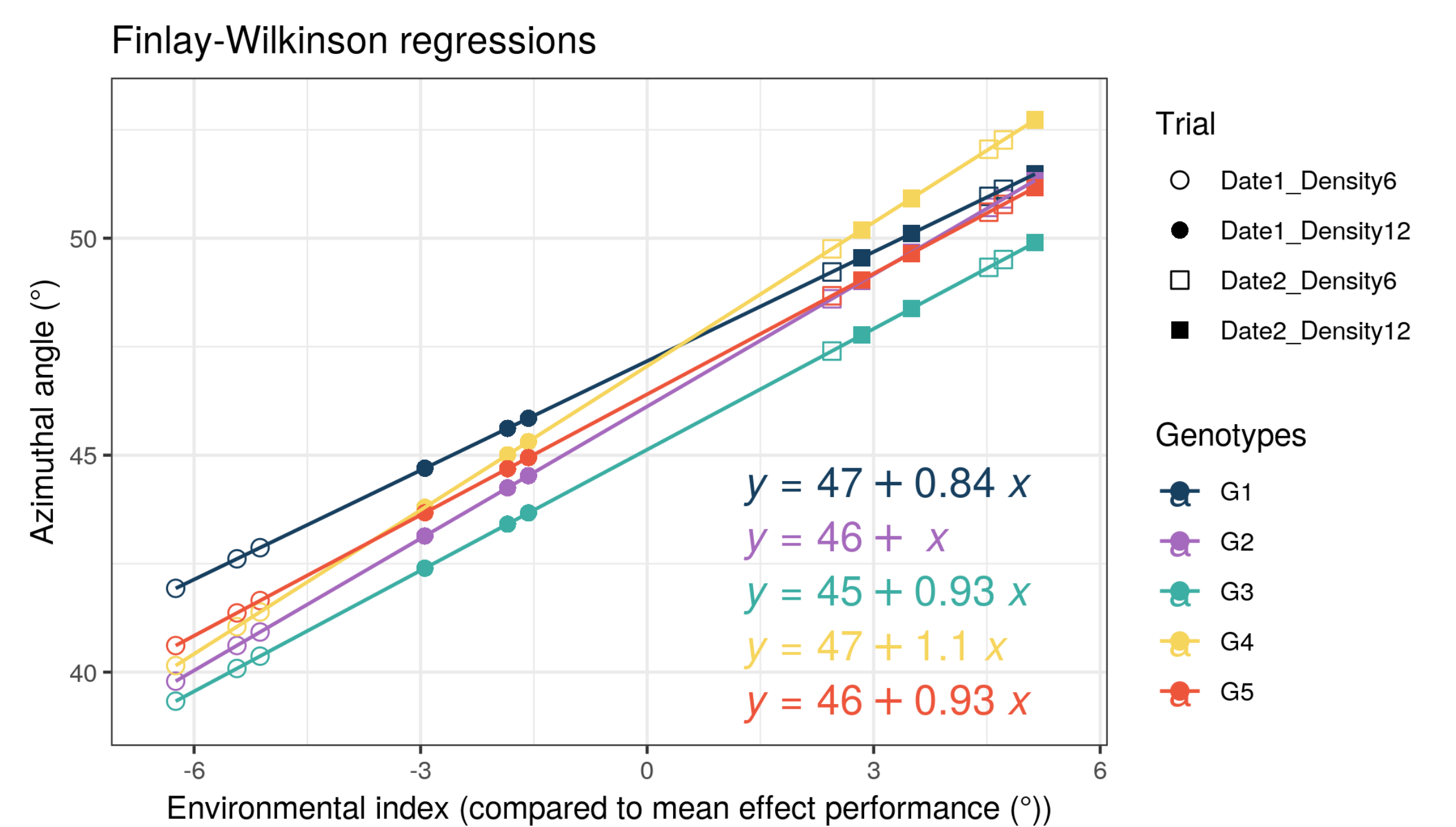
LiDAR-derived traits on leaves dimensions and inclination indicates significant differences among genotypes.

The differences are observed for leaves length and inclination:

G3 presents, systematically, shorter and more inclined leaves compared to all the others.

No significant differences were observed among the genotypes depending on plant density

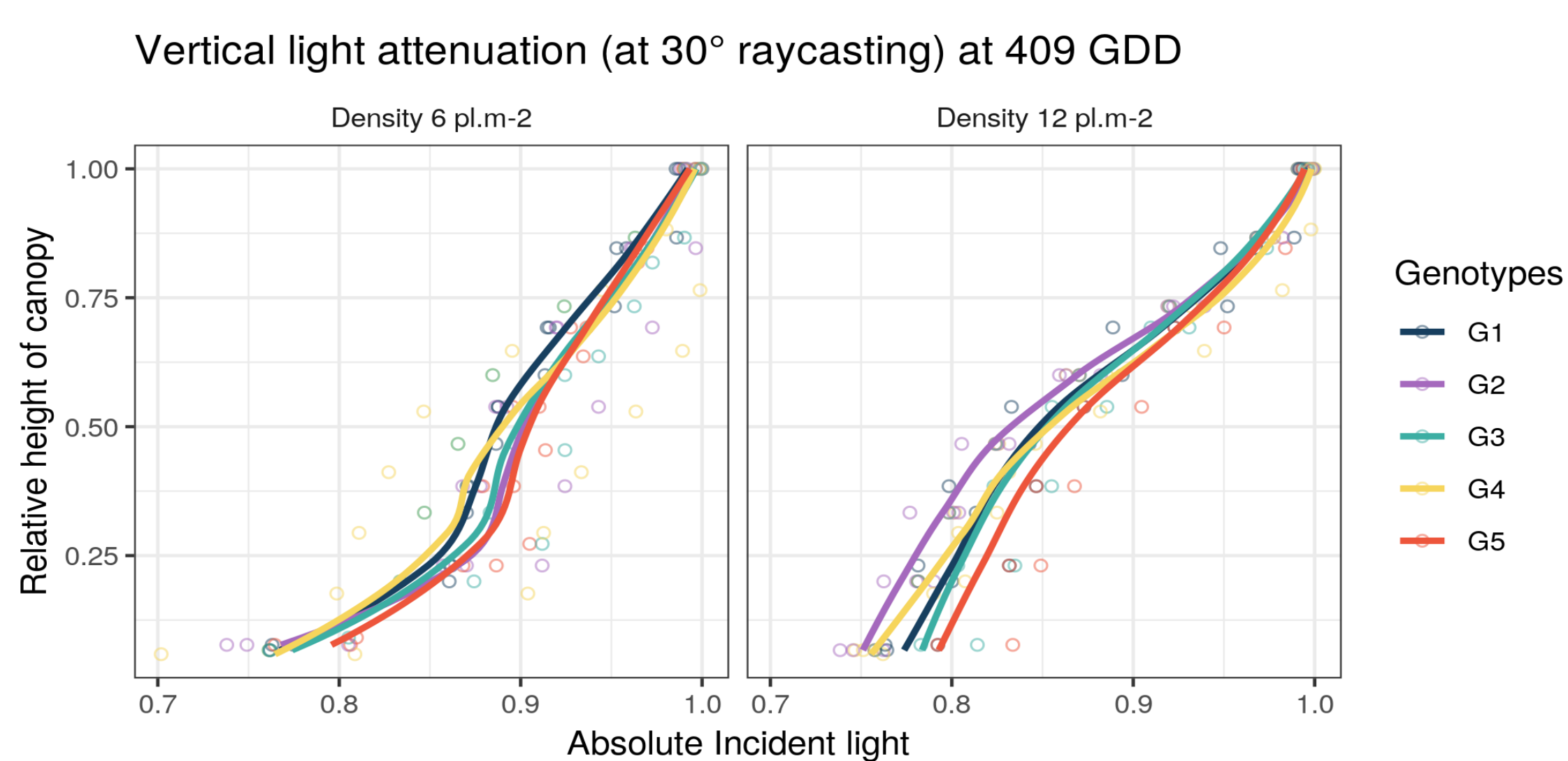
#### Leaves orientation



An increased proportion towards azimuth angles > 45° as density increases is noted. The G4 genotype has the highest tendency to position itself perpendicular to the row in high density environments. It is also the most sensitive to environmental changes, with the highest 1 + β<sub>i</sub> value at mean environment. G3 is the least sensitive of the five genotypes presented to environmental variations. G1 is not as capable of adjusting in competitive environmental conditions.

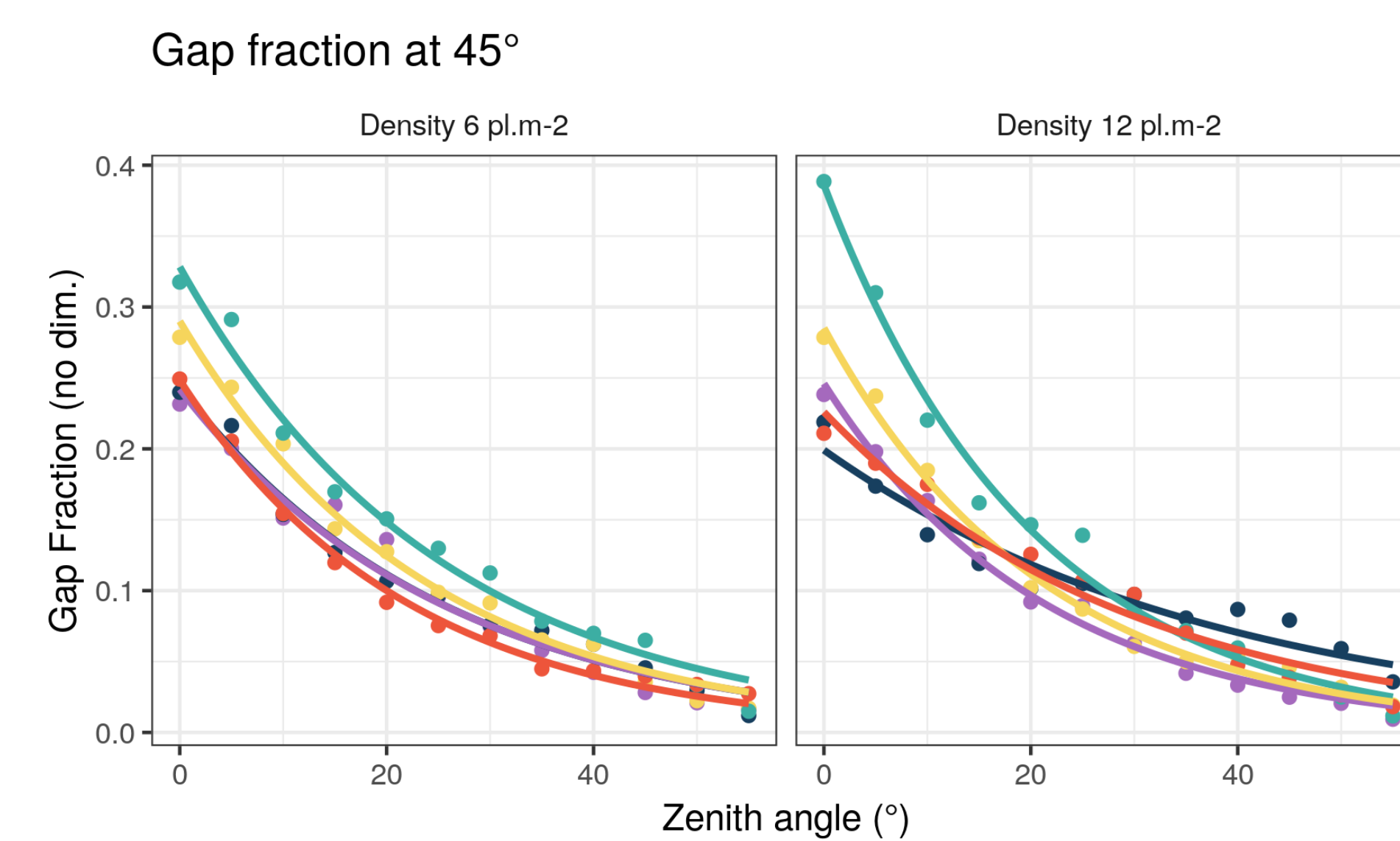
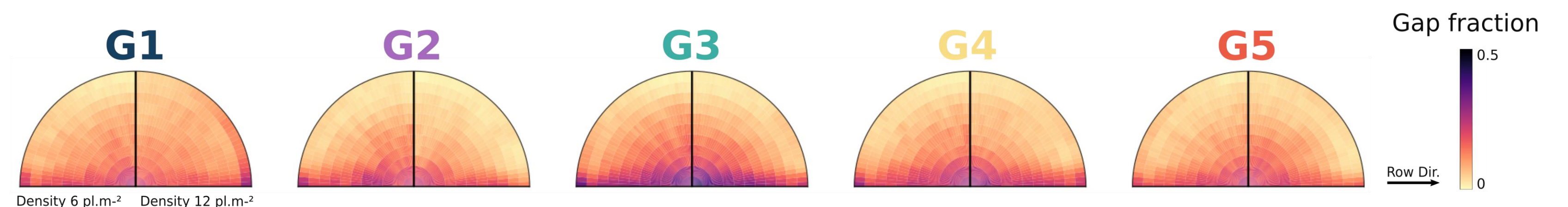
### Consequences for canopy transmittance

#### Vertical profile of light attenuation at stage V8



It can be estimated from LiDAR transmittance, inverting Beer-Lambert law. Thus, vertical light attenuation, i.e. impact of architecture in canopy light distribution, can be computed, also showing up to 5% differences in light perception between genotypes in lower canopy layers at early-medium stage. Further stages should be studied later.

#### Total canopy gap fraction at flowering



G3 seems, due to its least plasticity, to be more sparse with holes, especially in the near nadir directions, that may play a role in the amount of light perceived in direct radiation. The question here would be: Is the azimuthal plasticity, i.e. light interception and shade avoidance, a consequence of genetically and poorly adapted set of correlated functional traits?

## CONCLUSION

According to GxE interactions traits distributions, we would be able to model realistic canopies and further investigate impact of radiative transfer on yield.



SEROUART Mario  
mario.serouart@inrae.fr



## REFERENCES

- Wang, Di. (2020). Unsupervised semantic and instance segmentation of forest point clouds. ISPRS Journal of Photogrammetry and Remote Sensing.
- Jin, Shichao et al. (2019). Separating the Structural Components of Maize for Field Phenotyping Using Terrestrial LiDAR Data and Deep Convolutional Neural Networks. IEEE Transactions on Geoscience and Remote Sensing
- Serouart M et al.(2022) SegVeg: Segmenting RGB Images into Green and Senescent Vegetation by Combining Deep and Shallow Methods. Plant Phenomics