



# AGROBRANCHE PROJECT

## TOWARDS SUSTAINABLE WOOD FILLERS

### FROM AGROFORESTRY FOR WPC

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## Introduction: connecting field and industrial sector for WPC

Current environmental concerns push towards more sustainable and local practices for biomass production. In this regard, agroforestry has been highlighted by researchers and policies as a highly efficient approach for carbon sequestration, and a sustainable alternative to short coppice rotation. One of the key parameters for agroforestry adoption is of course the short-term return. Agroforestry implies regular branch cuts that are processed into wood chips and mostly used as energy wood. New higher added-value chains could be considered such as reinforcements or specific molecules for bio-based materials and chemistry.

Since 90's, Wood-Plastic Composites (WPCs) have experienced significant growth, particularly

in building, and constitute the largest share of bio-based composites developed at an industrial scale. Nevertheless, the quality of WPCs and variability in their performance are major technological issues for their implementation in industrial applications. This could be related to the difficulty in tracing the various origin of wood fillers as well as the different processing steps, from wood drying and defibration process to composite manufacturing. But a key issue is also the need for a sustainable production of biomass, without conflict as regards the cropping vocation of the agricultural areas.

### Wood fillers and manufacturing of WPCs

In this context, the development of quality-

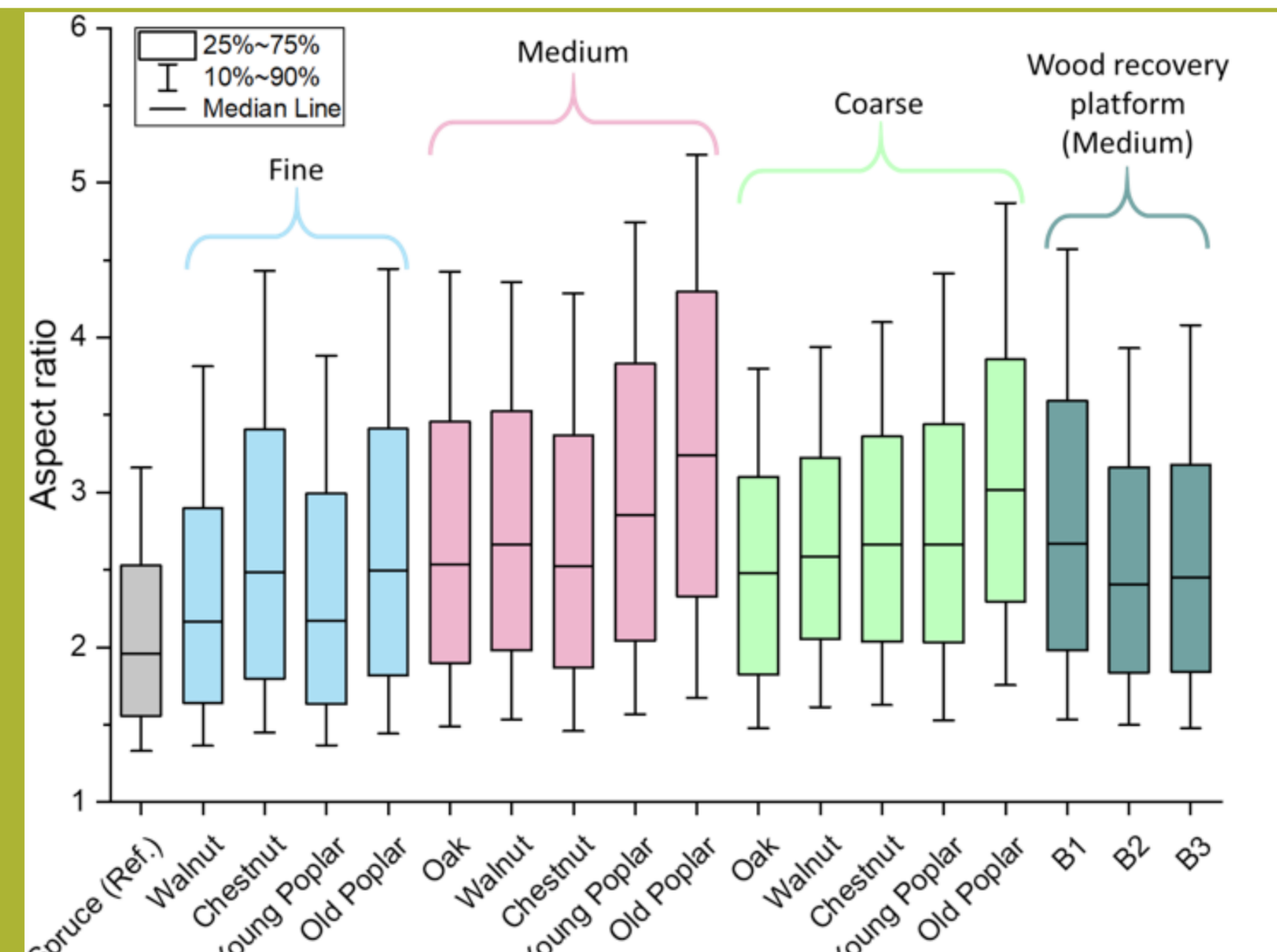
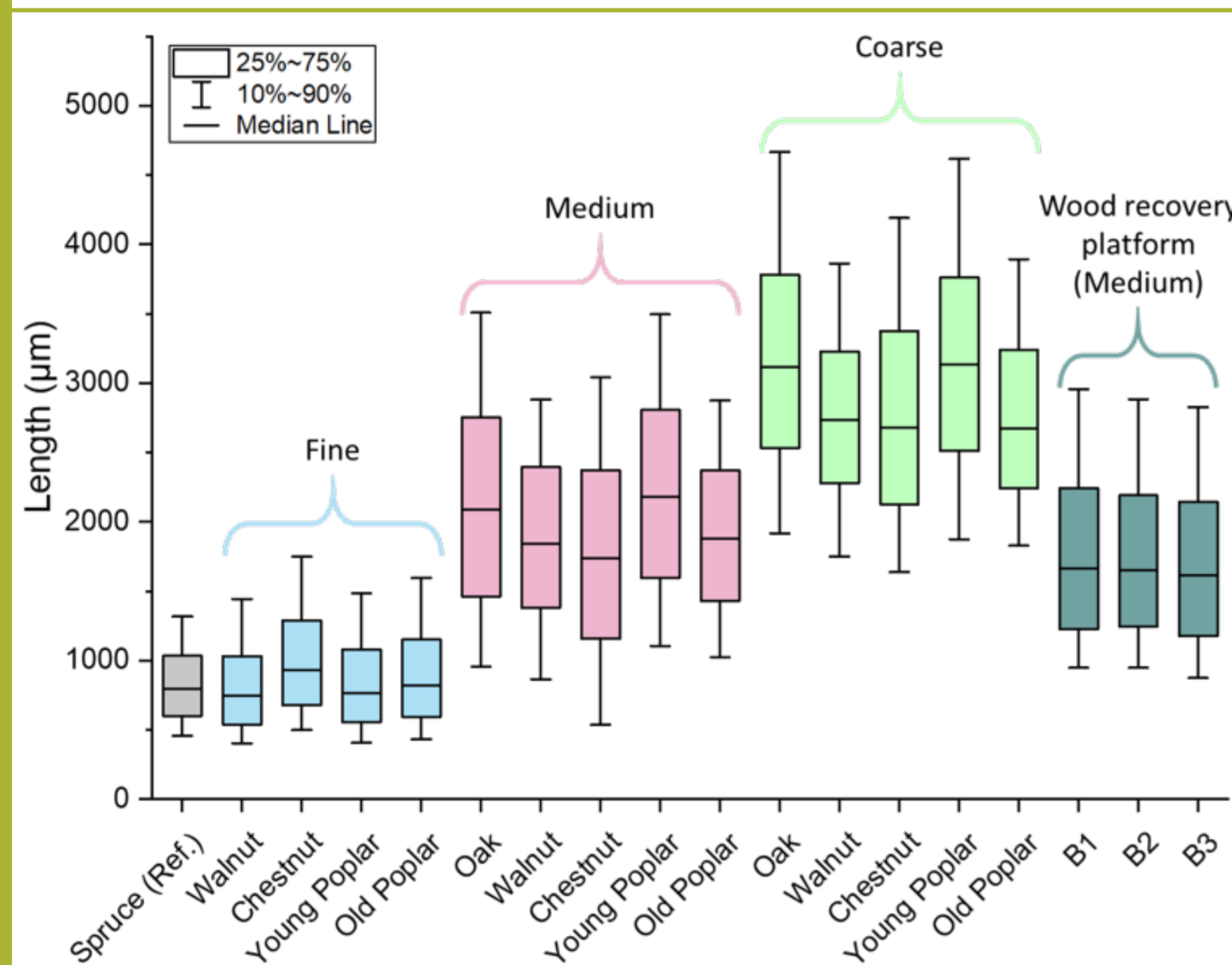
controlled agroforestry wood fillers in terms of granulometry, chemical composition and physical properties is therefore strategic for their implementation in wood-based products. This work investigates and evidences the influence of wood species (poplar, oak, walnut, chestnut) and filler size and shape on the microstructure and mechanical properties of polypropylene (PP) / wood composites manufactured by extrusion/ injection moulded. Moreover, the potential for hedge wood from recovery platforms in Brittany (mix of several species) was also investigated. A definition of wood species and fractionation routes have been produced to optimize composite performances in relation with wood structure (anatomy, cell wall composition).



## PREPARATION & CHARACTERIZATION OF WOOD FRACTIONS

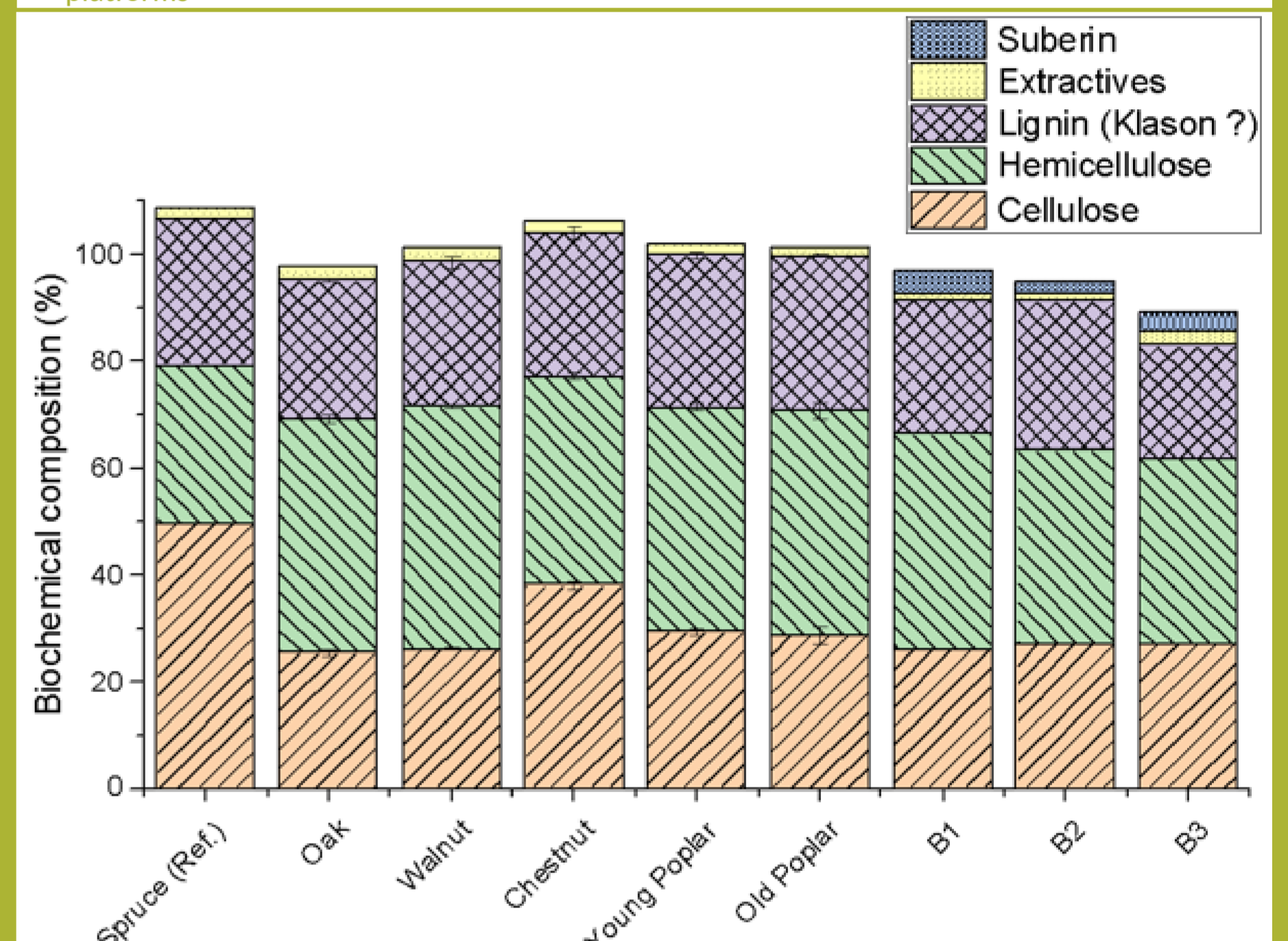
### Granulometry

- 3 distinct fractions in terms of initial length, regardless of wood species
- No significant effect on the initial aspect ratio AR
- (except lower AR for spruce and slightly higher AR for old poplar medium and coarse)



### Biochemical composition (LERMAB)

- Less cellulose and more hemicelluloses for wood branches and wood from recovery platforms
- Similar amounts of lignin / extractives
- Suberin was also found but only analyzed for B1, B2 and B3



## MANUFACTURING OF WOOD PLASTIC COMPOSITES (WPCs)

### Compounding by TWIN-SCREW EXTRUSION



PP 65%w  
PP-g-MA 5%w  
Wood fillers 30%w

### Injection parameters:

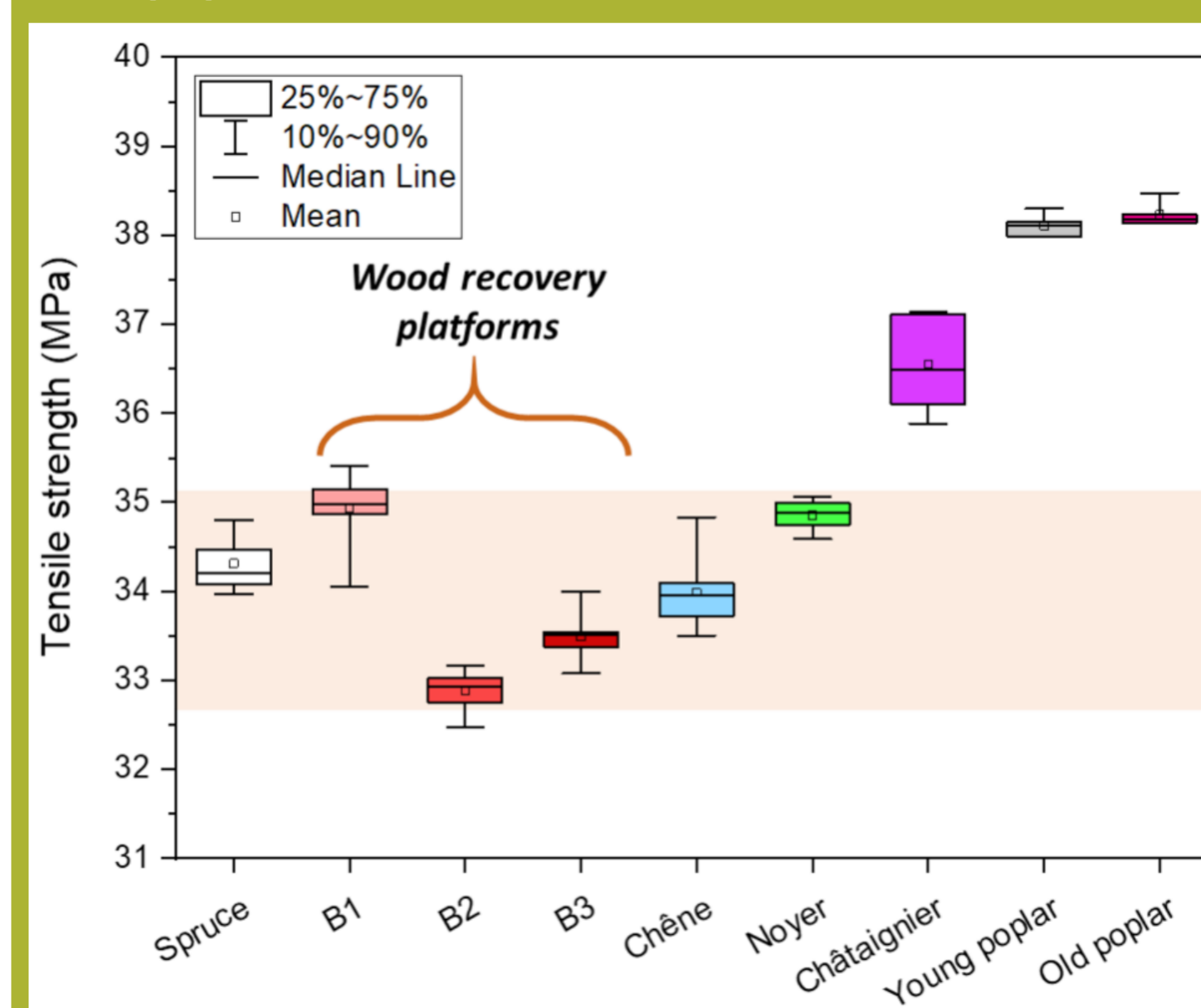
- Pressure 800-950 bar
- speed 120 rpm
- Melt temperature 180°C
- Mould temperature 30°C

### INJECTION MOLDING

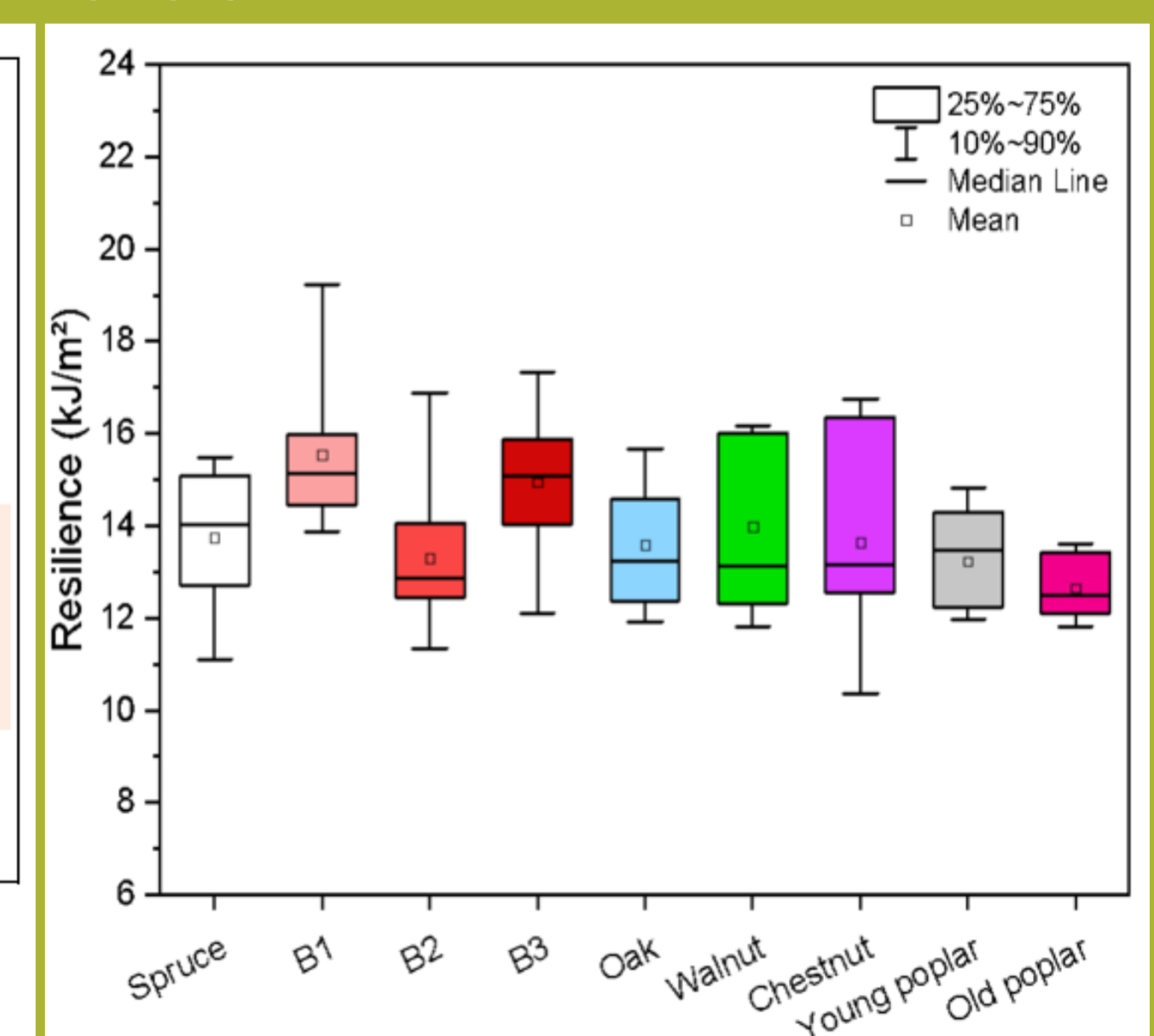


## TOWARDS THE USE OF EXISTING AGROFORESTRY FEEDSTOCKS for medium granulometry

### Tensile properties



### Impact properties



## Results

- Microstructure and resulting mechanical behaviour of the composites are highly species and granulometry dependent, up to 40% variation in stiffness and strength!
- Agroforestry wood branches are relevant as wood fillers for WPCs
- Definition of wood species and fractionation routes to optimize composite performances in relation with wood structure (anatomy,

- morphology, cell wall composition)
- From an economical aspect, the agroforestry chips are perhaps less interesting than the forestry chips, but with a better Life Cycle Analysis and strong impact on the agriculture environmental services. This option becomes credible for many companies involved to integrate the environmental dimension into their production.

## Perspectives

- Study the effect of intraspecific variability and age of wood species
- Validate the potential of existing agroforestry wood recovery platforms (mixed species) in a demonstration-case production.

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