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Genotype × environment interactions in black soldier fly (BSF) larvae grown on different feed substrates

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Context: Background and aims

Factors influencing BSF life history performance and larvae body composition?

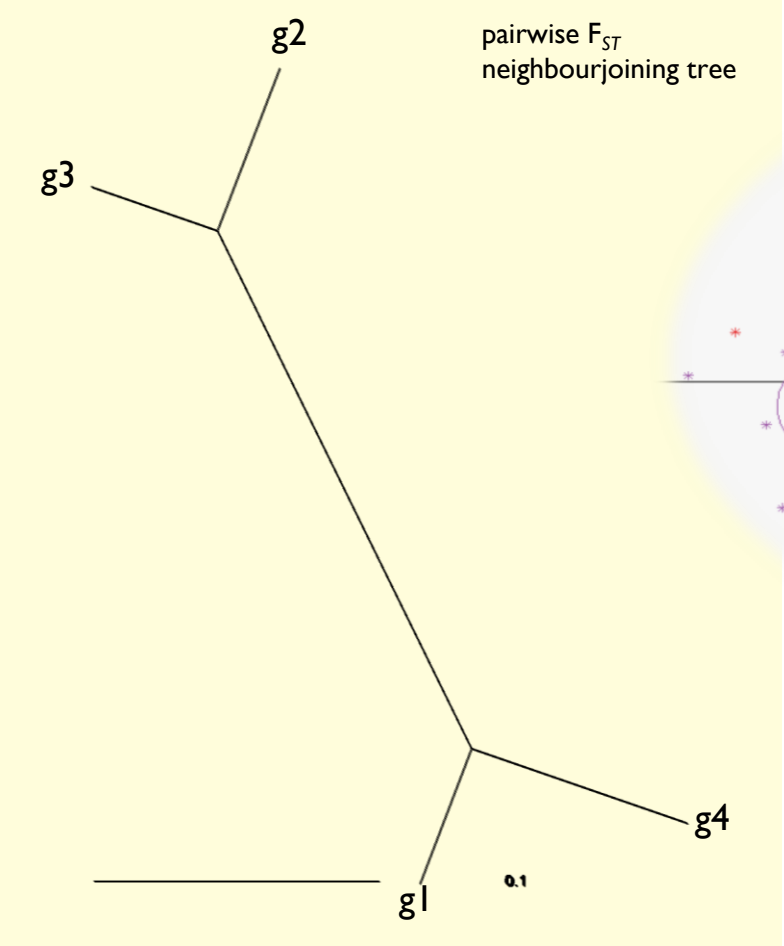
Own ongoing research:
Global BSF population genetic architecture (high-resulution polymorphic markers)

Aim of the present study:
Effects of feed substrate, BSF genetics and potential interactions thereof

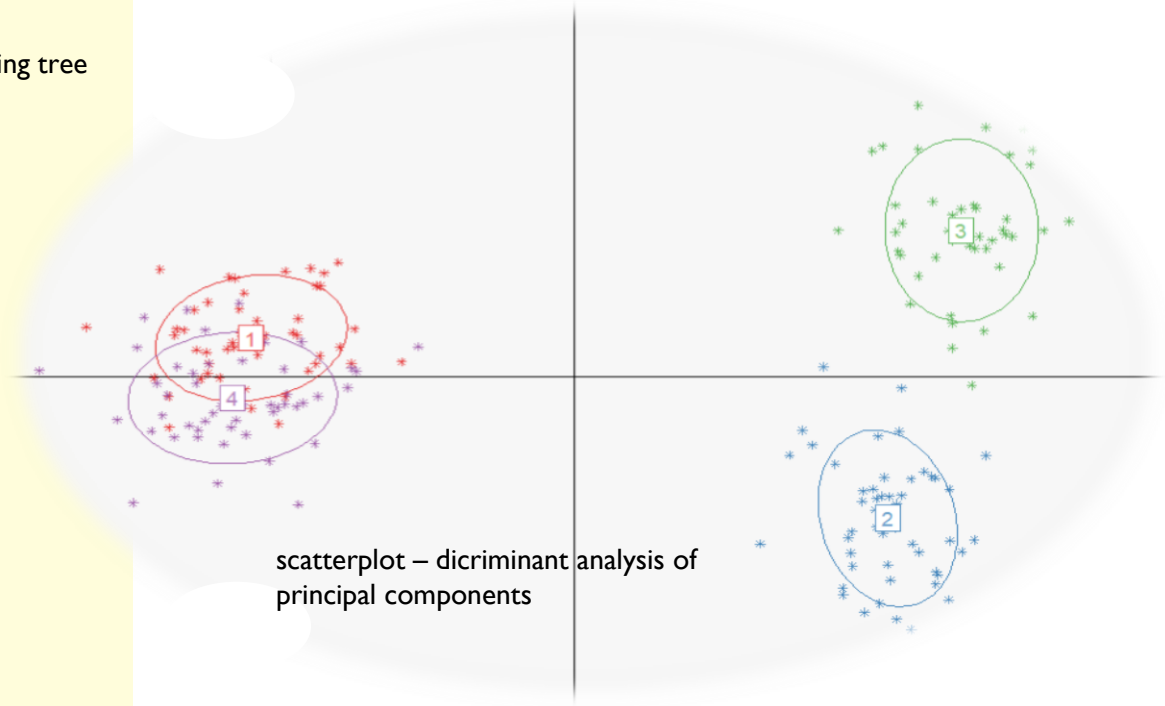
Photosgraphs: Wohlfahrt/Alföldi, Hauser/Rojo

Experimental setup

Fully crossed experimental design:
4 genetically distinct BSF strains × 3 feed substrates (6 replicates each)



pairwise F_{ST} neighbourjoining tree



scatterplot – dicriminant analysis of principal components

All strains reared ≥2 generations under same conditions prior to experiment

Thanks to the providers of live BSF material!

Experimental setup

Fully crossed experimental design:
4 genetically distinct BSF strains × 3 feed substrates (6 replicates each)


Chicken feed (Cf)


Food waste (Fw)

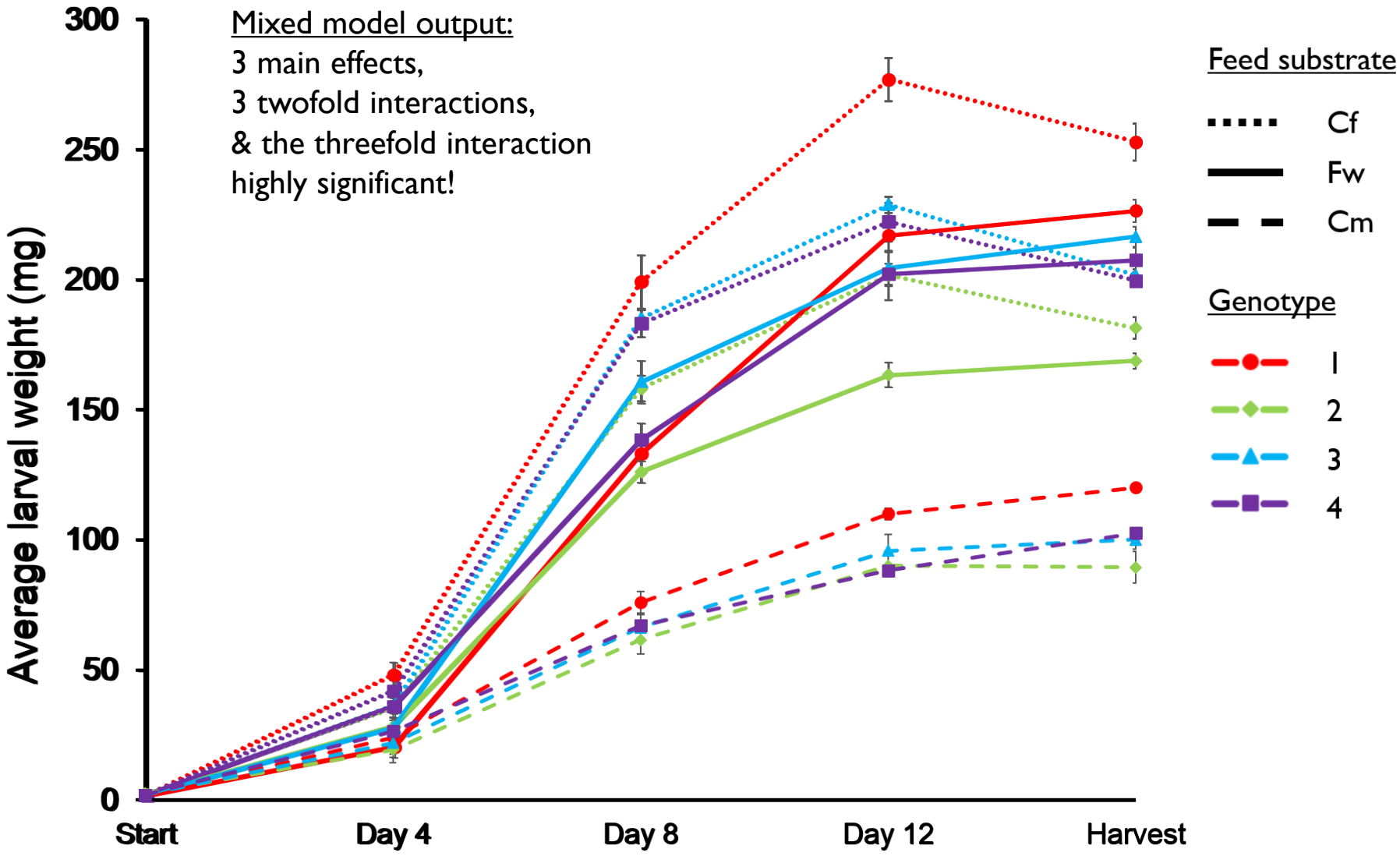

Chicken manure (Cm)

- Feed substrates adjusted to equal dry matter contents
- 72 × 100 neonates (5 days old, ~2 mg)
- Fed equal amounts every two days
- Constant 28 °C, 50% rel. humidity

- Growth tracking during development
- Survival to harvest (15 pairs of first prepupae)
- Proximate contents of feed substrates, larval biomass & residues/frass
- Calculation of relevant indices

Photosgraphs: Leupi

Results: Larval growth dynamics over time



Results: Mortality, average larval weight & total larval dry matter

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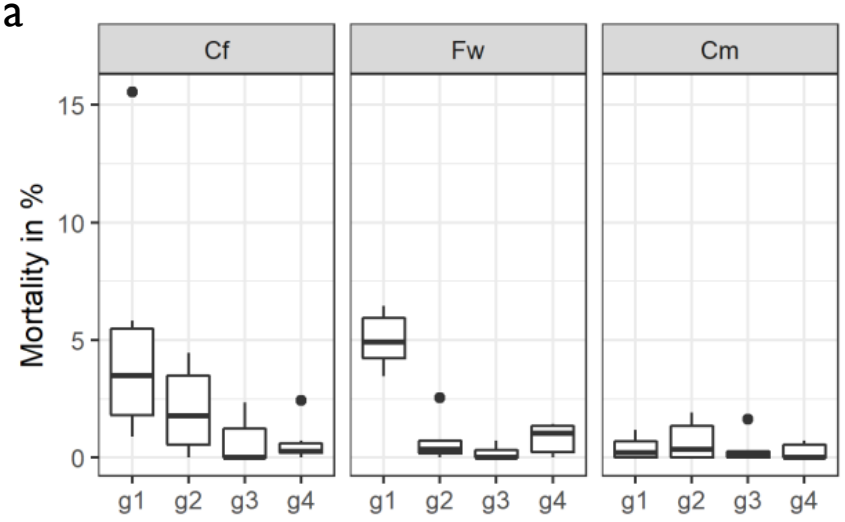

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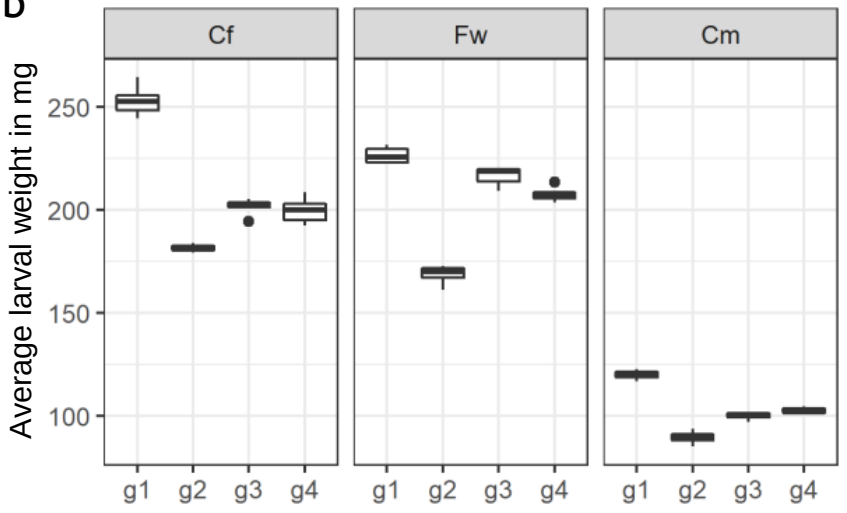

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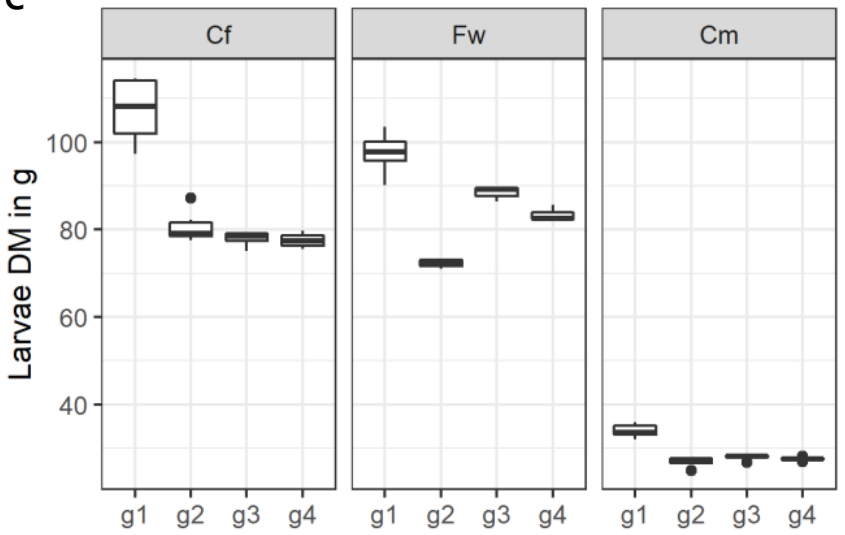
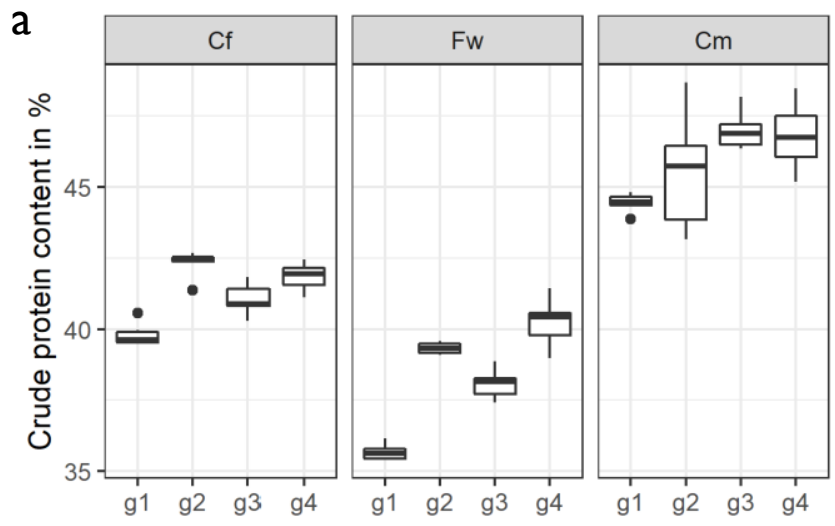
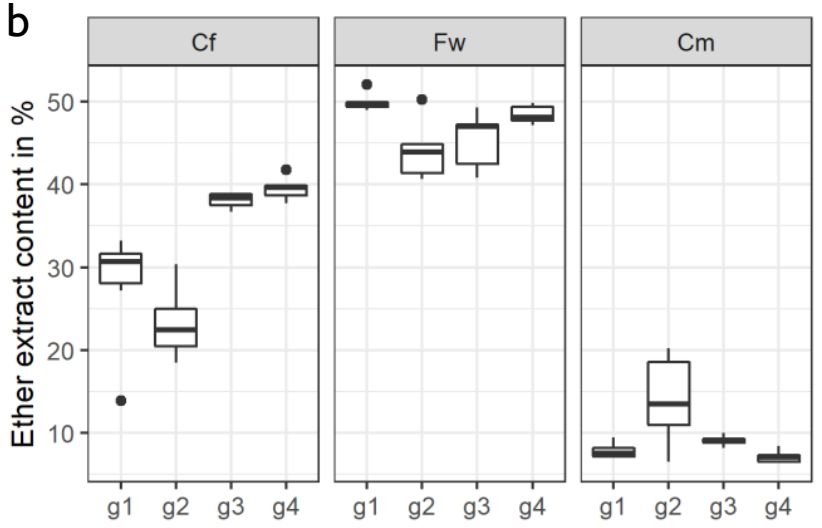
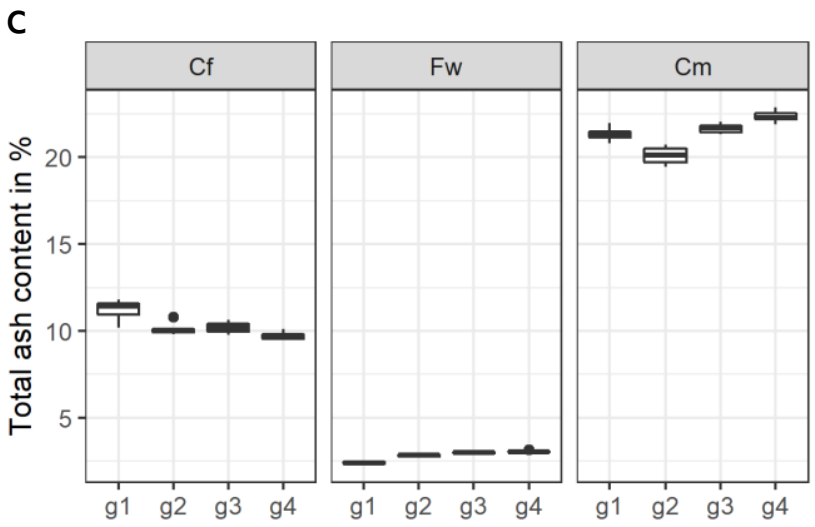


	Geno -type	Feed	Inter- action
Mortality (%)	***	***	***
Average larval weight (mg)	***	***	***
Larvae DM (g)	***	***	**

Results: Crude protein, ether extract & total ash







	Geno -type	Feed	Inter- action
Crude Protein (% of DM)	***	***	***
Total crude protein (g)	***	***	***
Ether extract (% of DM)	***	***	***
Total ether extract (g)	***	***	***
CP/EE ratio	***	***	***
Total ash content (% of DM)	***	***	***
Total ash (g)	***	***	***

Results: Feed conversion ratio, efficiency of conversion of ingested feed, dry matter reduction & emissions

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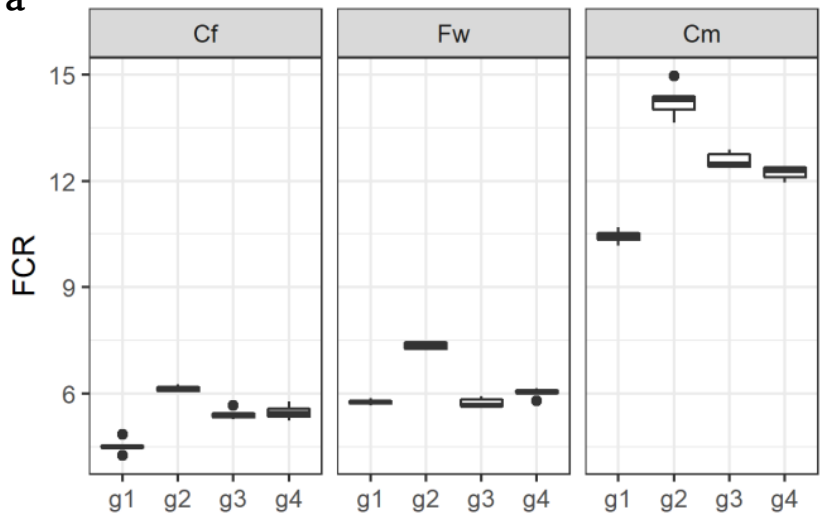

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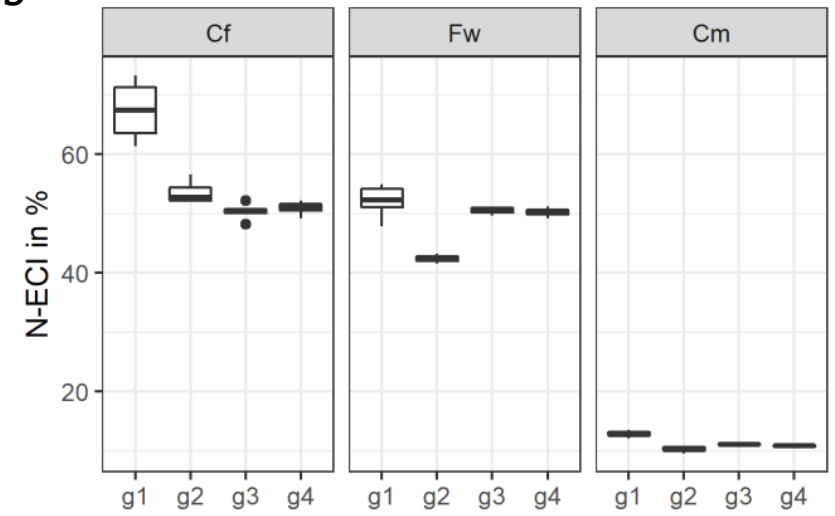

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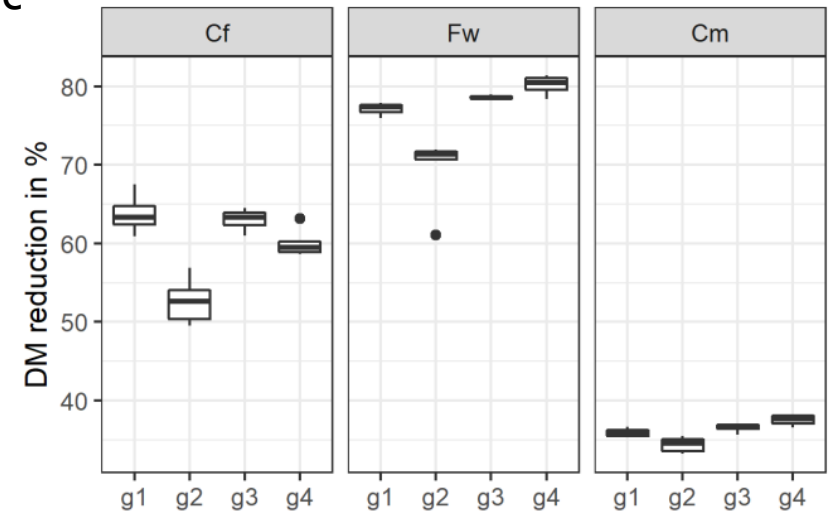

	Geno-type	Feed	Inter-action
FCR (FM)	***	***	***
ECI (%, DM based)	***	***	***
N-ECI (%)	***	***	***
DM reduction (%)	***	***	***
DM emissions (g)	***	***	***
C emissions (g)	***	***	***
N emissions (g)	***	***	***

Results: Degradation of feed substrate fiber (feed vs. residue)

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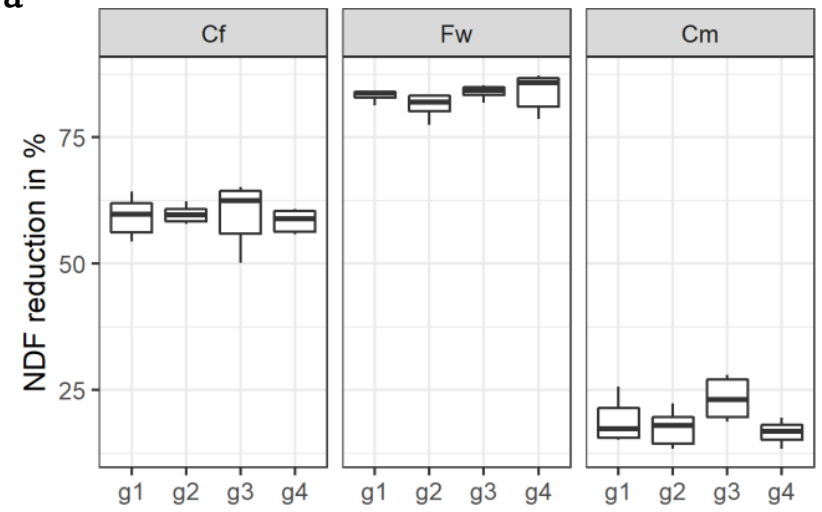

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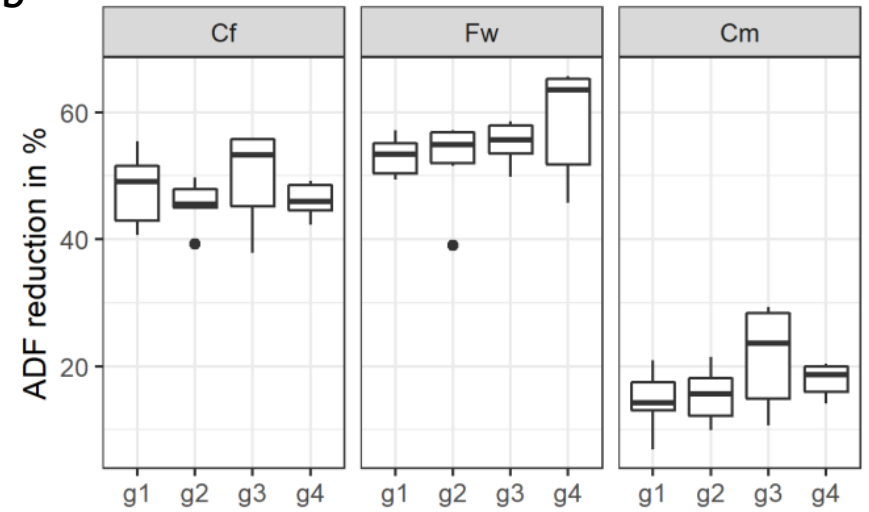

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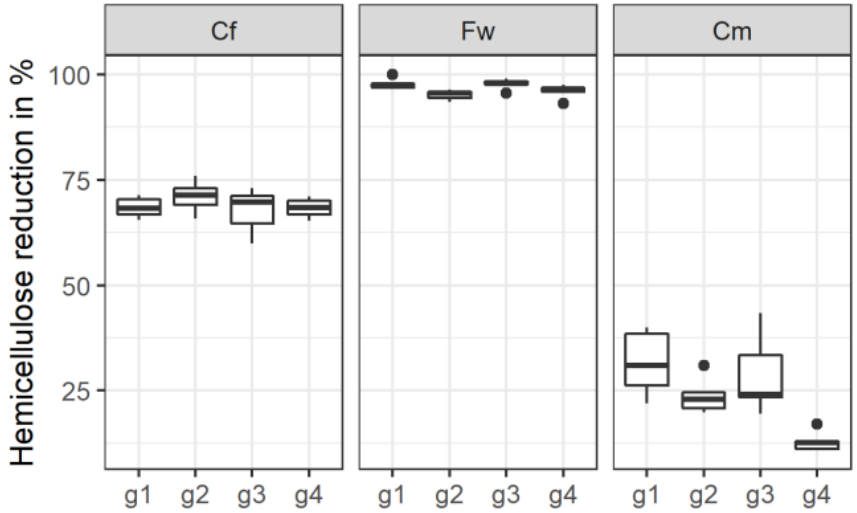

	Geno -type	Feed	Inter- action
Neutral detergent fiber (NDF) reduction (%)		***	*
Acid detergent fiber (ADF) reduction (%)		***	***
Hemicellulose reduction (%)		***	***

Conclusions & implications

Frequent & substantial genotype x feed substrate interactions across virtually all target parameters (and highly significant main effects)

Strong effects of feed (as expected) - yet BSF genetics cannot be ignored for interpreting & triggering performance outcomes

No generally superior BSF strain – distinct BSF genetic origins characterised by different nutritional requirements or physiological traits (phenotypes!)

Considering BSF genetics & interactive effects with feed could be vital to increase efficiency & sustainability of BSF productions –
depending on substrate availability and/or intended use of particular BSF products

Monitoring-toolbox for population genetics & phenotypic traits – ample indication for strain-specific variation provide promising insights for pinpointed BSF breeding

Interactions may be even more complex – e.g. including microbial levels

Thank you for your attention! – Questions?

Final call: BSF samples for global population genetics survey (wild populations from native ranges)

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