

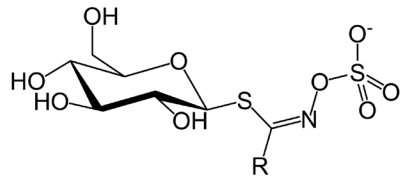


Export of defensive glucosinolates is key for their accumulation in seeds

Niels Christian Sanden

DynaMo Center, Department of Plant and Environmental Sciences, University of Copenhagen

Glucosinolates – A model system to study specialized metabolite transport

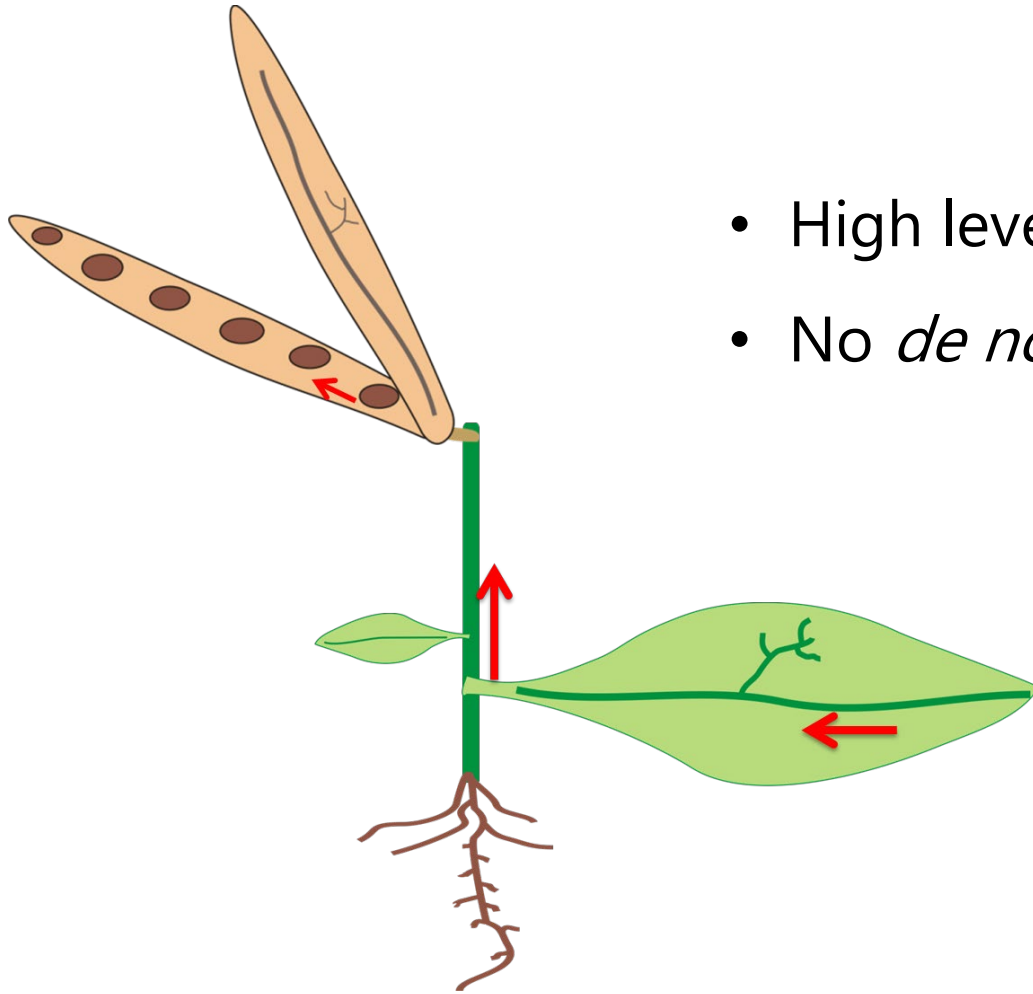


Technological potential -
Transport engineering in
rapeseed

- Improve pest resistance
- Improve ... s cake



The initial question: how are glucosinolates transported to the seeds?

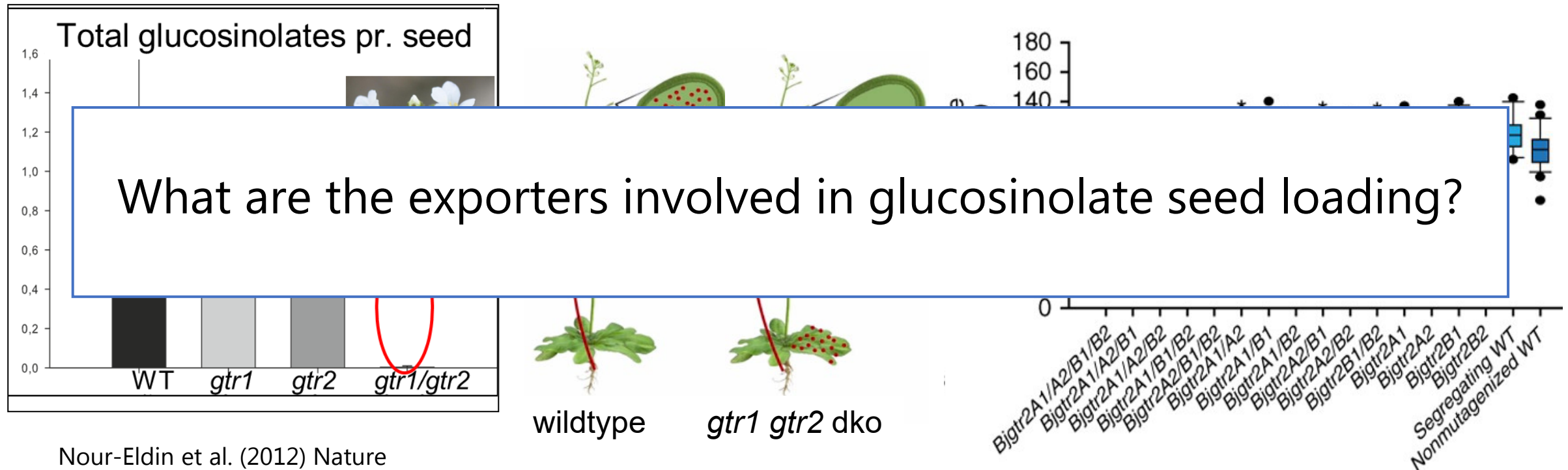


- High levels of glucosinolates in seeds
- No *de novo* synthesis in seeds

Previous discovery: GTR importers are essential for seed glucosinolate accumulation

Arabidopsis

B. juncea, field trial



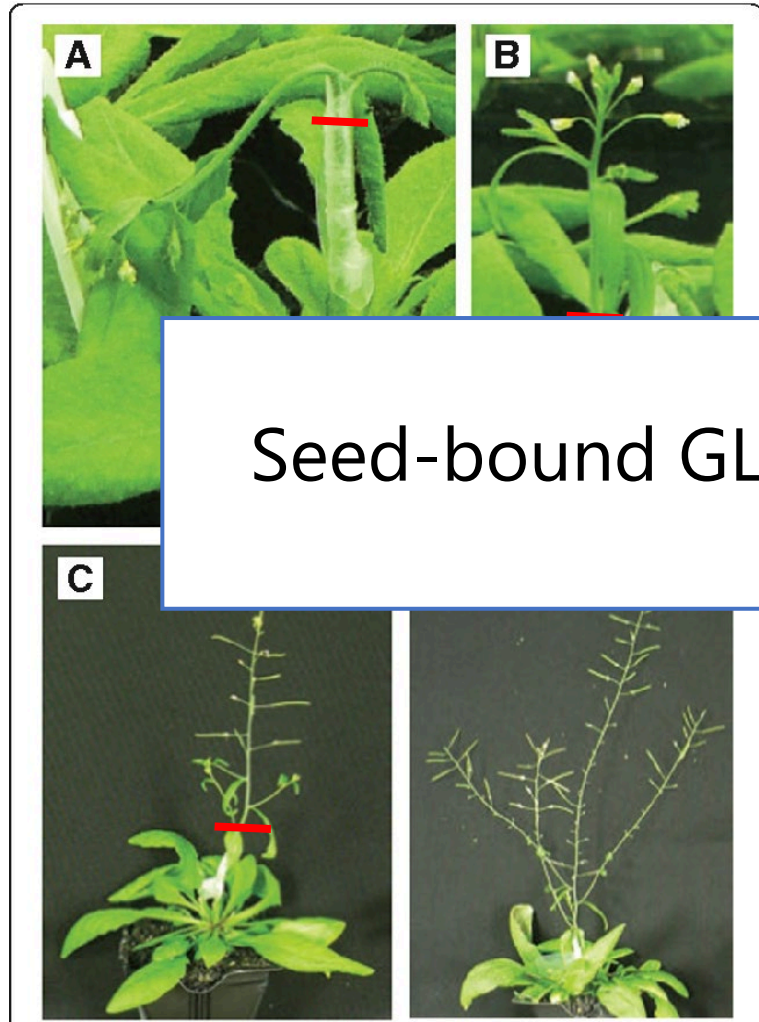
Nour-Eldin et al. (2012) Nature

Nour-Eldin et al. (2017) Nature biotechnology

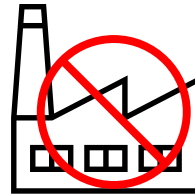
- Multiple knock-outs required to achieve reduction

Where are seed-bound glucosinolates produced?

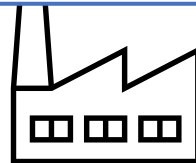
Strategy: inflorescence stem grafting



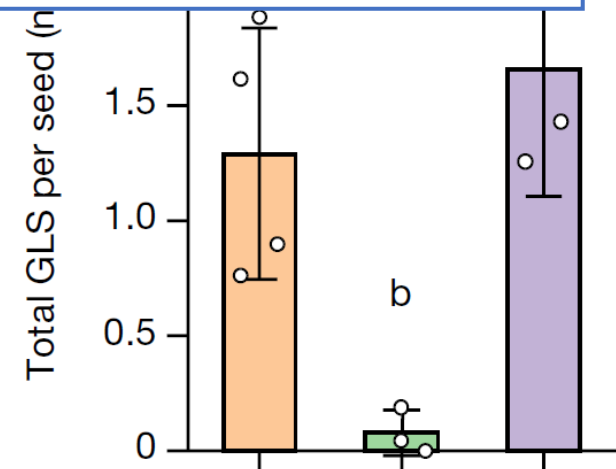
Inisar et al. (2012) Plant Methods



Seed-bound GLS are produced in reproductive organs

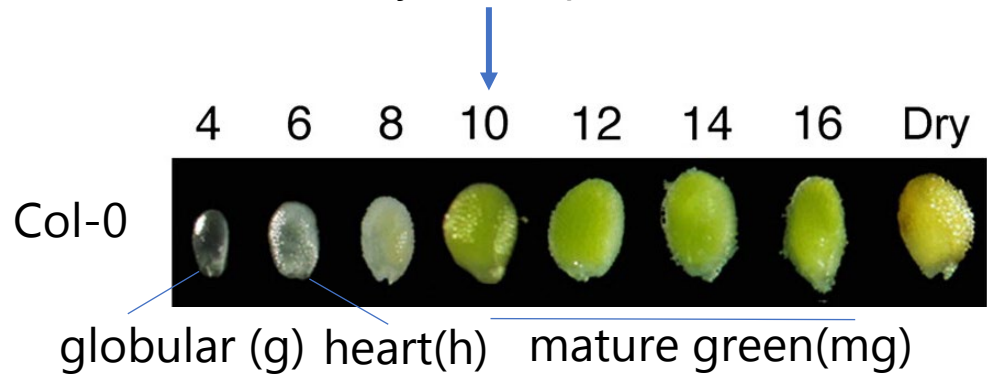
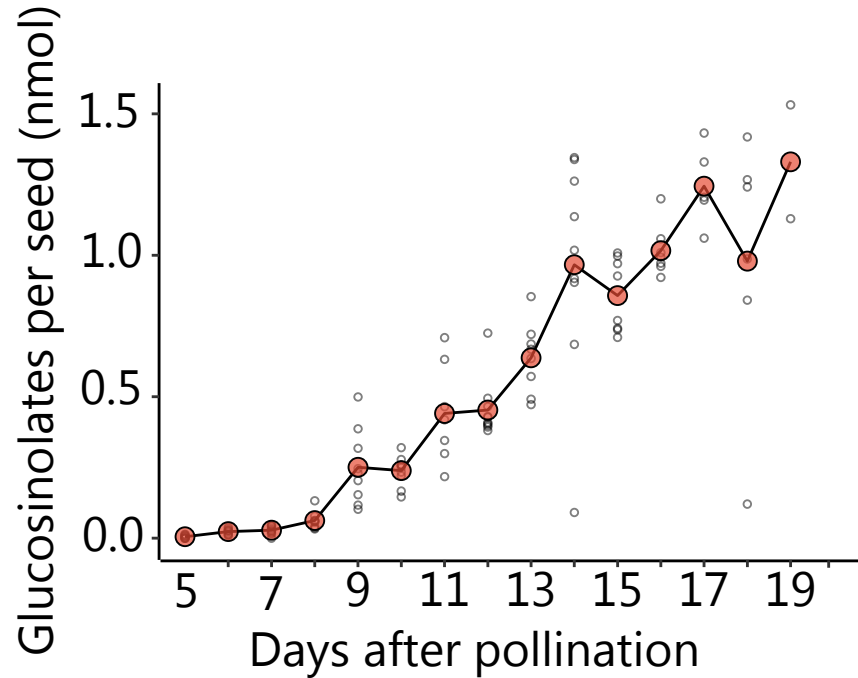


WT : wildtype



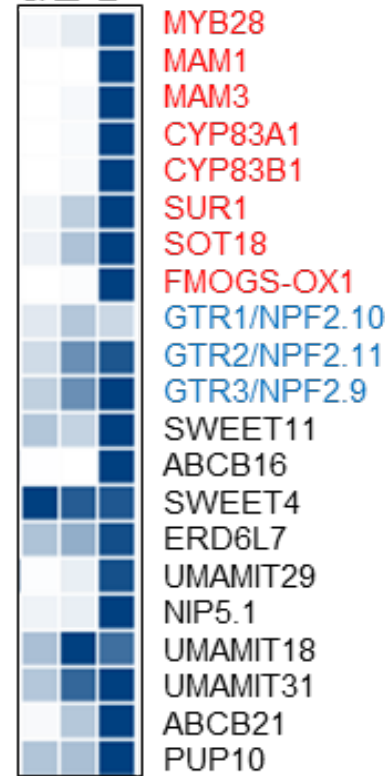
Xu et al. (2023) Nature

When does accumulation of glucosinolates in seeds begin?



Funiculus Transcriptomics Atlas

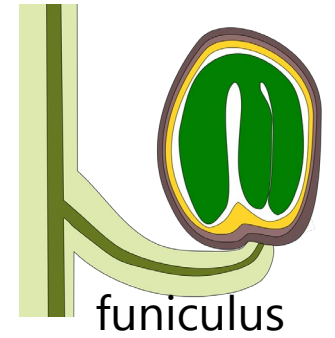
globular
heart
mature green



glucosinolate biosynthetic genes

glucosinolate importers

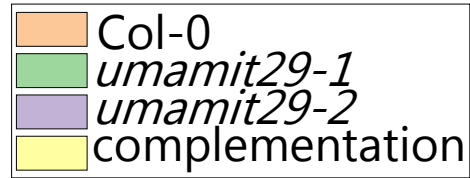
candidate glucosinolate exporters



Khan et al. (2015) Plant J,
Xu et al. (2023) Nature

Screening candidate exporters mutants

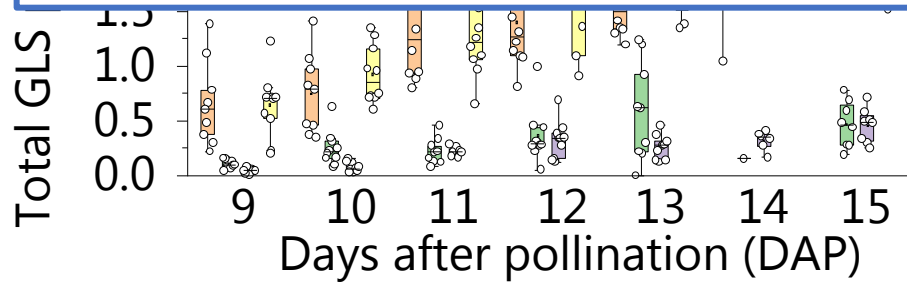
Seed GLS loading in *umamit29* mutant



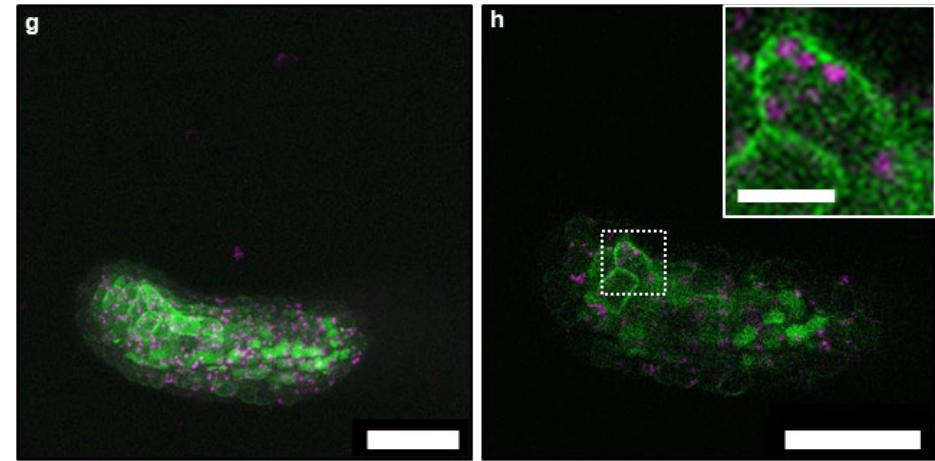
~80% reduction in total seed glucosinolates



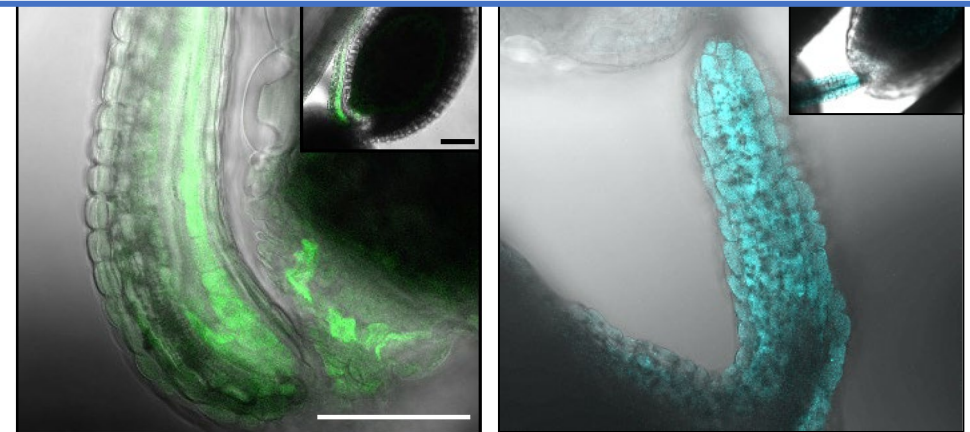
UMAMIT29 is key for seed accumulation



UMAMIT29-mVenus plasma membrane localized



Can UMAMIT29 transport glucosinolates ?



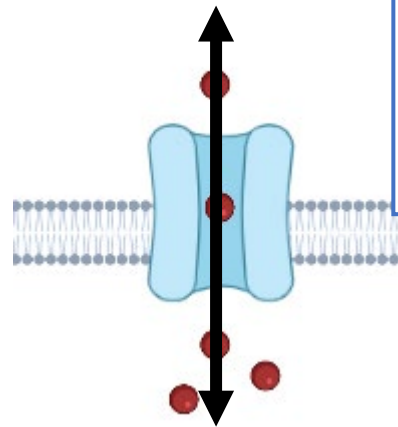
Xu et al. Nature (2023)

Biochemical characterization of UMAMIT29 export activity

UMAMIT = USUALLY MULTIPLE AMINO ACIDS MOVE IN AND OUT TRANSPORTER

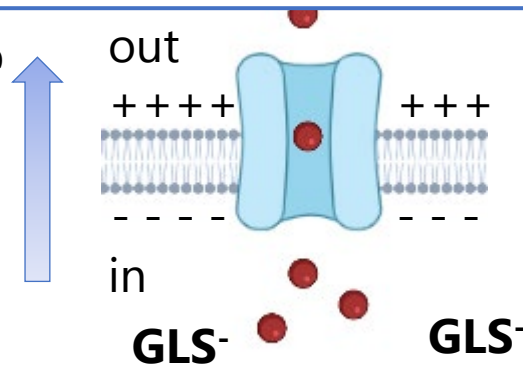
Facilitators are bidirectional and the transport is driven by:

- 1) electrochemical gradient
- 2) membrane potential

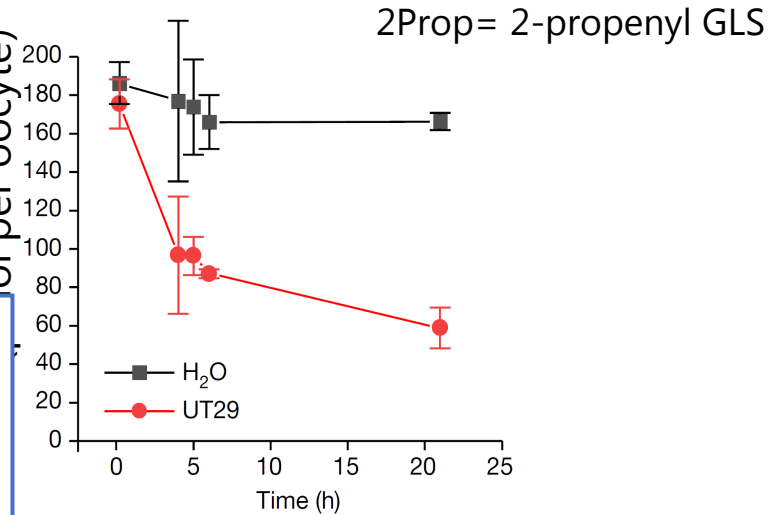


UMAMIT29 can export GLS

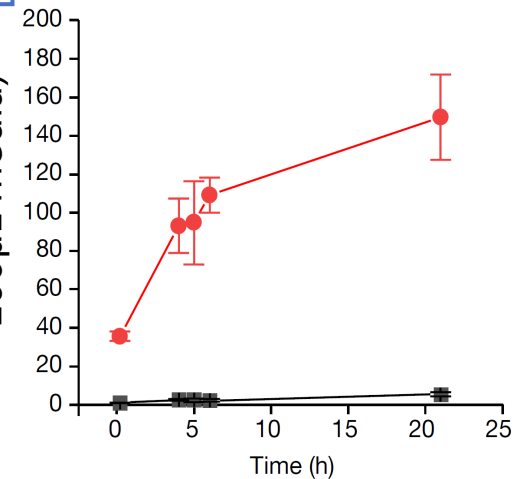
electrochemical gra



lar 2Prop in oocyte

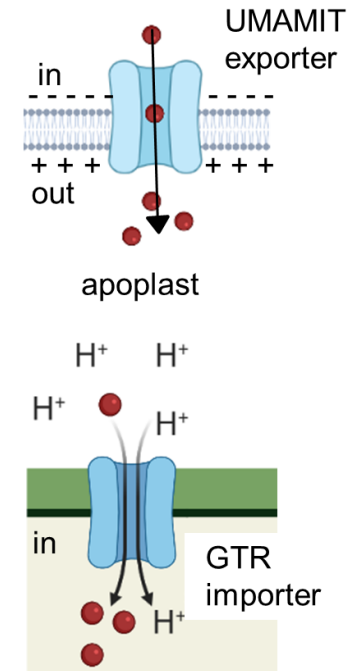
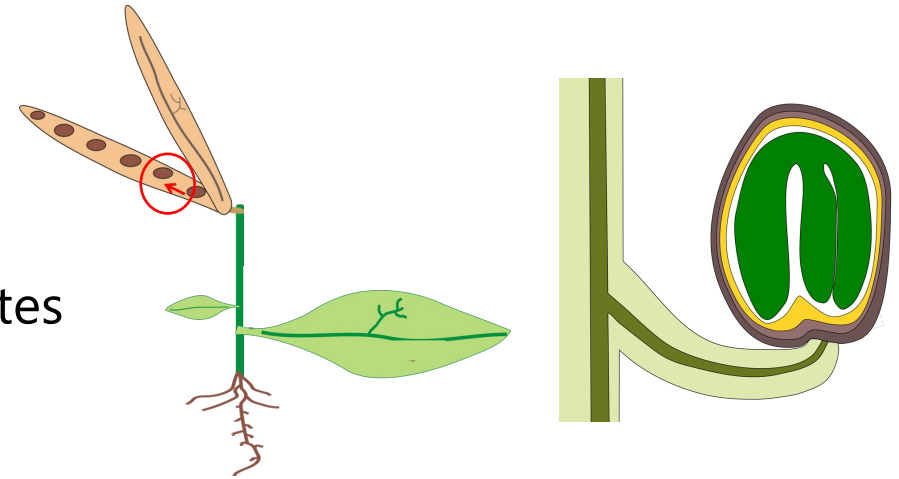


Exported 2Prop in (pmol per oocyte in 100µL media)



Conclusions

- Funiculus is a key hub for synthesis of seed-bound glucosinolates
- Glucosinolate exporters belong to the UMAMIT family
- The *umamit29/30/31* triple mutant has 6% of WT glucosinolate levels in seeds without causing mis-localization in other tissues



Perspective: Future goals in translational and basic research

Translational research: breeding targets in brassicaceous oilseed crops



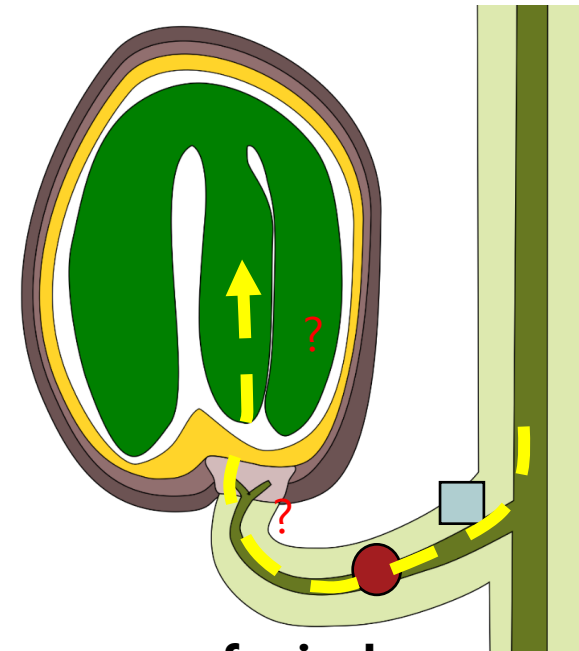
Arabidopsis

Brassica napus

- Pest resistance
- Plant based protein for food



Basic research: molecular tools for dissecting seed loading process



funiculus

● GTR



■ UMAMIT

Acknowledgements



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Export of defensive glucosinolates is key for their accumulation in seeds

[Deyang Xu](#) , [Niels Christian Holm Sanden](#), [Line Lykke Hansen](#), [Zeinu Mussa Belew](#), [Svend Roesen Madsen](#), [Lasse Meyer](#), [Morten Egevang Jørgensen](#), [Pascal Hunziker](#), [Dorottya Veres](#), [Christoph Crocoll](#), [Alexander Schulz](#), [Hussam Hassan Nour-Eldin](#) & [Barbara Ann Halkier](#) 

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