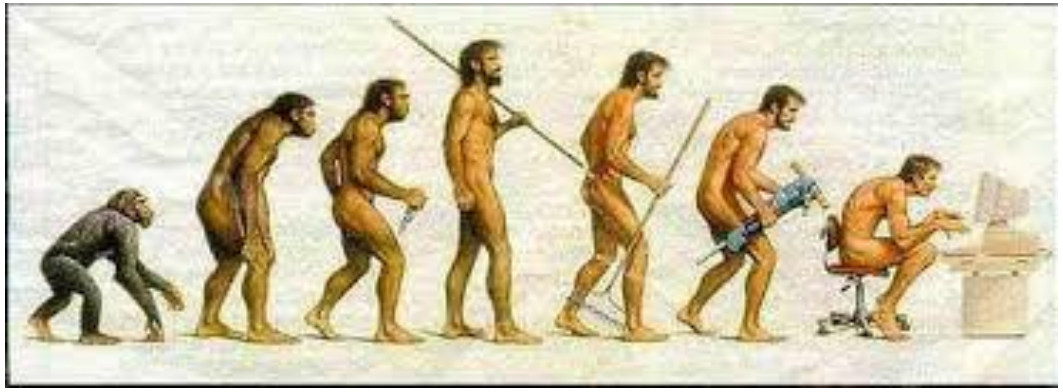
Polar proteins guide development in leaves and roots

Patricio Pérez-Henríquez
Jaimie Van Norman Lab
Zhenbiao Yang Lab (retired)

Early Career Scientist Symposium
June 18th, 2024

Development and polarity

Development; change over time

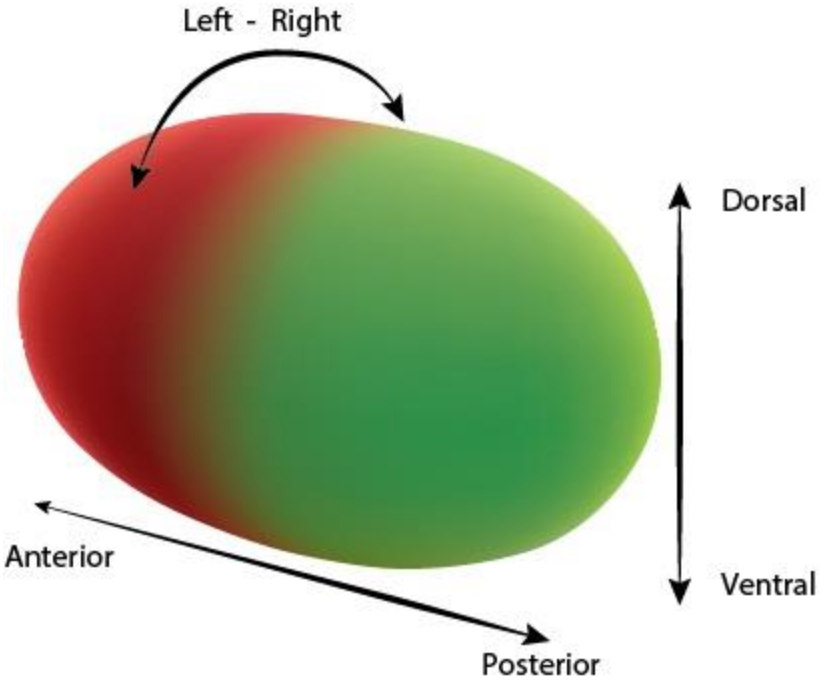


Polarity; opposing positions

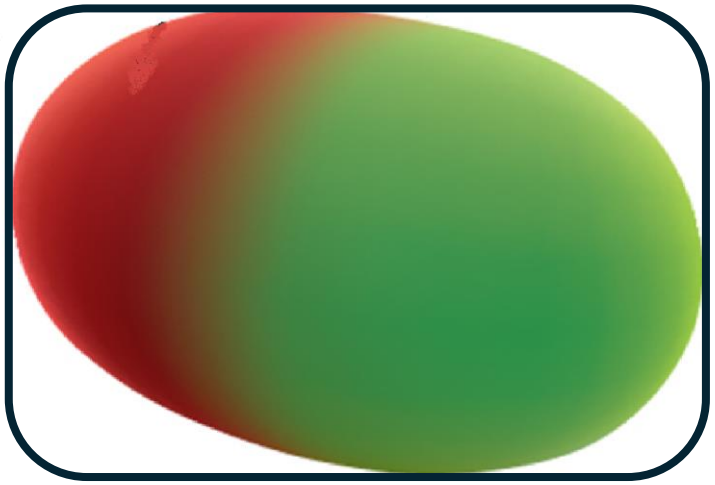
Development and polarity

Plant Development; change over time

Cell Polarity; opposing positions



Protein cell polarity



What is green and what is red?

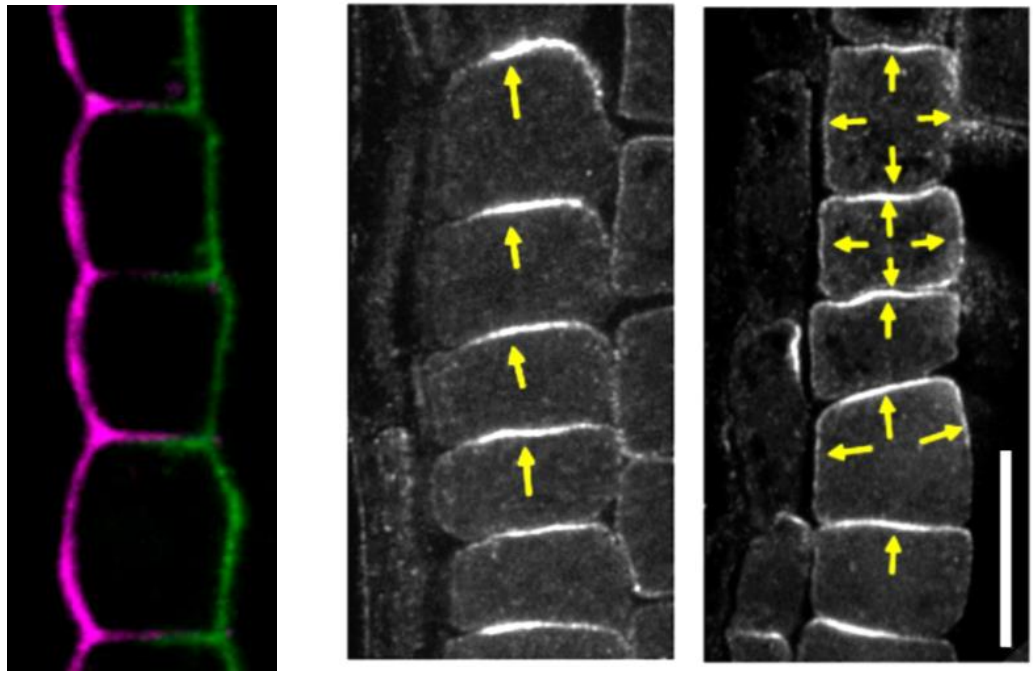
- Lipids
- Small molecules,
- Soluble proteins
- etc

....

- Membrane proteins

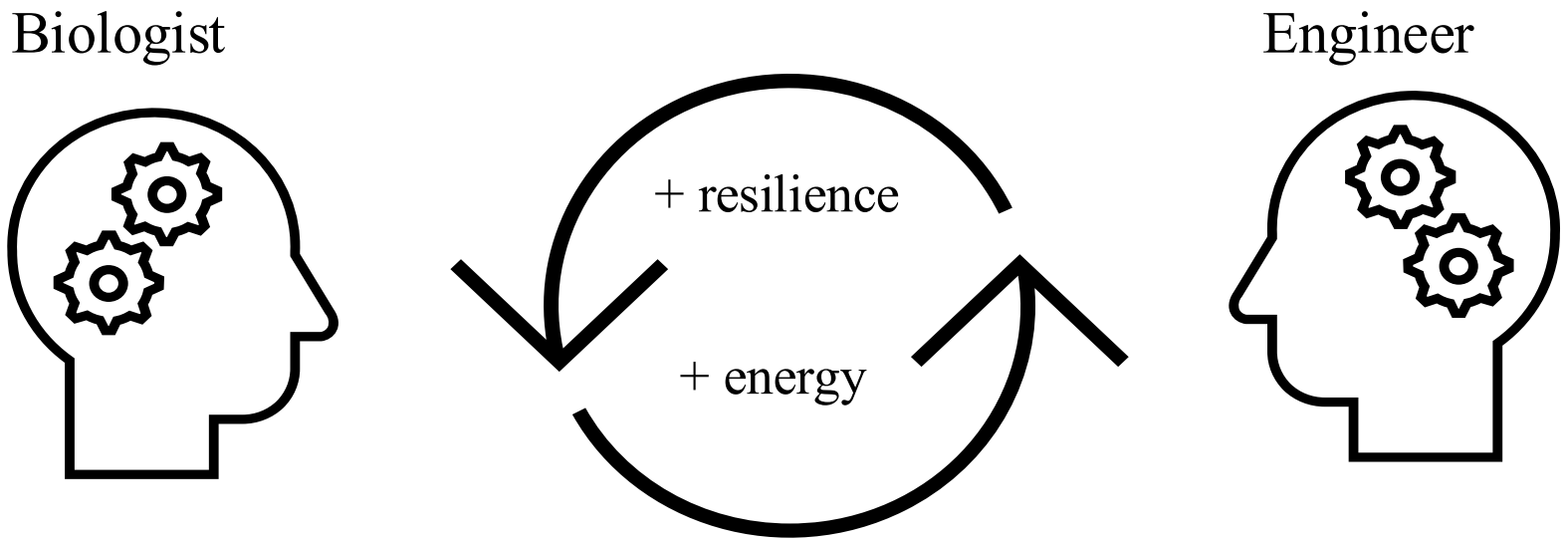
Protein of Interest
tagged with a Fluorescent Protein
[PIN-GFP]

normal | normal | altered



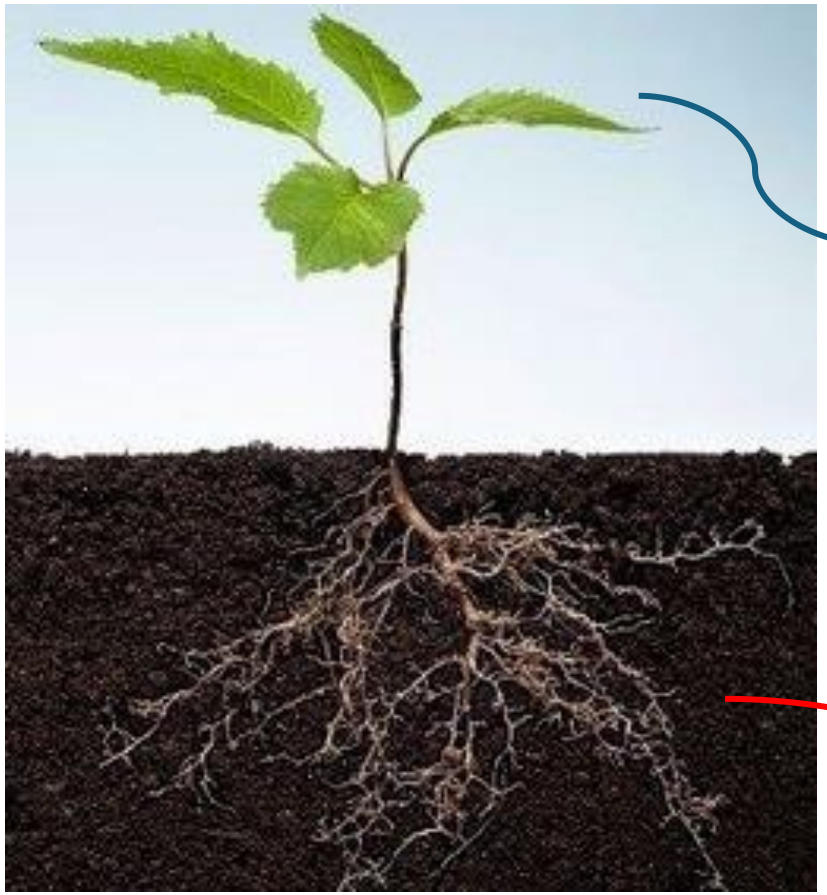
Rodriguez-Furlan *et al* 2022, Nature Comm
Tanaka *et al* 2013, Plos Genetics

Plant development;
The best inspiration for engineering?



Graphical summary of my dream as a researcher

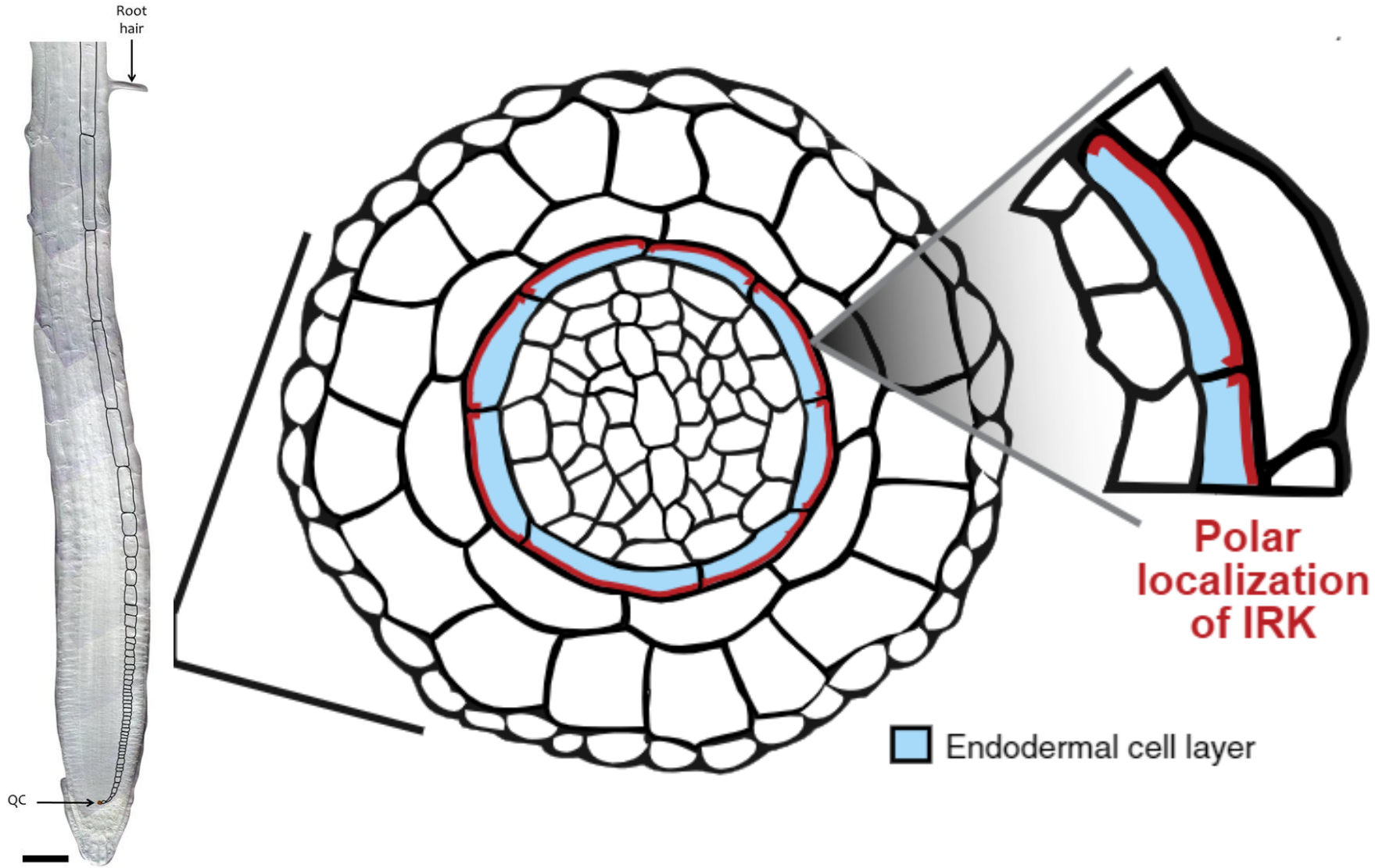
Plant development;
Achieving the perfect structure for the job



b. flat, perfect to harvest light

a. cylindrical, perfect to explore the soil

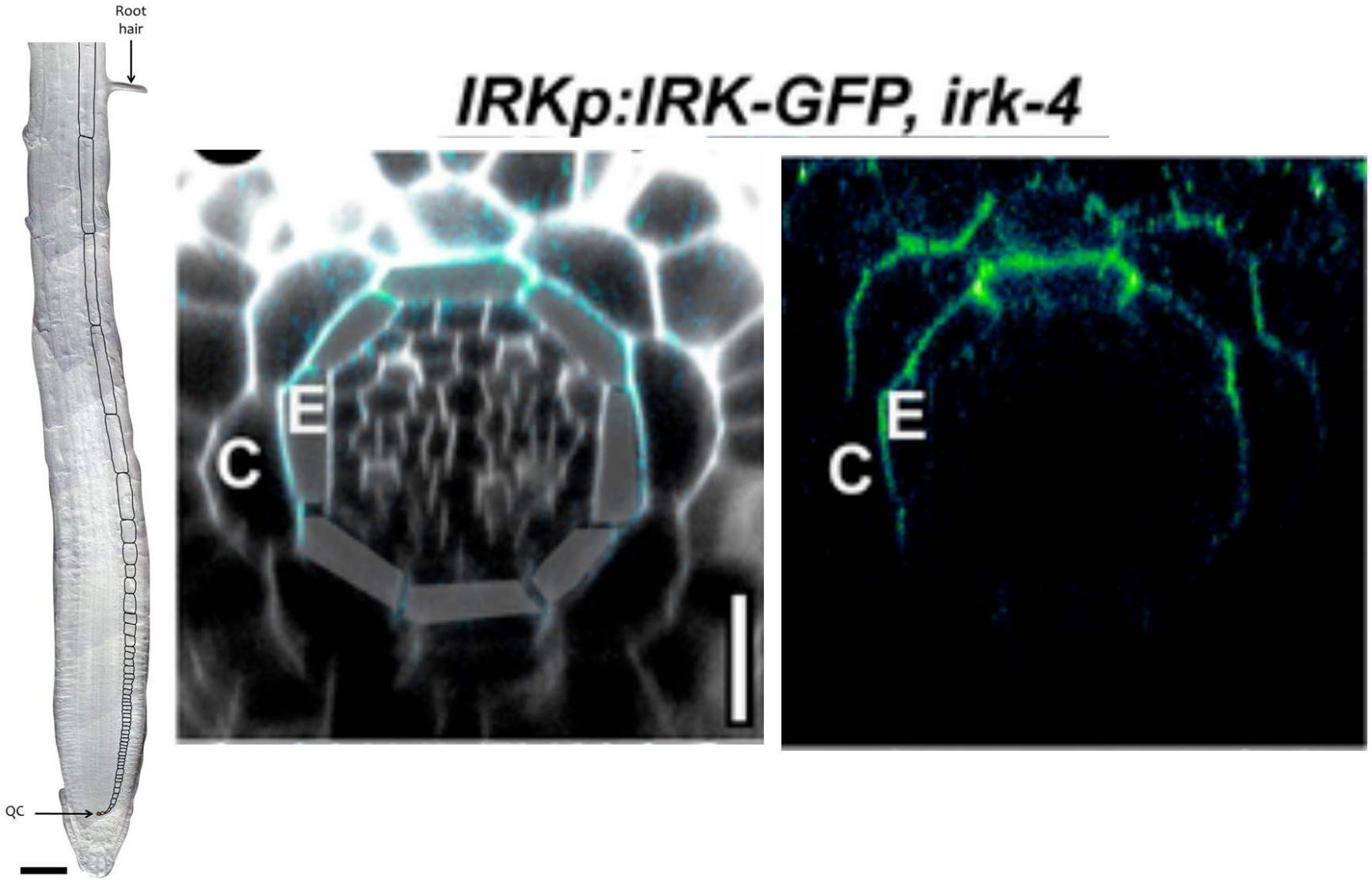
IRK, a polar protein in root



Campos *et al* 2020, Dev Cell

Rodriguez-Furlan *et al* 2022, Nat Comm

IRK, a polar protein in root



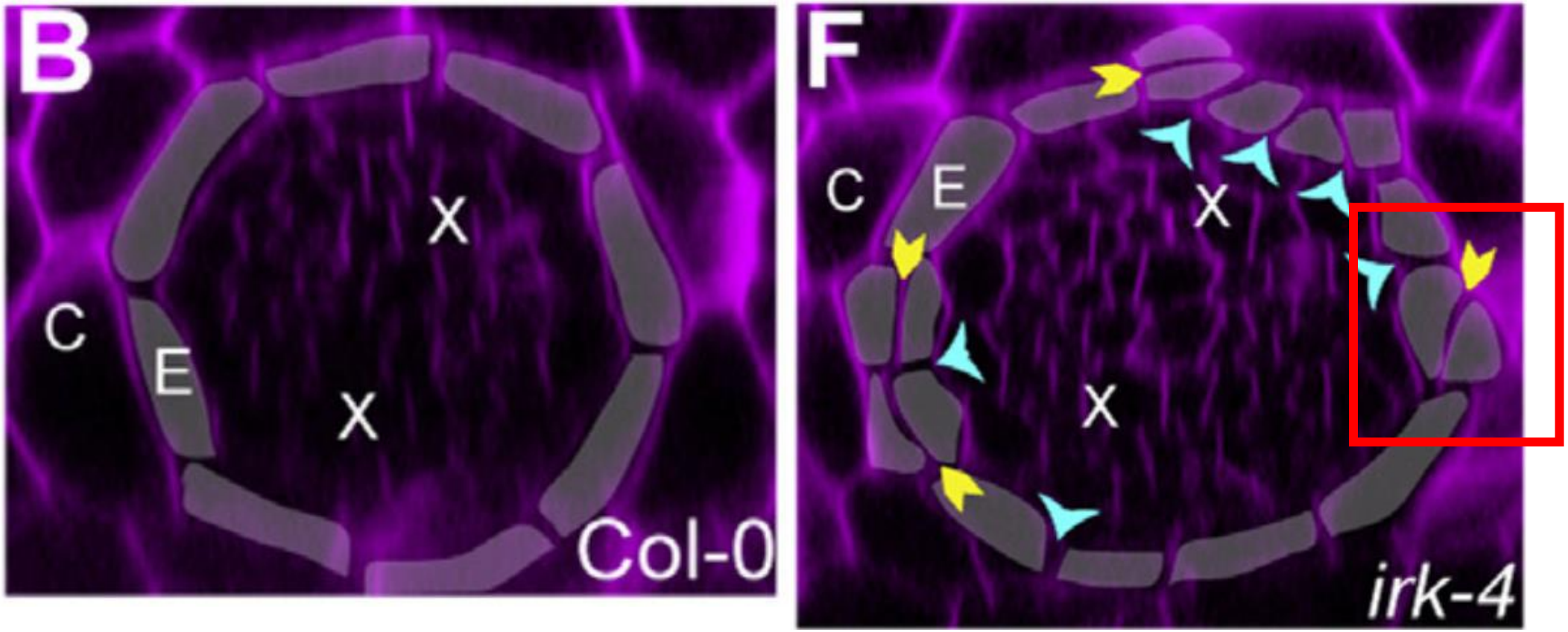
Campos *et al* 2020, Dev Cell

Rodriguez-Furlan *et al* 2022, Nat Comm

IRK is required to control root diameter

Control

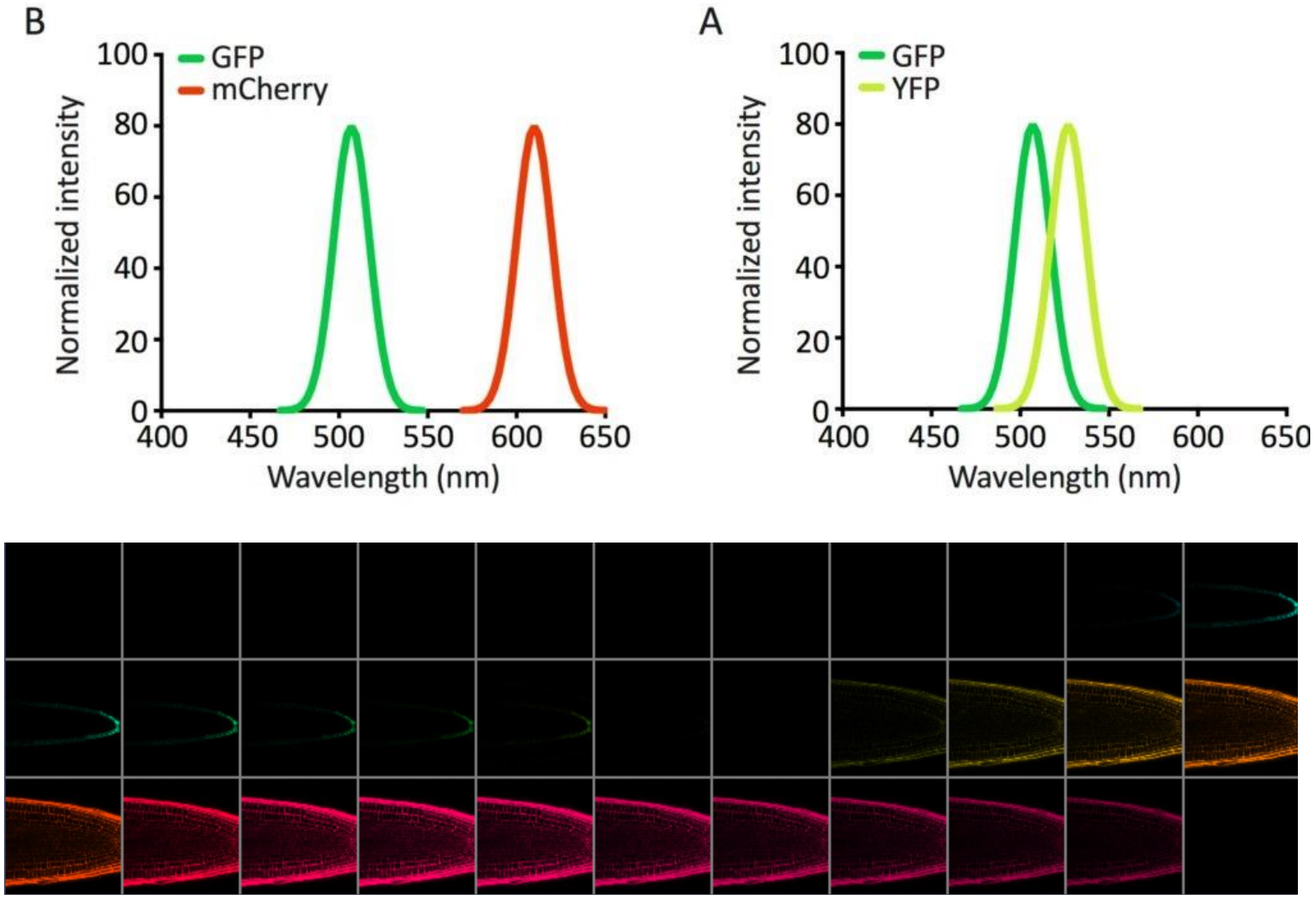
irk



- thicker vasculature

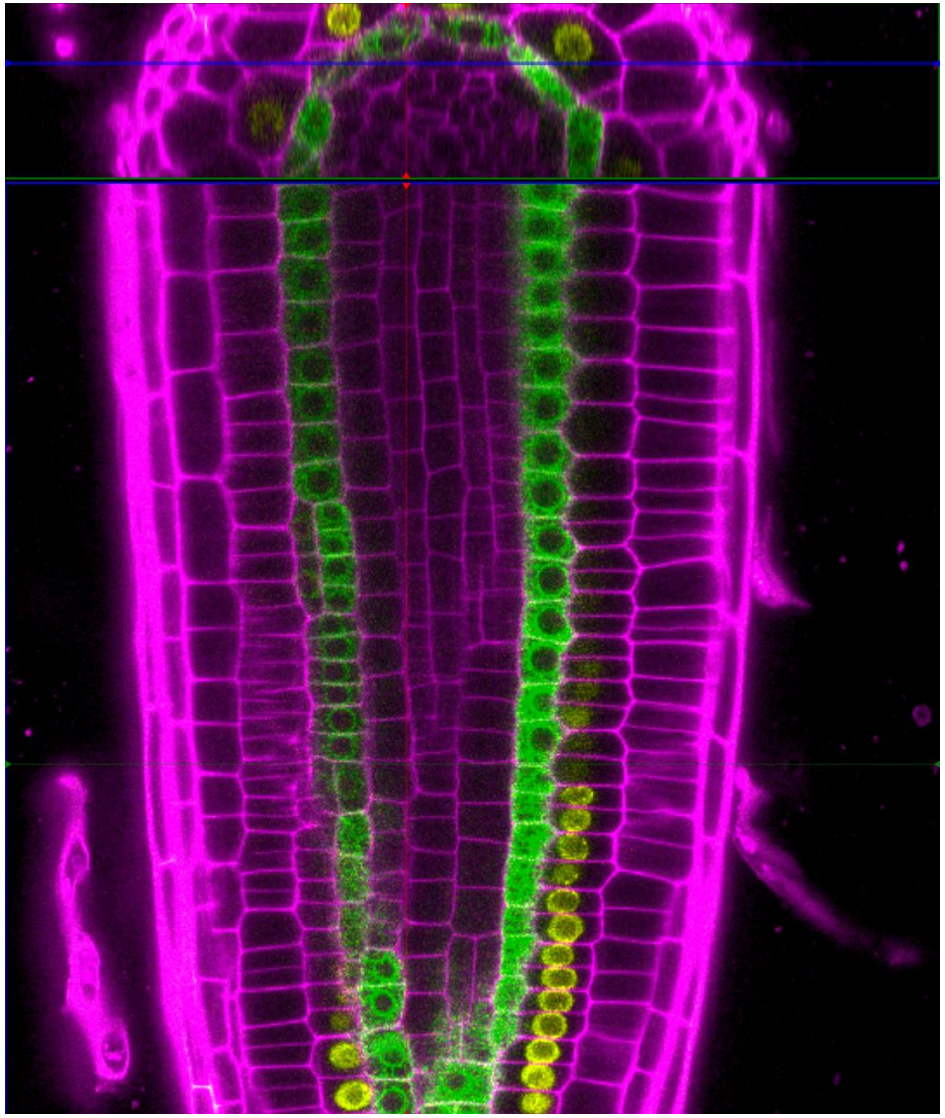
Campos *et al* 2020, Dev Cell

Spectral imaging to separate overlapping spectra

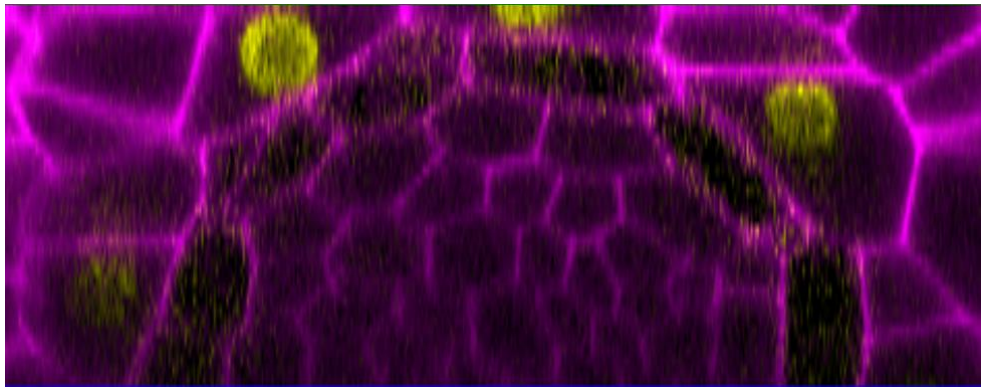


Rony *et al* 2024, in revision

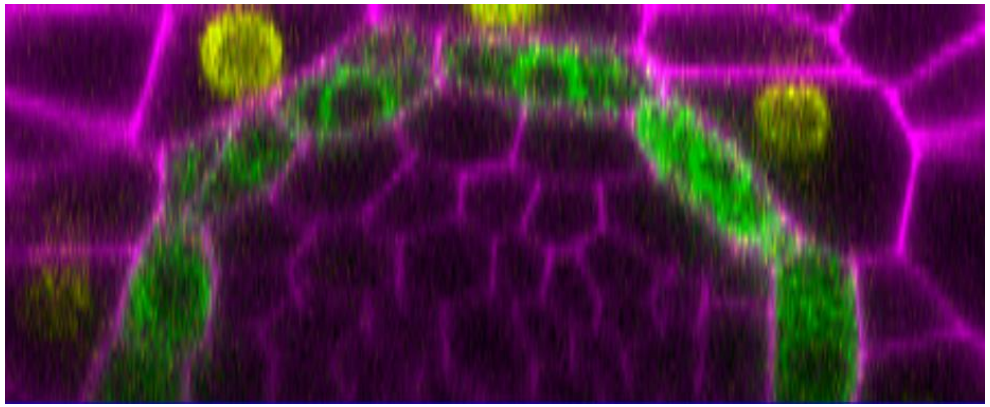
Spectral imaging to separate overlapping spectra



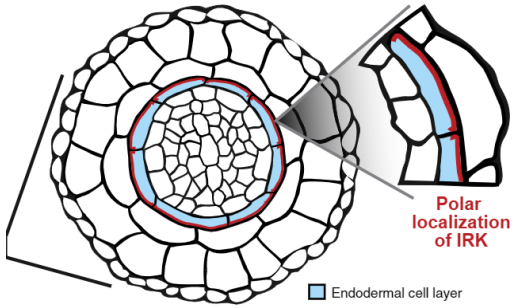
YFP only



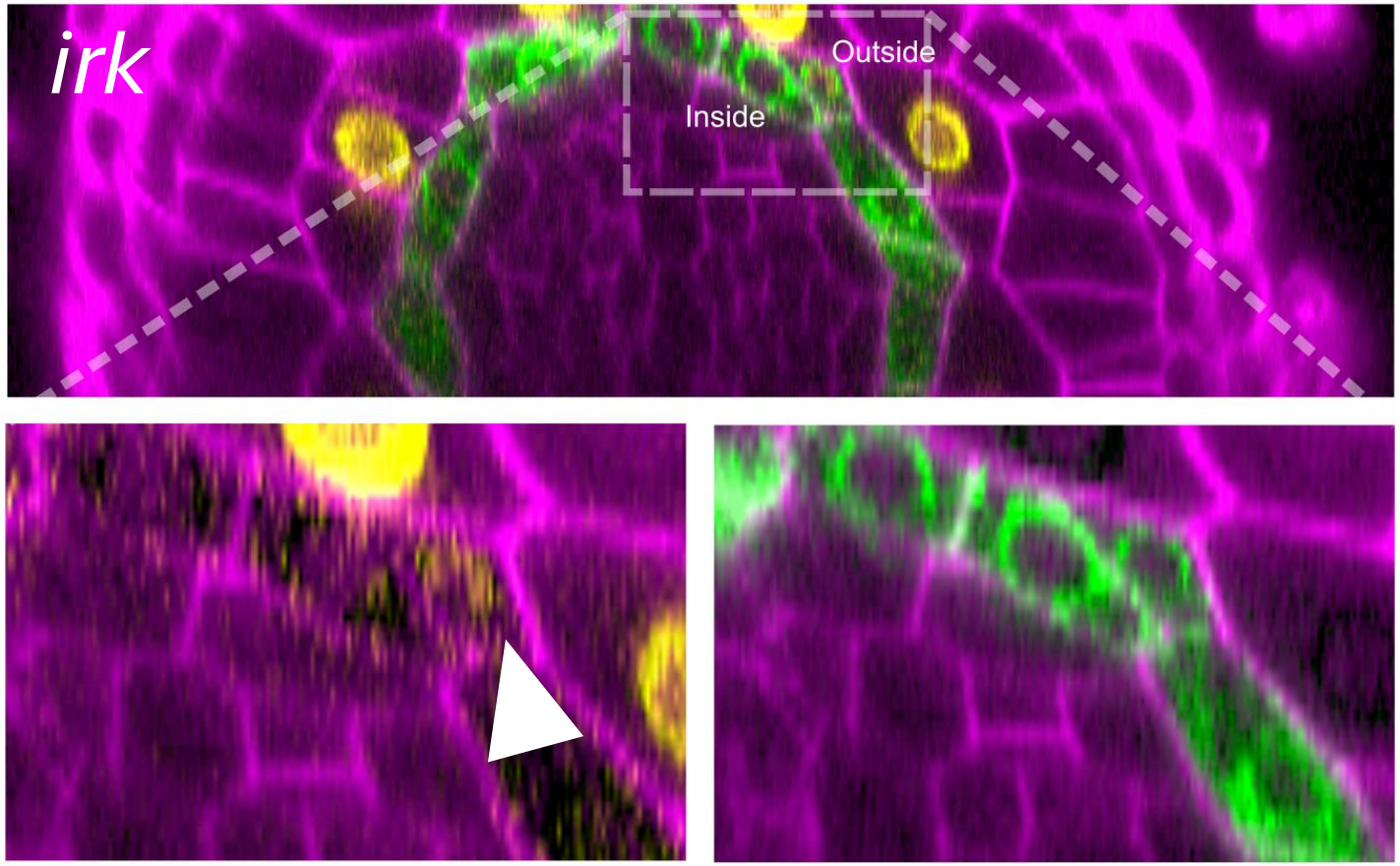
GFP and YFP

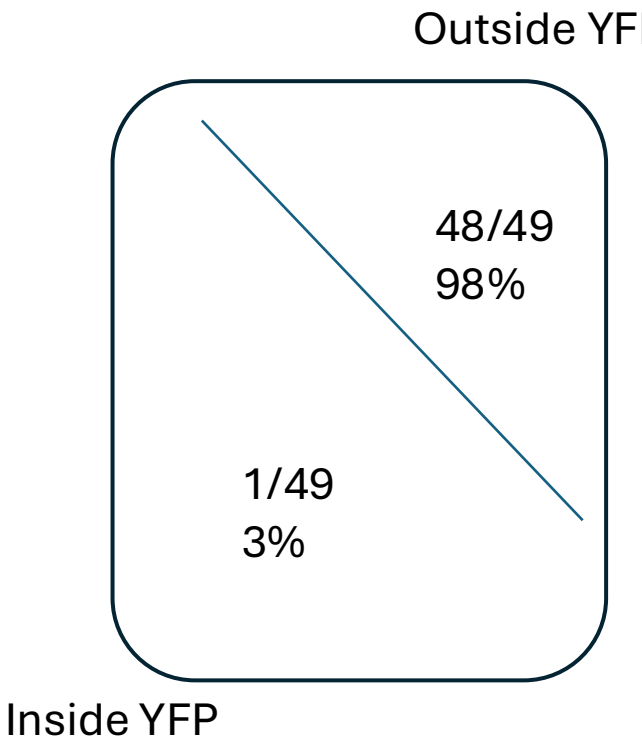


Rony *et al* 2024, in revision



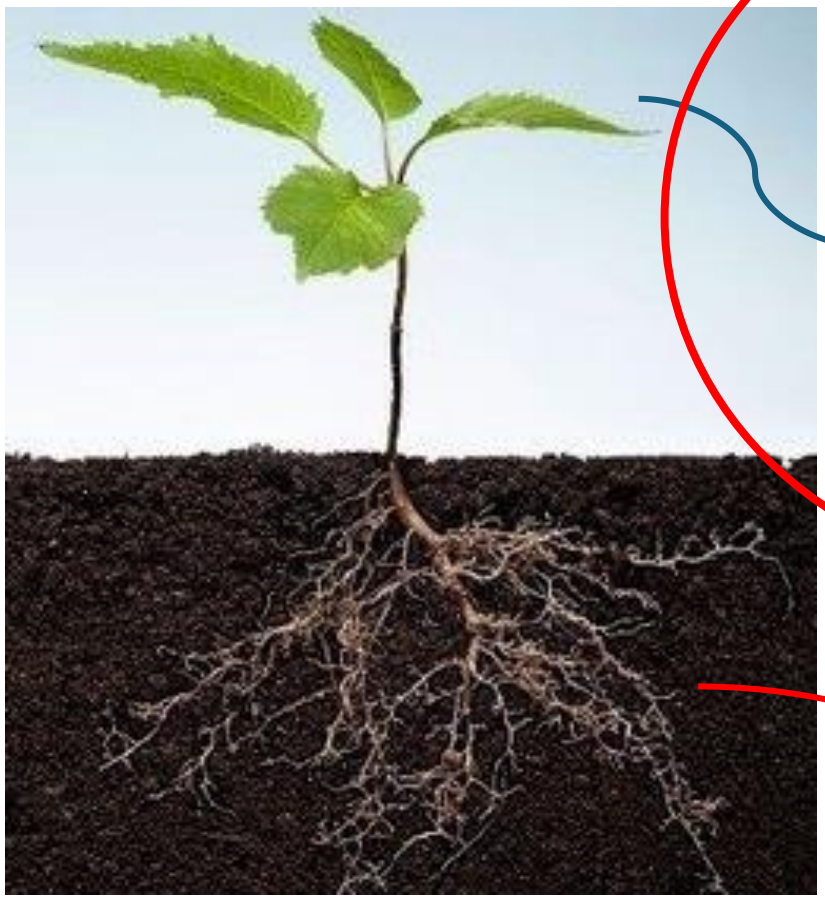
Creating new outer layers





Rony *et al* 2024, in revision

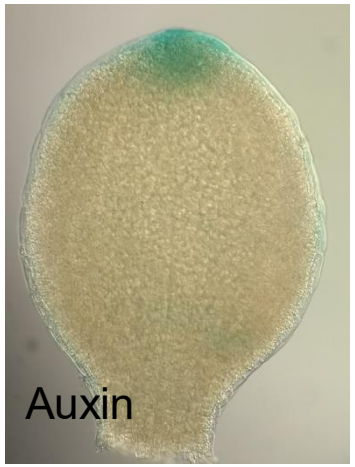
Plant development;
Achieving the perfect structure for the job

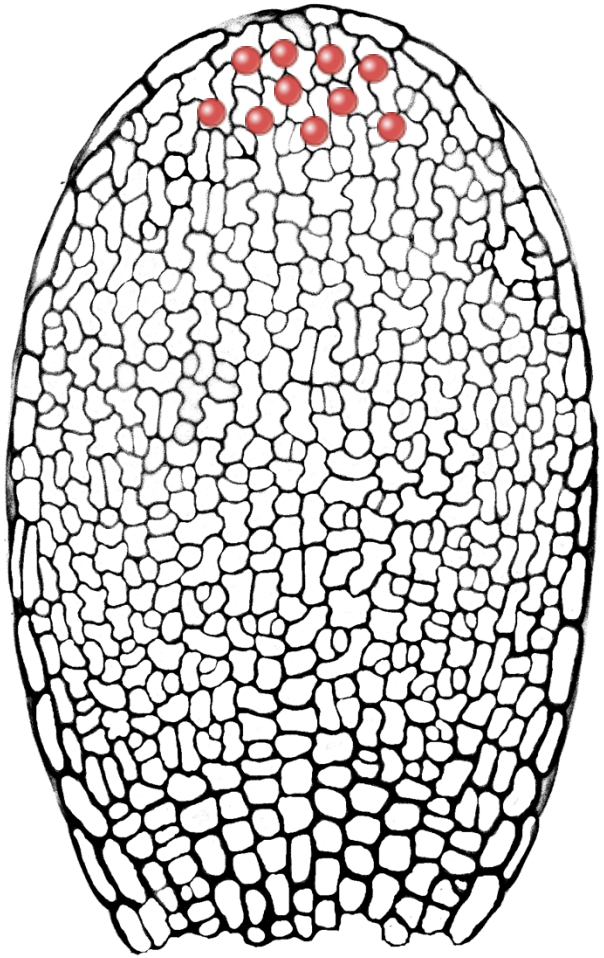


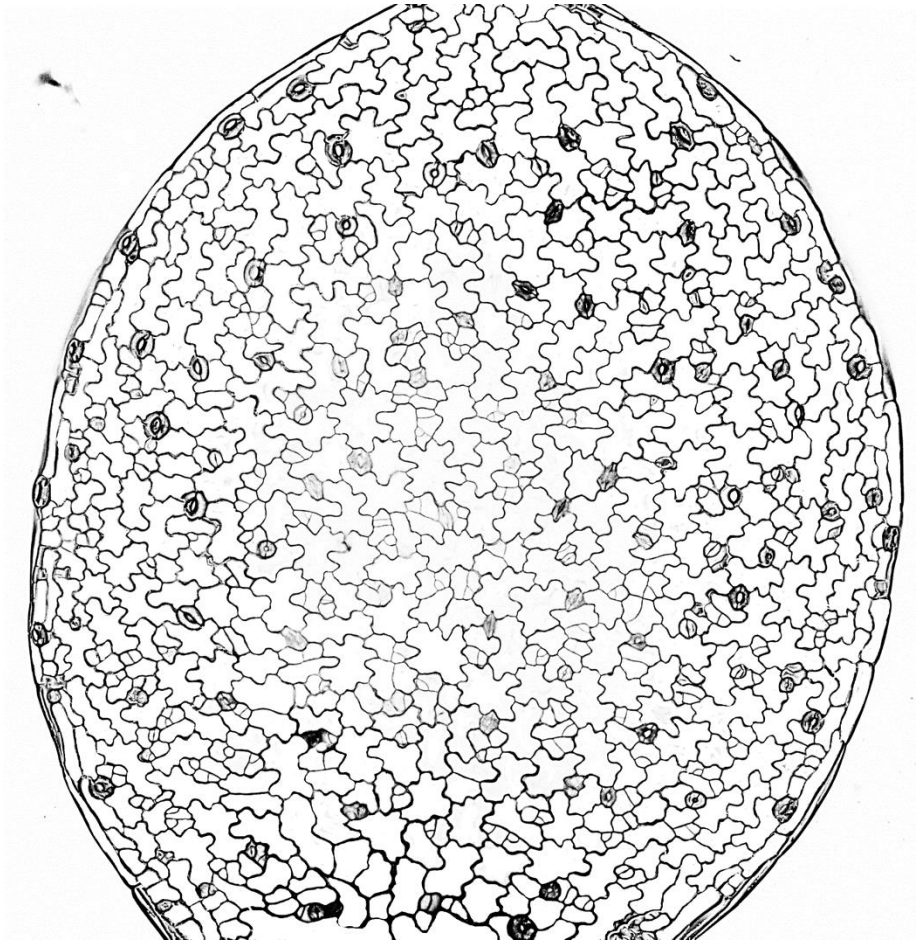
b. flat, perfect to harvest light

a. cylindrical, perfect to explore the soil

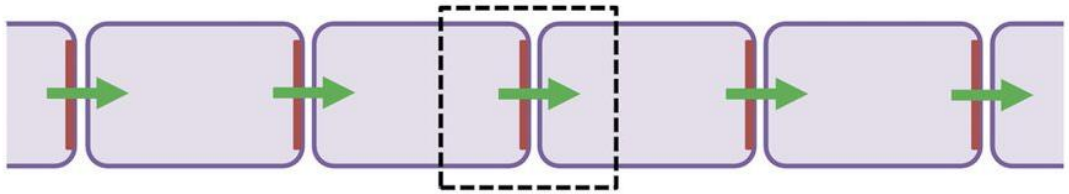
Crafting a flat leaf is guided by hormones (auxin)





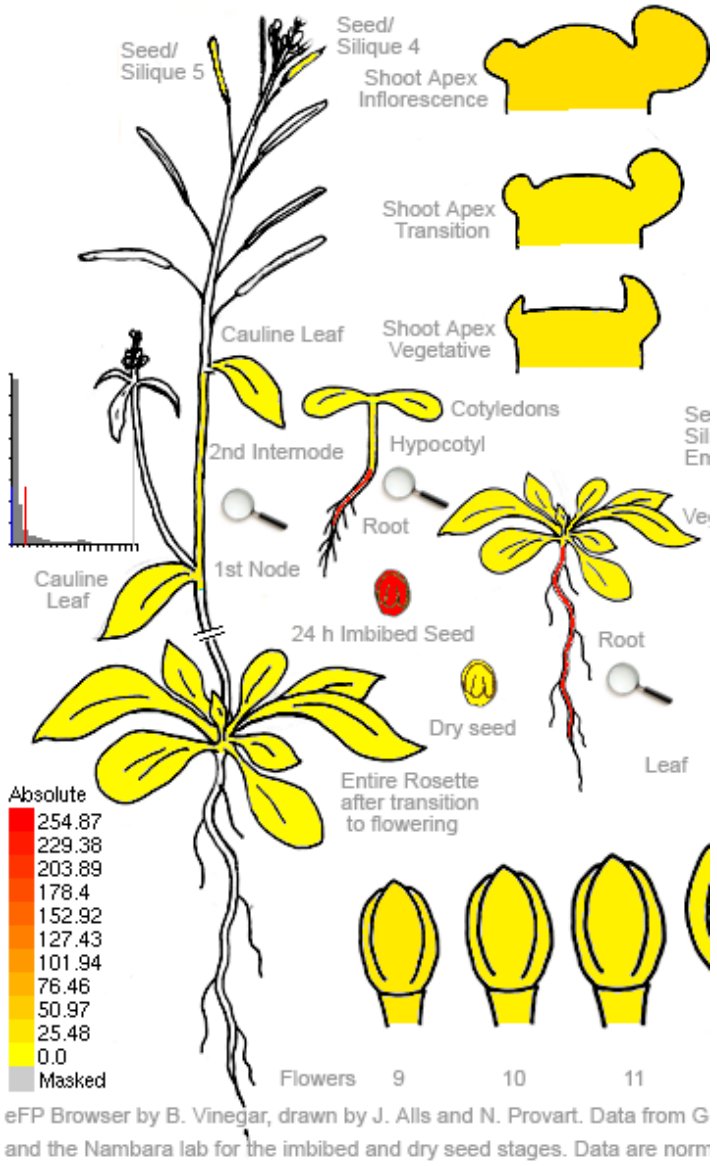


Auxin moves assisted by polar proteins



Adamowski and Friml 2015. The Plant Cell

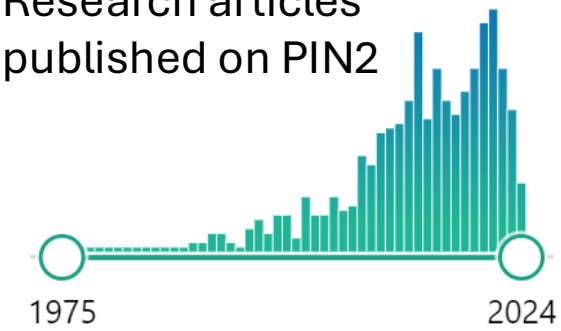
PIN2 247947_at AGR



eFP Browser by B. Vinegar, drawn by J. Alls and N. Provart. Data from G
and the Nambara lab for the imbibed and dry seed stages. Data are norm

PubMed®

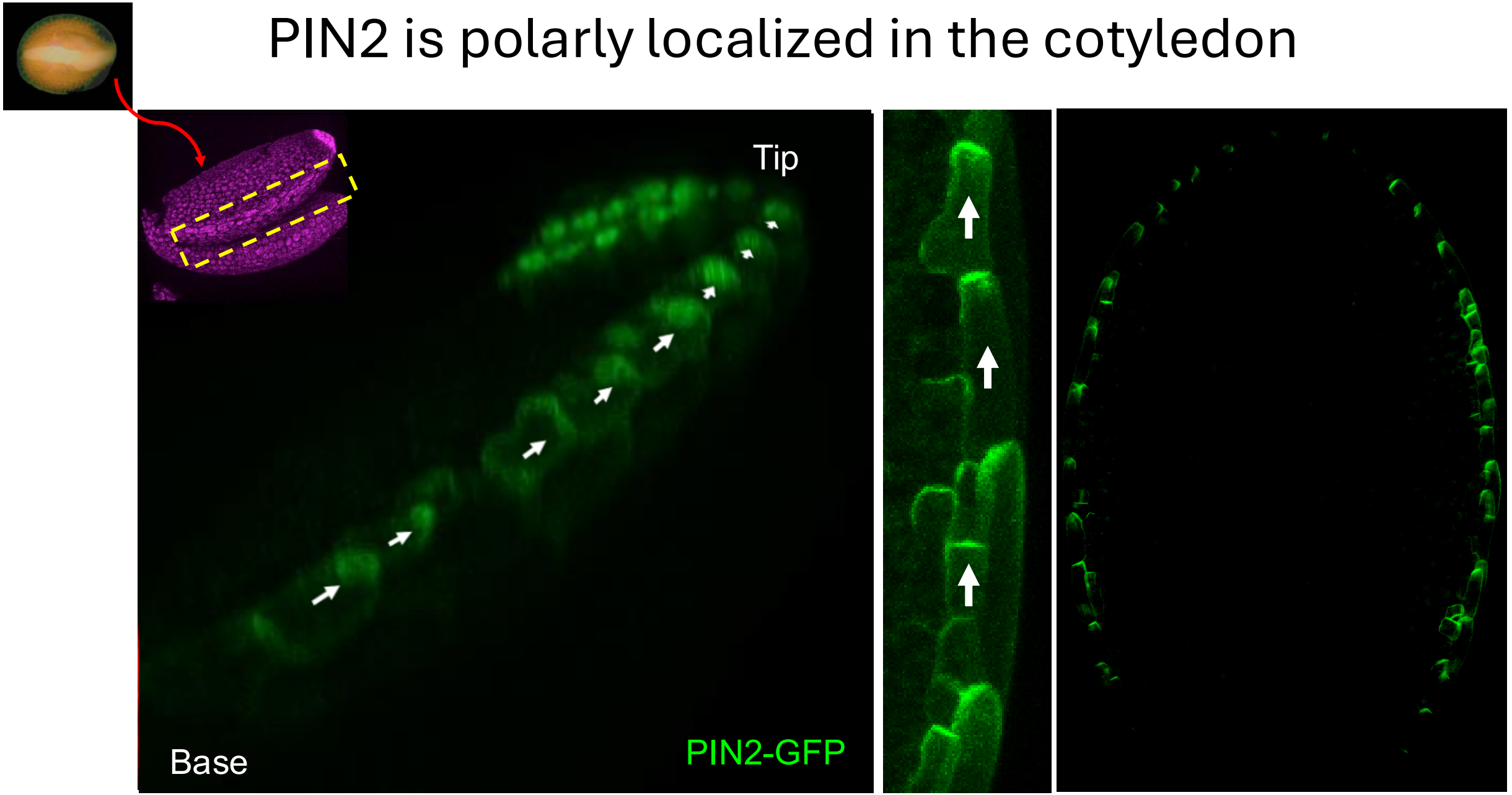
Research articles published on PIN2



Roots; 603

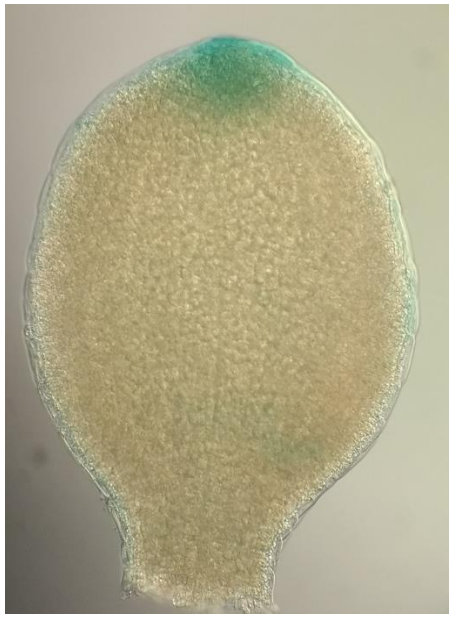
Early seed; 0

PIN2 is polarly localized in the cotyledon



…and required to move auxin and to shape a “flat structure’

control



Auxin

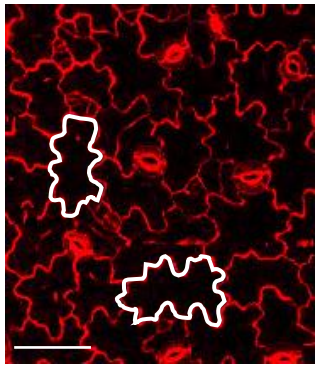
pin2

Lower Auxin

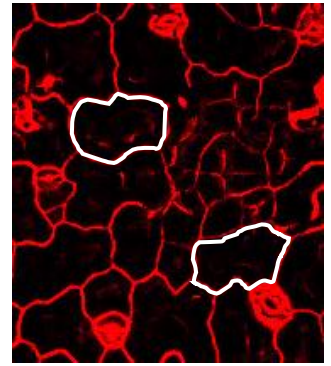
PIN2 activators

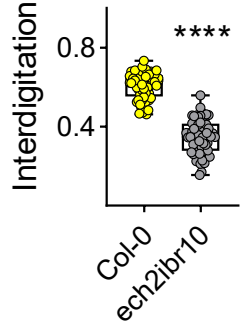
PIN2

Control



activators



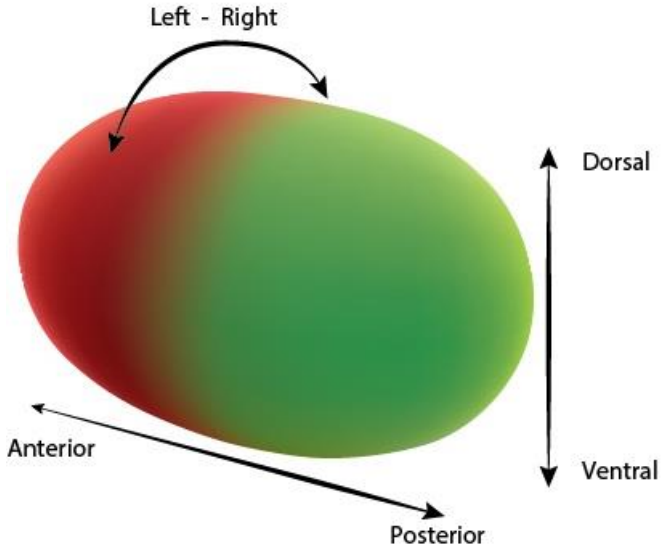


Control

activators

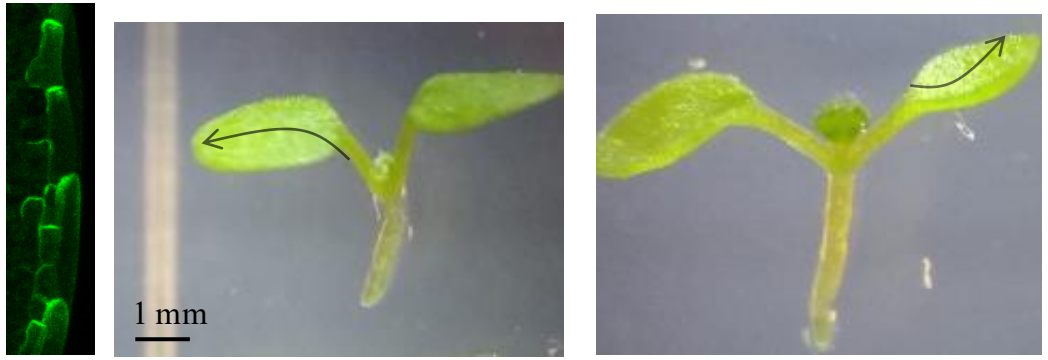
Take home message 1; cell polarity drives plant development

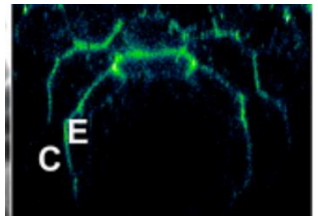
Cell Polarity; opposing positions



Present

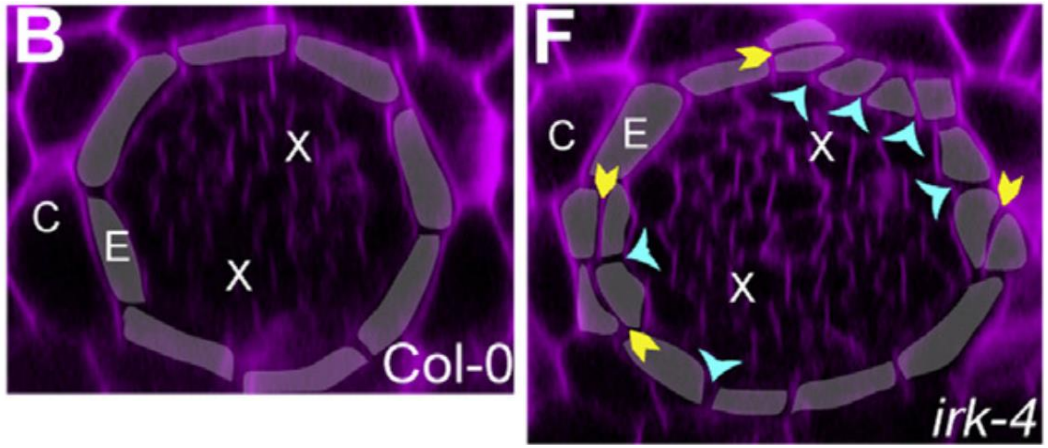
Absence



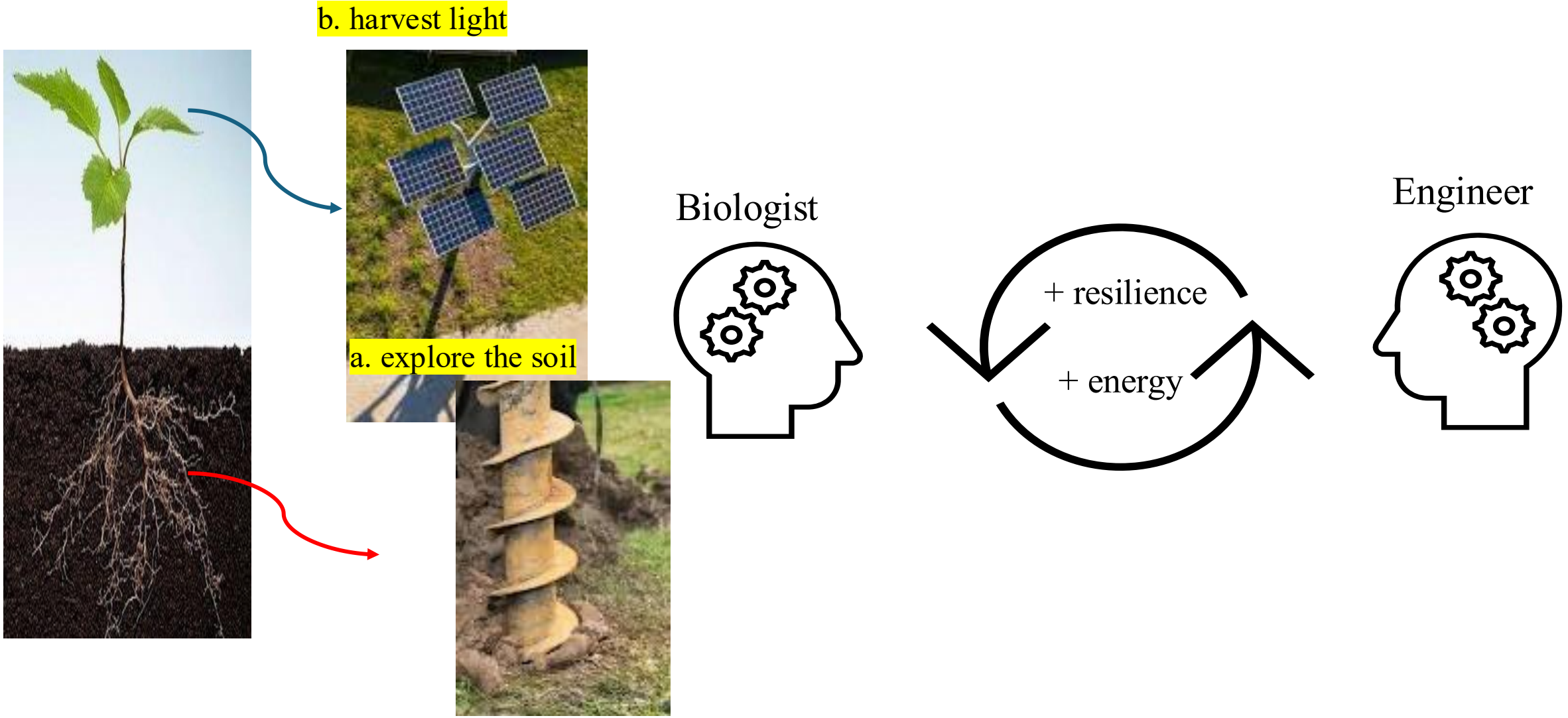


Present

Absence



Take home message 2; plants are perfect for biomimetics



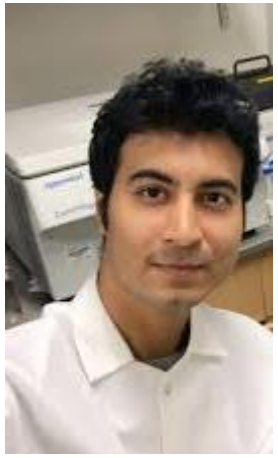
Output, all in revision…

Radial askew endodermal cell divisions reveal IRK functions in division orientation
R. M. Imtiaz Karim Rony, Roya Campos, **Patricio Pérez-Henríquez**, Jaimie M. Van Norman
in revision at *Plant Physiology*

Hierarchical global and local auxin signals coordinate cellular interdigitation in *Arabidopsis*
Patricio Pérez-Henríquez[1,2], Hongjiang Li[1,5], Xiang Zhou[3,4], Xue Pan[6], Wenwei Lin[2], Wenxin Tang[2]， Shingo Nagawa[2], Deshu Lin[2], Tongda Xu[2], Marta Michniewicz[7], Michael J. Prigge[8], Lucia C. Strader[7], Mark Estelle[8], Ken-ichiro Hayashi[9], Jiří Friml[5], Linlin Qi[3], Zhongchi Liu[3,], Jaimie Van Norman[2], Zhenbiao Yang[3]
in revision at *Cell*

PIN2-mediated self-organizing transient auxin flow contributes to auxin maxima at the tip of Arabidopsis cotyledons
Patricio Pérez-Henríquez[1,2], Shingo Nagawa[2], Zhongchi Liu[3,4], Xue Pan[1,5], Marta Michniewicz[6], Wenxin Tang[2], Carolyn Rasmussen[1], Jaimie Van Norman[1], Lucia Strader[6], Zhenbiao Yang[1,2,3,4] *
in revision at *Nature Communications*

… all in bioRxiv by the end of this week


Acknowledgements

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Xiang Zhou
Christian Craddock
Wenxin Tang

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Ken-Ichiro Hayashi, Okayama U

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FAFU-UCR HBMC

NSF

NIH

Thanks for your time!