Cytoskeletal Organisation in Plant Cells Under Geometry Control

What is Cytoskeleton?

Some polymers in a plant cell.

Including microtubules, and actin.

Idea: Confine plant cells without walls to various geometries,

The cytoskeleton aligns with long axis in rect. well,

What do we Know?

- Simulations say some geometry-based rule describes MT organisation
- Not tested in real life yet.

What does paper show?

- Cytoskeleton aligns with long axis
- Actin organisation depends on MT, but not vice-versa.
- Model of self-organising MTs in 3D.

In plant cell MTs on outside determine shape, by guiding synthesis of cellulose.

MTs rigid on cell dims (persistence length on order of mms)

Study used "microwell" approach:

Confine cells to tiny wells of diff geo.

Steps of experiment:

- Cell walls of "Arabidopsis thaliana" callus cells digested
  → protoplasts ← plant cell – cell wall
- Protoplasts put in microwells.

Shapes used: ○, □, △, ▭

Avg orientation of MTs unbiased by circle / square / triangle well

But MT network more anisotropic for any confinement than in free spherical protoplast.

In ▭ the avg orientation aligns with long-axis.

3D Model:

- Each MT is growing/shrinking line segment.
- MTs interact with other MTs + cell membrane.
- Paper added "crossover severing" interaction.

By adding this, the simulation does not have MTs aligning with diag. in □ (as happens in experiment)