Модели дифференцировки камбиальных клеток

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Model of Tree-Ring Formation ("TreeRing 2000")

Shashkin A.V., Sukachev Institute of Forest SB RAS, Krasnoyarsk, Russia
Fritts H.C., Hemming D. Lab. Tree Ring Research, UA, Arizona, USA
Cell Division
Cell Enlargement
Cell Maturation

External

- Light flux
- Day length
- Day and night temperature
- Rainfall
- Relative Humidity
- Vapour pressure deficit

Internal

- Water potential
- Photosynthate
- Growth regulators
- Nutrients

Day temperature
Night temperature

Day and night temperature
Rainfall
Relative Humidity
Vapour pressure deficit

Light flux
Photosynthate
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Nutrients

External

Light flux
Photosynthate
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Internal

Water potential

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Cell Division
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Cell Maturation

B
A
R
K

Cambial zone
(2-10 weeks ???)
When rate drops to threshold ($V_{\text{min}}$), ability to divide is lost.
When the rate reaches $V_{\text{critical}}$, cambium becomes dormant.
Growth rate ($V_c$) increases with increasing distance from initial.
Daily variation in cell growth determined by interaction between potential cell size (e.g., 60 vs 30 microns) and growth rate

- \( V_e = b_{46} (d_{pot_j} - d_j(0)) \exp(-b_{46} \tau) F_e(s_s, T, W) (1 + (b_{51} - 1) C_r) / b_{51} \)
- \( d_{pot_j} = d_{max} - (d_{max} - d_{min}) \exp(-b_{44}(y - b_{45})) \)

Cell enlargement
TreeRing prediction for Palisades, Arizona, 1979

Day of year

Number xylem cells

- Mature
- Wall thickening
- Enlarging
- Dividing cells
CAMBIUM, a process-based model of daily xylem development in Eucalyptus

David M. Drew, Geoffrey M. Downes, Michael Battaglia

CSIRO Sustainable Ecosystems, Australia
Monash University, School of Biological Sciences, Australia Research Centre for Forestry, Australia
- the cell must be within a critical auxin concentration range;
- the cell must reach a particular minimum size, specified as a parameter $R_d \text{ min;}$;
- the minimum and maximum daily temperatures fall within the limits required for mitosis ($T_d \text{ min}$ and $T_d \text{ max}$);
- there must be sufficient allocated carbohydrate or stored resources available on day $d$;
- the time since last division must have been sufficient for each initial to synthesize a complete cell plate and duplicate its genetic material.

- The duration of the cell cycle decreases outwards from the cambial initials.
A physiological model of softwood cambial growth

EEMU HOLTTA, HARRI MAKINEN, PEKKA NOJD, ANNIKKI MAKELA and EERO NIKINMAA

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MORPHOGENETIC PROCESSES: APPLICATION TO CAMBIAL GROWTH DYNAMICS

Loic Forest, Jaime San Martin, Fernando Padilla, Fabrice Chassat, Francoise Giroud and Jacques Demongeot
Спасибо за внимание