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Stochastic modelling of development tree and biomass allocation: case of Teak

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In rhythmic growth tree species, the activity of shoot apical meristem shows an active period of phytomer production followed of a rest period. The number of organs produced varies with the annual seasonality and among the individuals of a population measured at a given time. Teak architecture is compound of 4 categories of axis, each corresponding to one physiological age of the meristems. This approach has been integrated in functional-structural tree model, GreenLab, based on the source –sink relationships at organ level. The originality of the presented research is the integration of the dynamics of tree development in the biomass production modeling over the time. The analyzed teaks have from one-year-old to seven-year-old. The stochastic aspect of phytomer production, resulting from meristem activity is based on the Bernoulli process. Light interception, biomass production and biomass partitioning among competing organs, including secondary growth, is performed according to the GreenLab model hypothesis. The annual growth pattern included the processes of shoot polycyclism and pre- and neoformation. Phytomer distributions inside growth units are analyzed according to their physiological and chronological ages. The branching pattern of growth units is detailed by taking account of the branching rate for each type of axillary axis (main branches, long shoot and short shoot. Data assimilation of the measurements is based on organic series which correspond to the organ weights according to their rank from the basis to the top of growth units. Parameter identification of development and growth is done by fitting the observed organic series with the theoretical ones, using the nonlinear least square method. Using the computed parameters and adding geometrical traits, enables the full 3D simulation of young Teak tree architecture including the secondary growth. The integration of the wood density as a parameter of the model is discussed. The using of this model can provide quantitative key insights in order to develop teak ideotypes.