

MIXED MODELS APPLIED IN BOTANY TO ESTIMATE TRUNK AND BRANCH CROWN RATIO

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In multicellular organisms, two opposing theories have been proposed to explain the relationship between a cell and the organism to which it belongs. The cell theory states that the properties of the organism are a mere reflection of the properties of the cells. On the contrary, in the organismal theory, cells constitute an organism and different cell configurations can produce organisms with similar characteristics. Our work tries to extend these ideas to determine if tree characteristics differ in consistent ways from those of stems. We focus on the crown ratio defined as the relationship between the foliage area and the diameter of the supporting structure. Our two main objectives are to determine if the crown ratio differs between trunks and branches and if the crown ratio varies between species. Eleven different species of eudicot trees were studied and a total of 355 trees were measured. All trees have trunk measurements. For some trees, stems located at different levels of the tree were also studied. A clear hierarchical structure exists: trunks and branches are nested within trees and trees are nested within species. A mixed model with a random effect for trees and a fixed effect for species was fitted. To attain normality, the logarithm of the diameter of trunks and branches was calculated as well as the logarithm of the foliage area supported by them. The existence of certain interactions determines if the crown ratio differs between structure type (trunk or branch) and tree species. A variance function was introduced to take into account that different methods were used to measure the foliage area of each structure type.