Dynamical models for plant pattern formation

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In recent years computer models have become increasingly important in providing insights into the developmental process of plants. The study of phyllotactic patterns provides a good example of this. Despite the huge diversity of plant forms there are only a few ways in which plant organs such as leaves, florets, scales, *etc.* are arranged along a plant stem. The prevalence of a small number of phyllotactic patterns is the result of a regularly occurring process in the shoot apical meristem (SAM). Plant organs begin in the SAM as primordia which form in succession with the position of the newest primordia determined by the existing primordia. Processes such as this are well suited to being modeled with discrete dynamical systems.

This poster will present the results of a family of discrete dynamical systems [1,2] based on developmental rules proposed by Hofmeister [3] and the Snows [4]. These developmental rules are compatible [5,6,7] with recent discoveries on auxin efflux transporters in meristematic tissue [8].

These models have been analyzed both mathematically and with computer simulations. We will show that the structure of the bifurcation diagram for the fixed points of these discrete dynamical systems consists of a collection of curves inside the space of spiral lattices. The longest curves correspond to the spiral lattices whose parastichy numbers are consecutive Fibonacci numbers. Other bifurcation curves correspond to spiral lattices whose parastichy numbers are consecutive Lucas. Such patterns have also been observed in plants. We will discuss the role patterns in the early stages of plant development have in selecting which curve of fixed points are exhibited by plants thereby accounting for the prevalence of Fibonacci numbers as well as less commonly observed phyllotactic patterns.

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