

Introduction to Botany. Lecture 14

Alexey Shipunov

Minot State University

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Outline

- 1 Questions and answers
- 2 Morphology of stem and shoot
 - Phyllotaxis
 - Modifications of shoot

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Previous final question: the answer

What is the difference between monopodial and sympodial branching?

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- Degradation of terminal bud (in sympodial)
- Triangle-shaped crown (in monopodial)
et cetera



Morphology of stem and shoot

Phyllotaxis



Spiral phyllotaxis: Fibonacci rule

- Multiple types of leaf spiral leaf arrangement mostly follow **Fibonacci rule**
- Formulas of leaf arrangements is very similar to Fibonacci fractions: $\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{5}$, $\frac{3}{8}$, $\frac{5}{13}$, *et cetera*
- Numerator is number of spiral circulations, denominator is number of leaves in a series (counted from zero)
- Denominator gives the number of **orthostychy** (this is plural)

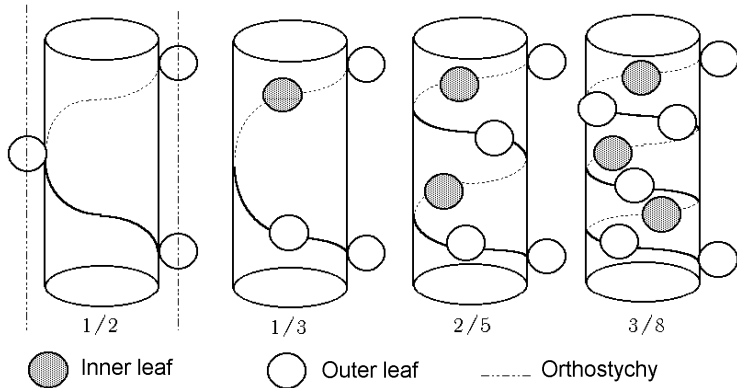


Spiral phyllotaxis: how to make a formula

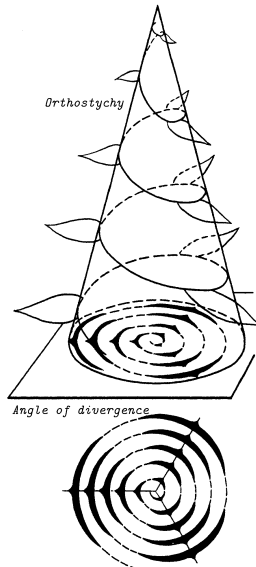
- Take a branch, find any leaf (it will be leaf #0)
- Find the second one which is located in the same position (exactly above or exactly below leaf #0)
- Count how many leaves are in this series (start from 0), this will be a denominator
- Imagine (or use a real thread) a spiral which go from leaf #0 to the last leaf of series, count how many times this spiral circulate the stem—this is a numerator



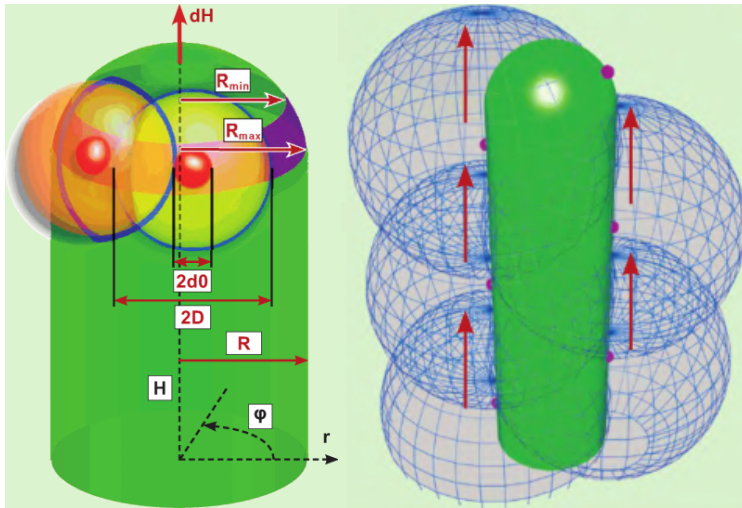
Spiral phyllotaxis: orthostychny



Spiral phyllotaxis: angles of divergence for $1/3$



Phyllotaxis model (from Chub, 2011)



Morphology of stem and shoot

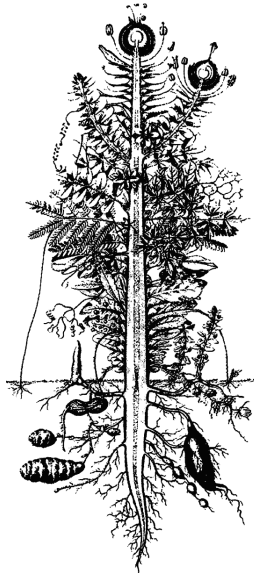
Modifications of shoot

Goethe's theory of modification



Famous German poet and writer Johann Wolfgang Goethe is also a founder of plant morphology. He invented an idea of “primary plant” (“Urpflanze”) where all organs were modifications of one primordial organ.

Urpflanze (another interpretation)



Modifications of shoots and stems

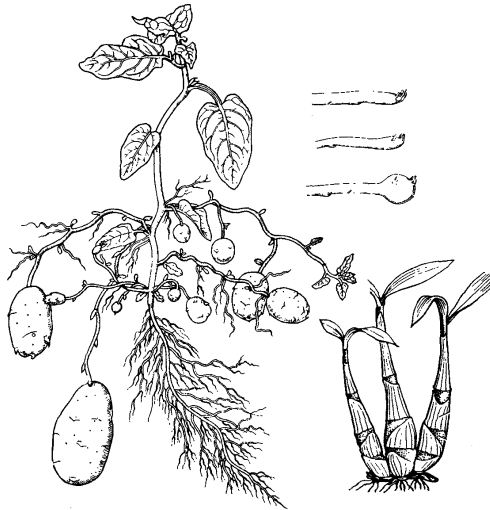
- **Rhizomes**: underground stems
- **Tubers**: enlarged portions of rhizomes
- **Bulbs**: storage shoots, leaves $> 50\%$ of mass
- **Corms**: storage shoots with developed leaves
- **Thorns**: defense shoots
- **Cladophylls**: leaf-like shoots
- **Stolons** (runners): aboveground horizontal shoots
- **Spines**: defensive emergencies of stem surface
- **Stem traps**: catch animals for some carnivorous plants



Bulbs and corms



Tubers



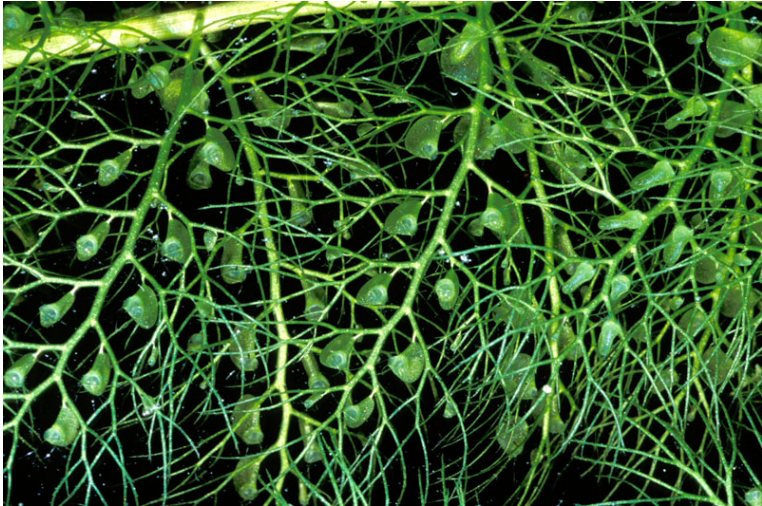
Thorns



Cladophylls



Traps of bladderwort (*Utricularia*)



External function and modifications

<i>Function</i>	Stem	Leaf	FU	Root
Anchoring	Rhizomes, stolons	...	...	DEFAULT
Storage	Bulbs, corms, tubers	...	...	Storage roots
Propagation	Rhizomes, stolons, bulbs, corms, tubers	...	...	Adventitious buds
Photosynthesis	Cladophylls	...	...	Green aerial roots
Defense	Thorns, spines	...	...	Root spines
Support	DEFAULT	...	...	Aerial and contractile roots
Interactions	Traps (bladderwort)	...	...	Mycorrhizae, nodules

Each external function requires a specific modification of organ.

Final question (2 points)

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What are tubers?
(give a short definition)

Summary

- Spiral arrangement of leaves follows **Fibonacci** rule
- Storage, defense and underground growth result in extensive modification of shoot

For Further Reading



J. E. Bidlack, Sh. H. Jansky.
Stern's introductory plant biology. 12th edition.
McGraw-Hill, 2011.
Chapter 6.



Th. L. Rost, M. G. Barbour, C. R. Stocking, T. M. Murphy.
Plant Biology. 2nd edition.
Thomson Brooks/Cole, 2006.
Chapter 5.

