

Rooting, Growth and Apical Dominance

The Biological and Agricultural Mechanisms of Auxins

AUXIN FUNCTIONALITY

Auxins, primarily Indole-3-Acetic Acid (IAA), are key phytohormones that regulate various aspects of plant development. Their polarized transport from the apical bud (source) to the roots (sink) establishes gradients crucial for growth control.

KEY MECHANISMS

- [Mechanism 1] **CELL ELONGATION:** IAA stimulates proton pumps, acidifying the cell wall and activating expansins for loosening.
- [Mechanism 2] **APICAL DOMINANCE:** High IAA concentrations in the apical bud inhibit lateral bud growth, prioritizing vertical growth.
- [Mechanism 3] **ROOT INITIATION:** Auxins promote the formation of lateral and adventitious roots, essential for nutrient uptake.

NOTE: CONCENTRATION
DEPENDENT RESPONSE

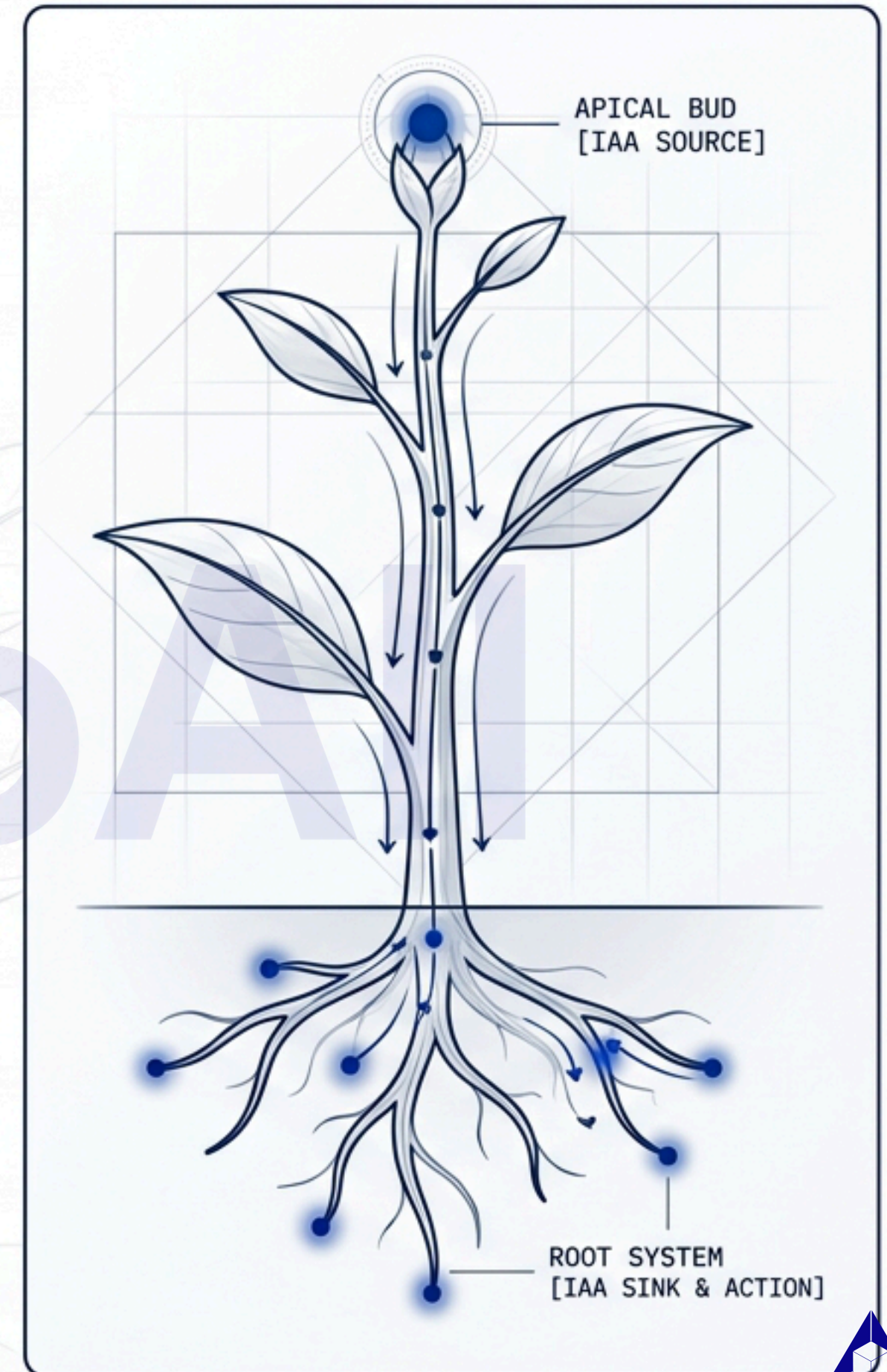
AGRICULTURAL APPLICATIONS

- **ROOTING AGENTS:** Synthetic auxins (e.g., IBA, NAA) are widely used to induce rooting in cuttings.
- **HERBICIDE ACTION:** Some synthetic auxins (e.g., 2,4-D) act as selective herbicides at high concentrations, causing uncontrolled growth.

WARNING: HERBICIDAL
PROPERTIES [HIGH DOSE]

BOTANICAL TAKEAWAY

Understanding auxin transport and action is fundamental to manipulating plant architecture for optimized agricultural yield and efficient propagation techniques.



The Auxin Library

Derived from the Greek auxein (to grow), auxins are primarily produced by growing apices of stems and roots, migrating downward to regions of action. (Fun fact: First isolated from human urine).

Natural Auxins



IAA (Indole-3-acetic acid)

IBA (Indole butyric acid)

Isolated directly from living plants.

Synthetic Auxins



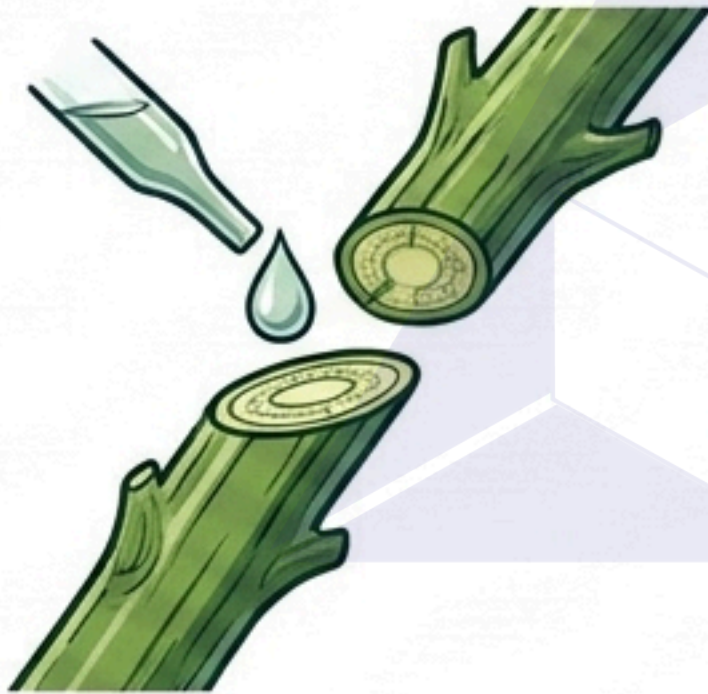
NAA (Naphthalene acetic acid)

2,4-D
(2,4-dichlorophenoxyacetic acid)

Engineered for extensive agricultural and horticultural practices.

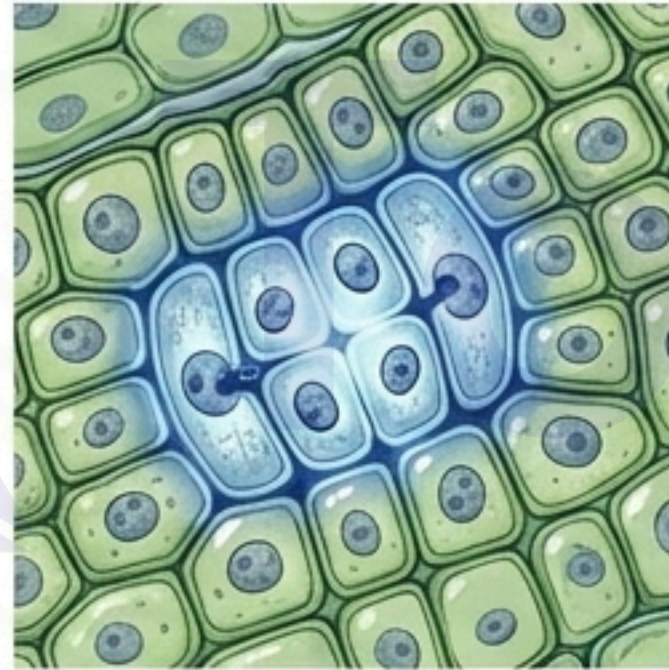
Foundation: Root Initiation & Tissue Differentiation

Input



Application of auxins to severed stem cuttings.

Process



Auxin controls xylem differentiation and stimulates rapid cell division at the wound site.

Outcome



Rapid root initiation, widely used for commercial plant propagation.



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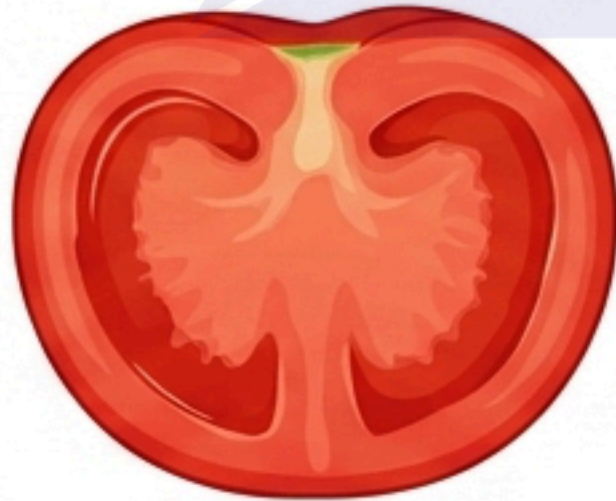


Floral & Fruit Regulation



Synchronized Flowering

Auxin application promotes and synchronizes flowering in pineapples, ensuring a uniform crop yield.

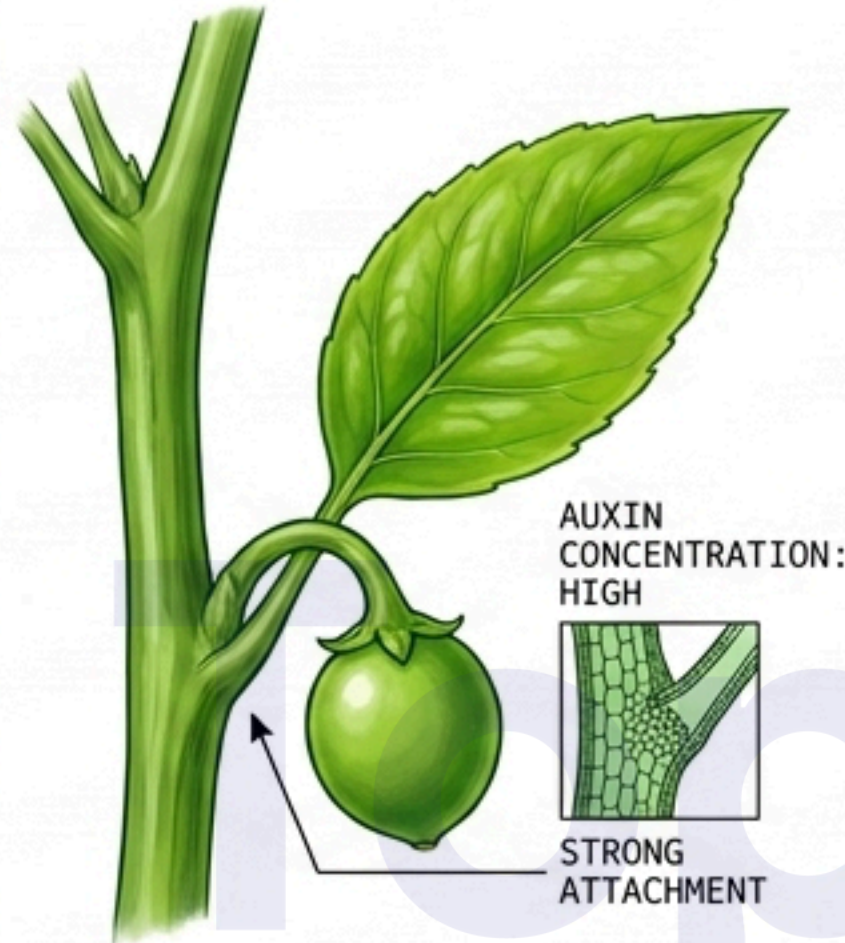


Induced Parthenocarpy

Auxins induce fruit development without fertilization in tomatoes, resulting in highly desirable seedless fruits.

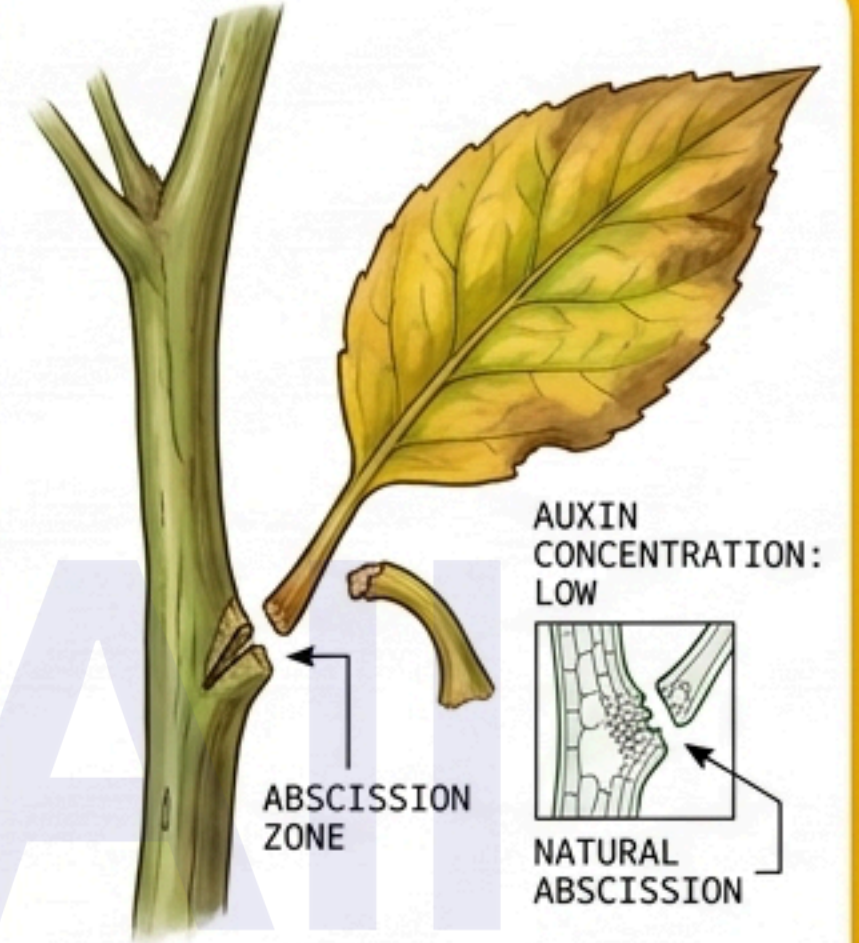
The Abscission Paradox

Auxin concentration dictates the attachment of plant organs, exhibiting dual, timing-dependent behaviors.



Prevention

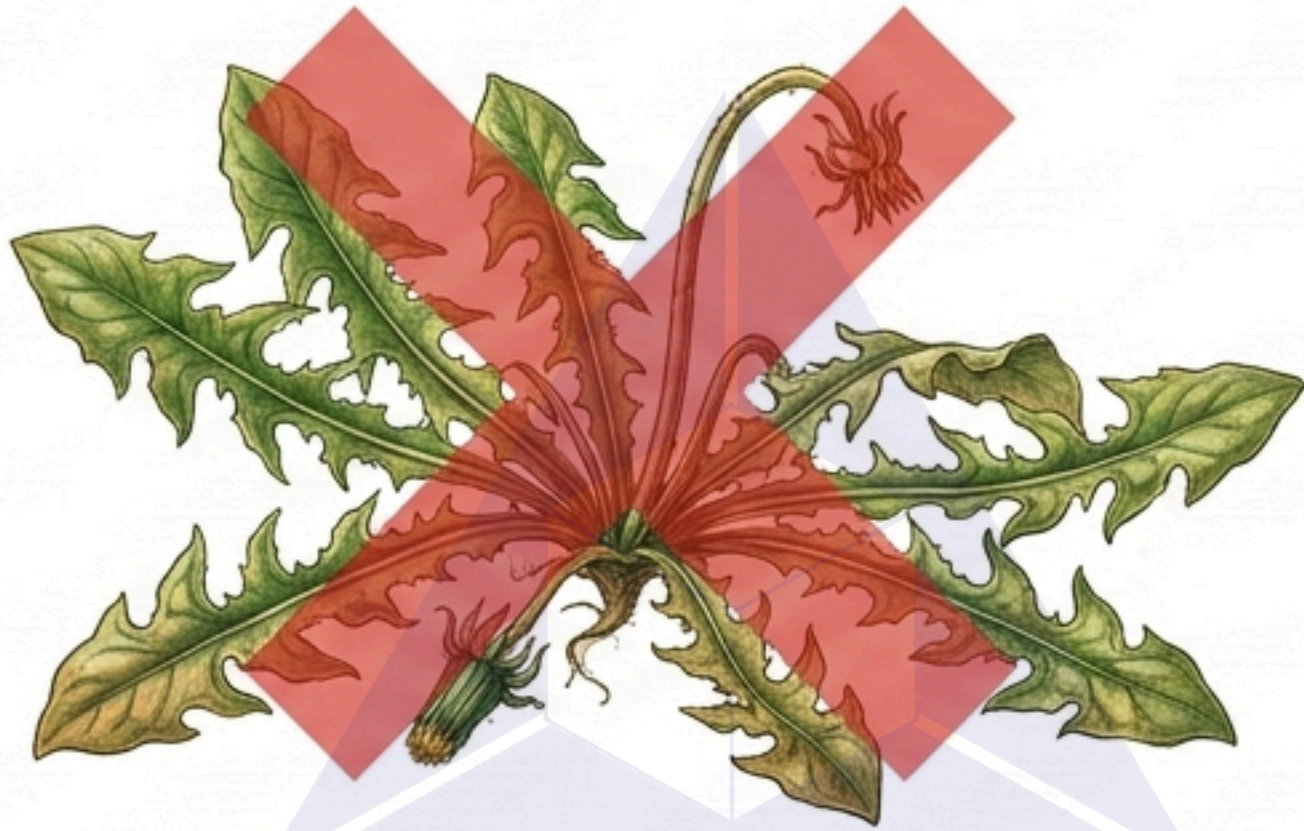
Prevents the early drop of juvenile fruits and leaves, securing developing crop yields.



Promotion

Promotes the natural abscission (dropping) of older, mature leaves and fruits to recycle resources.

Selective Eradication



Lethal to Dicots

2,4-D acts as a potent herbicide, overstimulating growth until the dicotyledonous weed collapses.



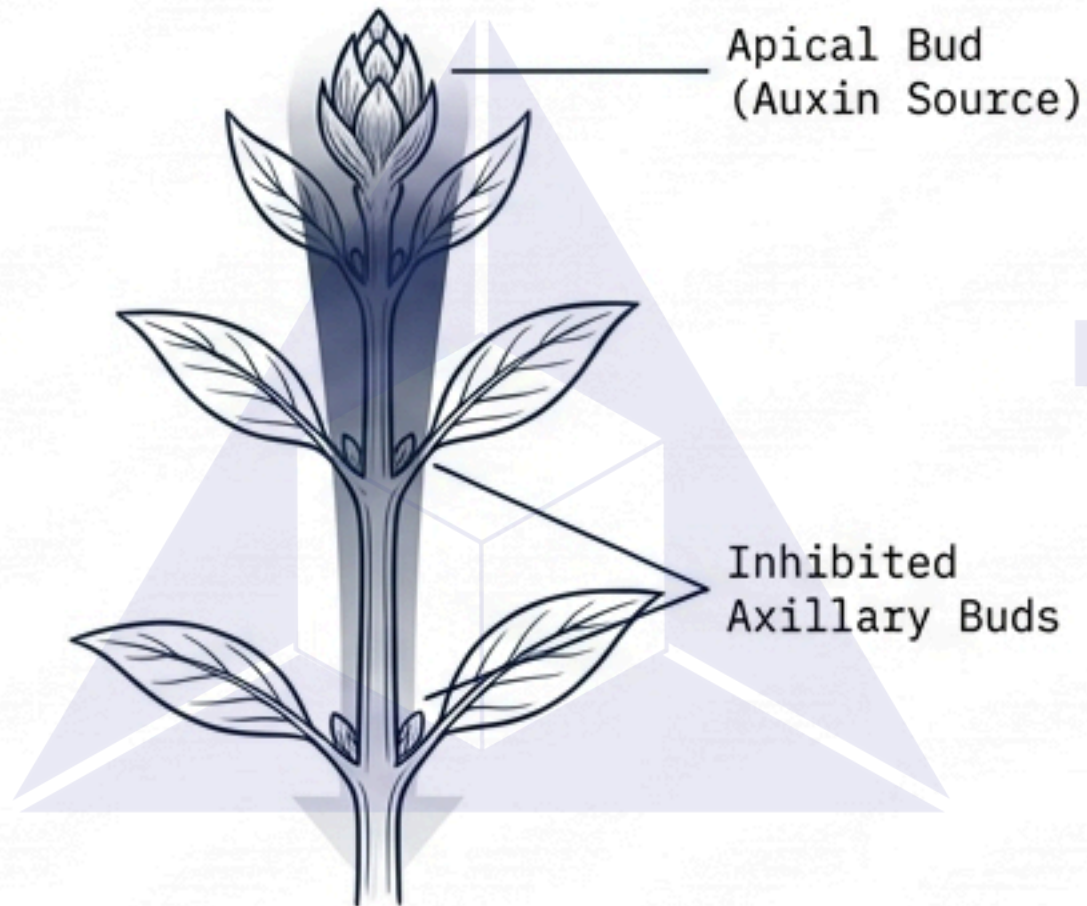
Safe for Monocots

Mature monocotyledonous plants remain entirely unaffected.

Extensively used by gardeners to prepare weed-free lawns without harming the grass.

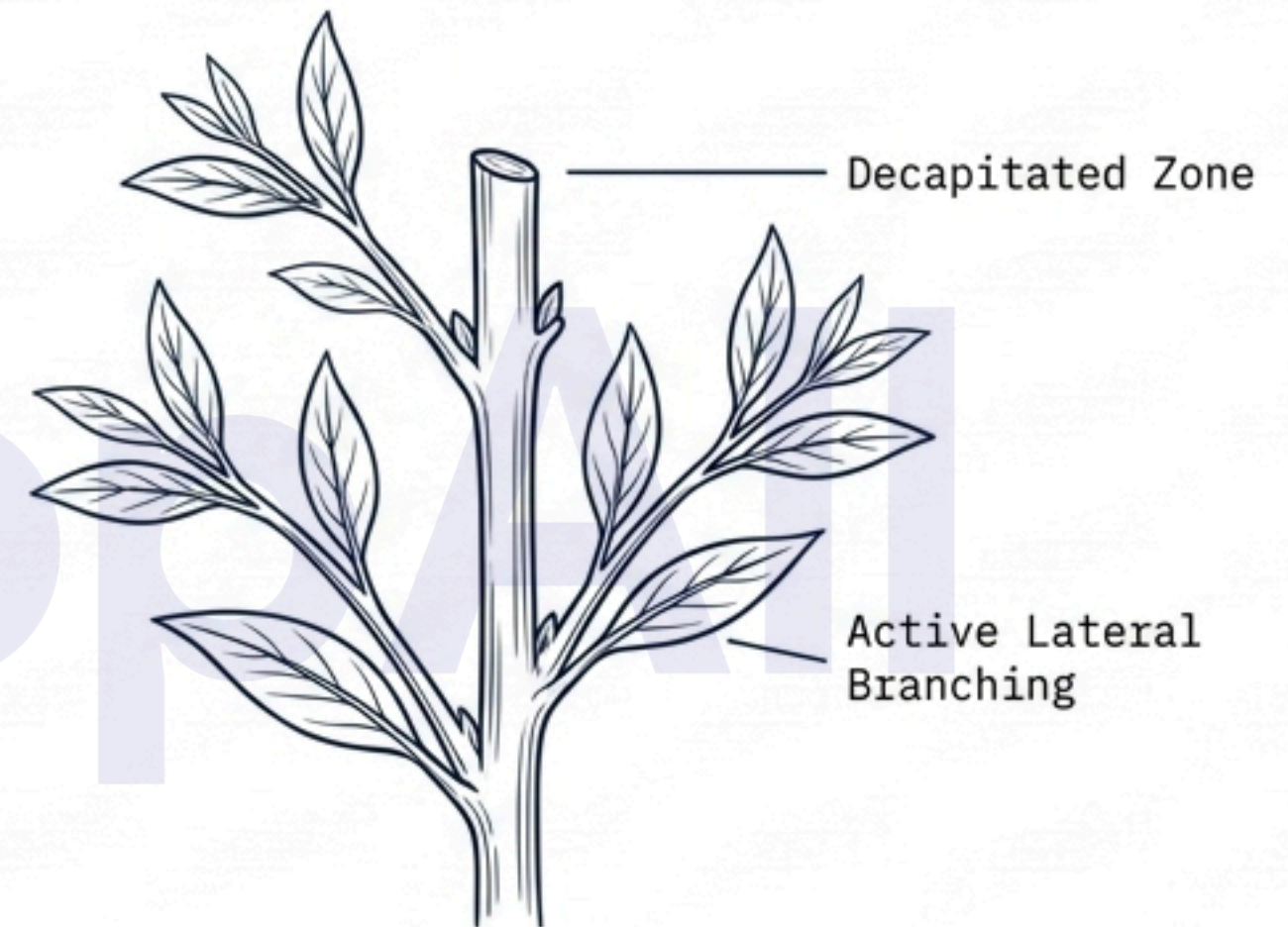
The Mechanism of Apical Dominance

Panel A: Intact Shoot



The growing apical bud produces auxin, which flows downward and physically inhibits the growth of lateral (axillary) buds.

Panel B: Decapitated Shoot



Removal of the shoot tip eliminates the auxin gradient, freeing lateral buds to grow.

This precise physiological principle is the foundation of hedge-making and tea plantation pruning.

Key Takeaway

A Master Regulator of Architecture.

Auxins demonstrate how a single class of chemical regulators dictates the physical shape of a plant—from forcing roots at the base to suppressing branches at the apex.

Nature's Design

Orchestrates root growth, tissue differentiation, and apical dominance.

Agricultural Control

Harnessed to synchronize flowering, prevent fruit drop, and produce seedless crops.

Weaponized Selectivity

Engineered as synthetic herbicides (2,4-D) to reshape plant ecosystems entirely.



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