Pharmacognosy

CHAPTERWISE NOTES

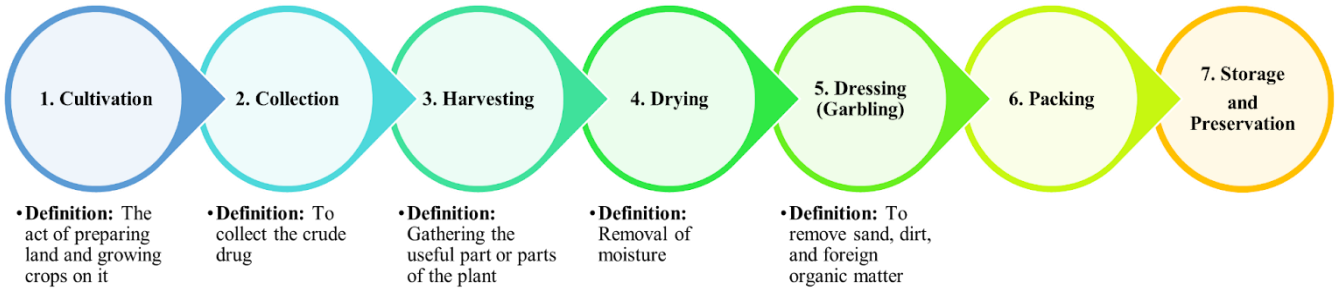
Cultivation, Collection, Processing and Storage

PHARMA

PHARMACOGNOSY

Cultivation, Collection, Processing and Storage

➤ Introduction



✶ Cultivation of medicinal plants enhances the **quality, yield, and availability of crude drugs** by ensuring controlled environmental conditions. The key benefits include:

➤ Soils, Seeds, and Propagation Material

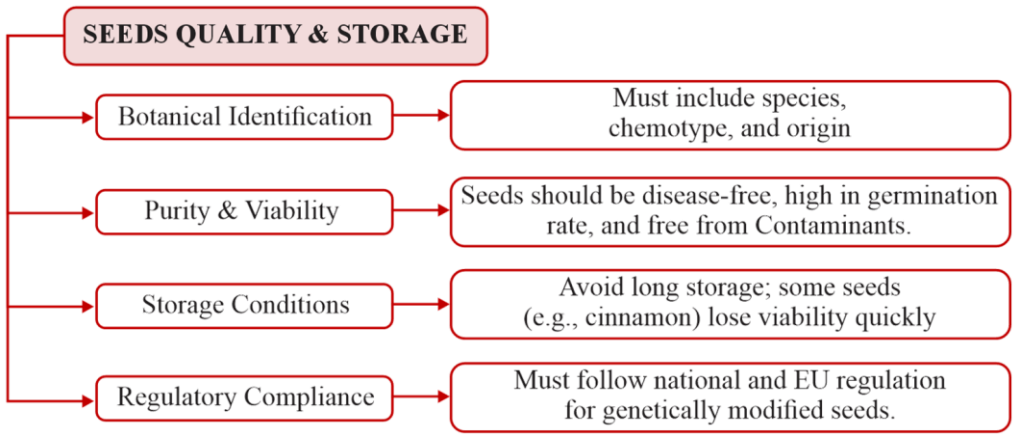
1. Soil Properties

✶ Physical, chemical, and microbiological properties influence plant growth.

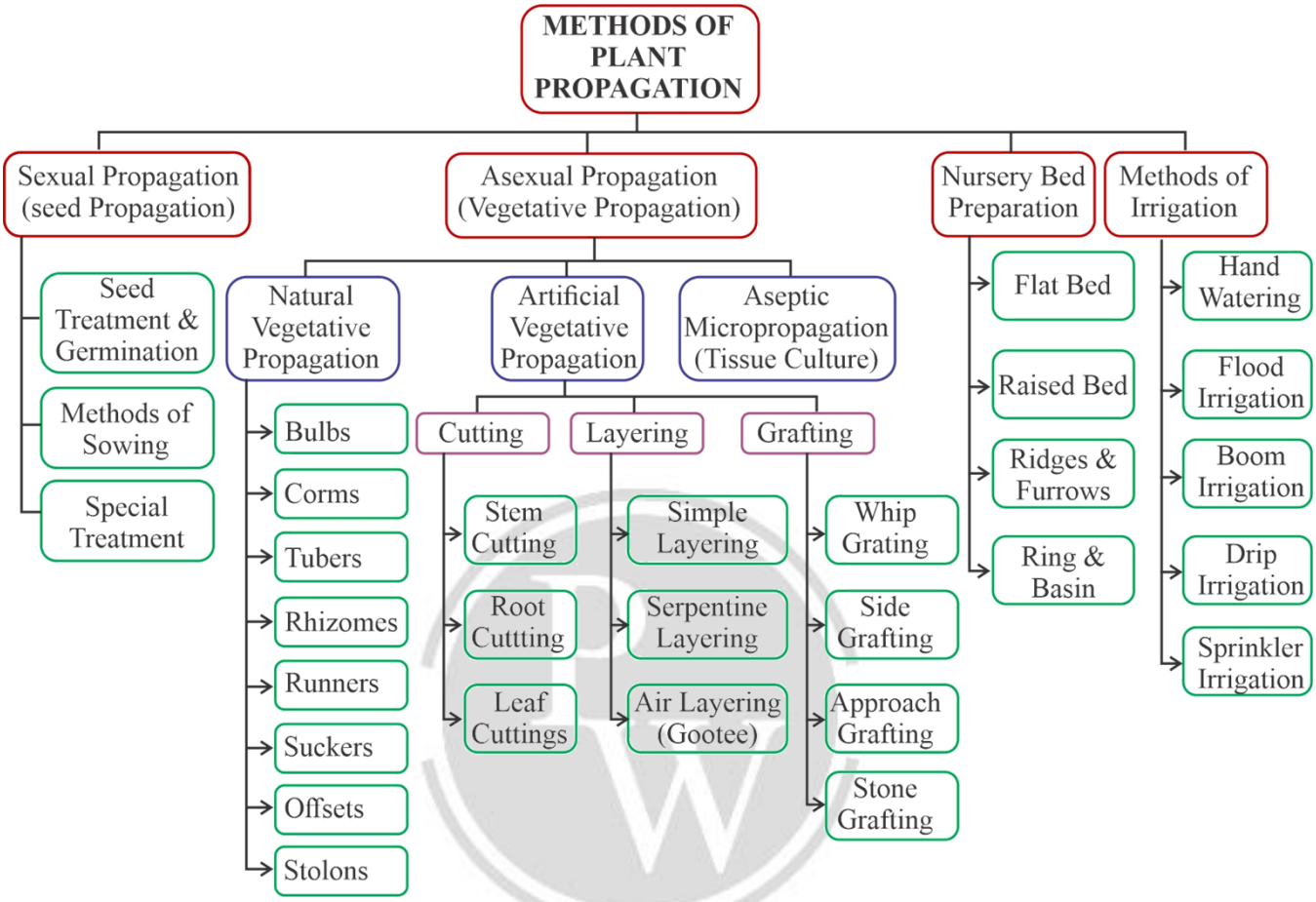
✶ Water-holding capacity affects plant health.

✶ Calcium content benefits some plants but is unnecessary for others.

2. Seed Quality & Storage



➤ Methods of Plant Propagation



1. Sexual Propagation (Seed Propagation)

✷ **Definition:** Plants are grown from seeds (seedlings).

Advantages	Disadvantages
Longer lifespan (perennials) with better yield	Variability in plant growth and yield
Cost-effective and easy method	Longer maturation time compared to grafted plants
New supenor varieties can emerge (e.g., Orange, Papaya)	Higher costs for maintenance (pesticides, labour)
Essential for plants that do not support vegetative propagation	No advantage of rootstock modification

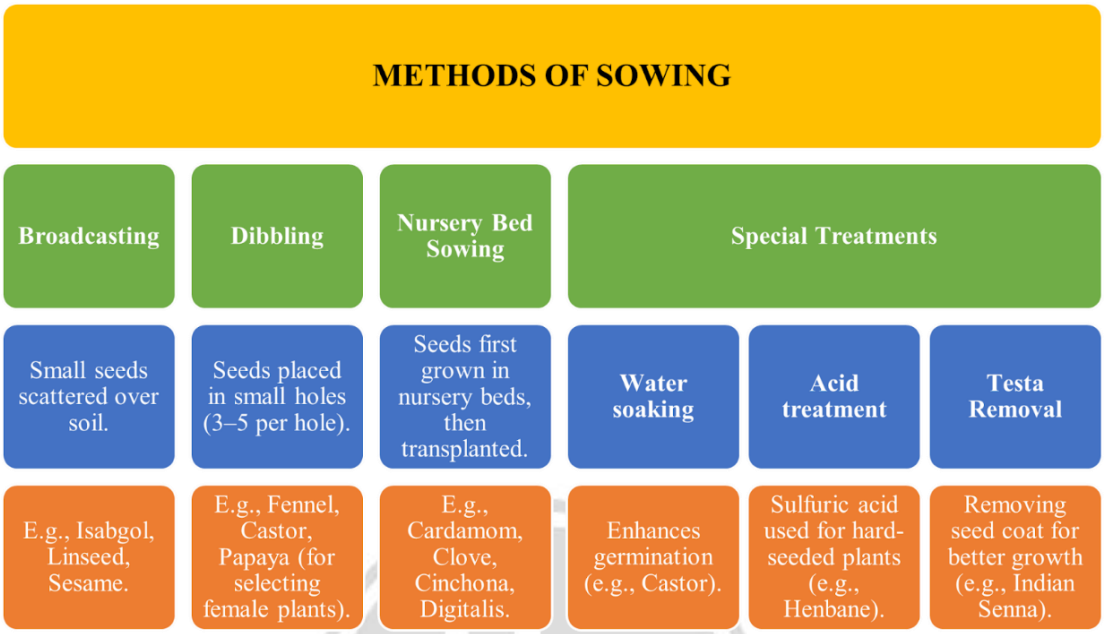
➤ Seed Treatment & Germination

✷ **Scarification:** Breaking seed dormancy for better permeability to water and gases.

✷ **Chemical Treatments:**

- **Gibberellic acid (GA3):** Enhances germination and seedling growth.
- **Potassium Nitrate (KN03):** Improves germination in dormant seeds.
- **Thiourea:** Helps seeds germinate in dark or high-temperature conditions.

➤ Methods of Sowing



2. Asexual Propagation (Vegetative Propagation)

✴ **Definition:** Plants are propagated from vegetative parts (stem, root, leaves).

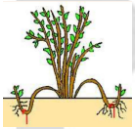
Advantages	Disadvantages
Genetically identical plants with uniform growth and yield	Shorter lifespan and reduced vigour compared to seed-grown plants
Faster maturity compared to seed propagation	No possibility of new genetic variations
Enables propagation of seedless varieties (e.g., Grapes, Pomegranates)	
Grafting improves disease resistance and adaptability	

A. Natural Vegetative Propagation

Propagation Type		Examples
Bulbs		Garlic, Squill
Corms		Saffron, Colchicum
Tubers		Potato, Jalap, Aconite

Rhizomes		Ginger, Turmeric
Runners		Peppermint
Suckers		Banana, Mint, Pineapple
Offsets		Aloe, Valerian
Stolon		Arrowroot, Liquorice

B. Artificial Vegetative Propagation

Method	Sub-type	Examples
Cuttings 	**Stem Cuttings:** Softwood	Barberry
	Stem Cuttings: Semi-hardwood	Citrus, Camellia
	Stem Cuttings: Hardwood	Rose, Orange, Bougainvillea
	Root Cuttings	Brahmi
	Leaf Cuttings	Bryophyllum
Layering 	**Simple Layering**	Guava, Lemon
	Serpentine Layering	Jasmine, Clematis
	Air Layering (Gootee)	Mango, Ficus, Bougainvillea
Grafting 	**Whip Grafting**	Apple, Rose
	Side Grafting	Sapota, Cashew Nut
	Approach Grafting	Guava, Sapota
	Stone Grafting	Mango

C. Aseptic Micropropagation (Tissue Culture)

- **Definition:** Growing plants from single cells, tissues, or organs in sterile conditions.
- **Propagation Sources:** Seeds, embryos, root tips, shoot tips, pollen grains.
- **Advantages:**
  - Produces disease-free plants.
  - Mass production of rare or slow-growing plants.
  - Conservation of endangered species.

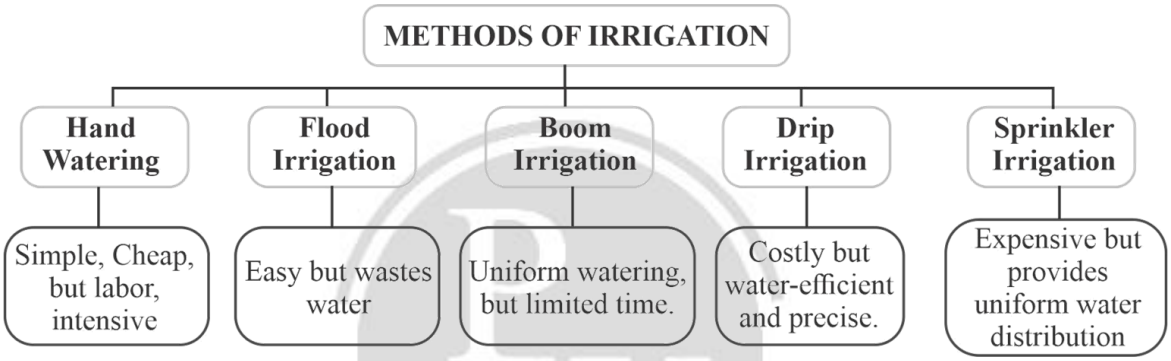
3. Preparation & Types of Nursery Beds

✶ Used when direct sowing is not feasible (small seeds, high-cost seeds, poor germination rates).

Types of Nursery Beds	○ **Flate Bed: Simple, for easy watering.** ○ **Raised Bed: Prevents waterlogging.** ○ **Ridges & Furrows: For deep-rooted crops.** ○ **Ring & Basin: Suitable for tree plantations.**

4. Methods of Irrigation

✶ Essential for crop growth; method selection depends on crop type and water availability.



➤ Good Agricultural Practices (GAP)

1. Cultivation Methods & Standard Operating Procedures (SOPs)

Selection of Suitable Area

✶ **Avoid:**

- ○ Soils with sludge, heavy metals, pesticides, chemicals
- ○ Human feces & industrial/hospital waste

✶ Choose clean, uncontaminated, well-aerated soil.

Fertilization & Soil Management

Criteria	Guidelines
Fertilizers	Based on soil fertility & plant needs
Chemical Use	Must meet EU residue limits
Soil Condition	Well-aerated, promotes healthy growth

Irrigation & Drainage

Aspect	Practice
Irrigation	Use minimal; only as needed
Water Quality	Must meet EU/national standards; contaminant-free
Drainage	Ensure proper drainage to avoid waterlogging

2. Pesticide & Herbicide Usage

Selection & Application

- **Use:**
  - High efficacy, low toxicity, low residue pesticides
  - Approved equipment by trained personnel
- Maintain records of all usage

Storage & Compliance

Requirement	Description
Storage	As per national/manufacturer guidelines
Buyer Info	Written details on brand, quantity & application date

3. Field & Yield Management

- **Yield Optimization Techniques**
  - Pruning
  - Shading
  - Soil aeration
  - Aim: Consistent yield & quality
- **Ecological Protection**
  - Use minimal pesticide to reduce environmental impact
  - Avoid contamination from garbage, hospital, and industrial waste

4. Cultivation vs. Wild Collection of Crude Drugs

- **Comparison Table**

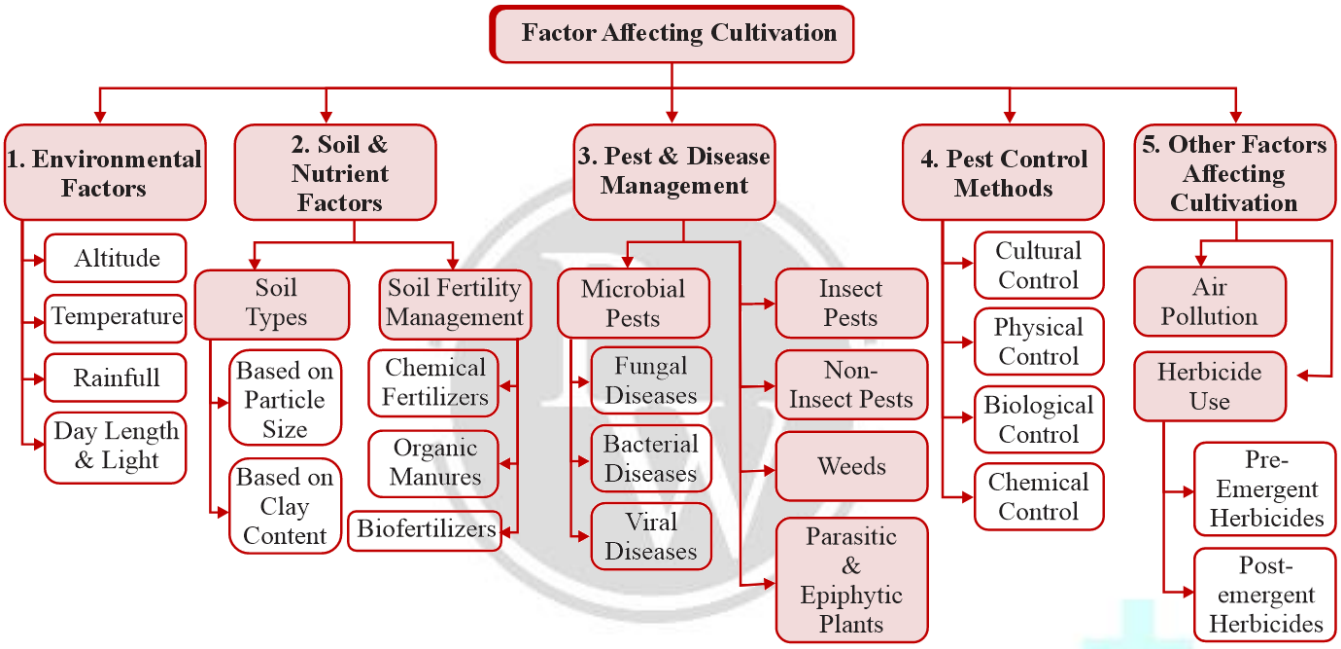
Aspect	Wild Collection	Cultivation
Source	Natural/wild areas	Structured farms
Risk	Overharvesting & depletion	Sustainable & controlled
Quality	Variable	Consistent
Supply	Seasonal/fluctuating	Reliable year-round
Application	Suitable for abundant species (e.g., Acacia, Nux vomica)	Necessary for high-demand species (e.g., saffron, poppy, peppermint)

- **Advantages of Cultivation**
  - Stable quality & supply
  - Genetic improvement
  - Better disease resistance

✴ Considerations for Cultivation

Factor	Examples
Agronomic	Soil type, rainfall, altitude, temperature
Technical	Irrigation, fertilizers, pesticides
Scientific	Genetic manipulation, biochemical properties

➤ Factors Affecting Cultivation



1. Environmental Factors

Factor	Impact / Details
Altitude	Required for optimal growth - Tea (1,000 – 1,500 m), Cinchona (1,000 – 2,000 m), Camphor ((1,500 – 2,500 m), Cardamom (600 – 1,600 m), etc.
Temperature	Influences metabolism & secondary metabolites - Tea (70 – 90°F), Coffee (55 – 70°F), Cardamom (70 – 100°F)
Rainfall	Xerophytes need low rainfall (e.g., Aloe). Excessive rain causes leaching & waterlogging.
Day Length & Light	Long-day →↑ Menthol in Peppermint Short-day →↑ Menthofuran in Peppermint Sunlight ↑ alkaloids in Belladonna, Cinchona

2. Soil & Nutrient Factors

Soil Types Based on Particle Size	
Particle Size	**Type of Soil**
<0.002 mm	**Fine clay**
0.002-0.02 mm	**Coarse clay or silt**
0.02-0.2 mm	**Fine sand**
0.2-2.0 mm	**Coarse sand**

Soil Types Based on Clay Content	
Soil Type	**Clay Percentage**
Clay	**>50%**
Loamy	**30-50%**
Silt Loam	**20-30%**
Sandy Loam	**10-20%**
Sandy Soil	**>70% sand**
Calcareous Soil	**>20% lime**

✴ Soil Fertility Management

- **Chemical fertilizers:** Essential nutrients include **nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur.**
- **Organic manures:** Includes **farmyard manure, compost, oil cakes, bone meal, and fish meal.**
- **Biofertilizers:** Microorganisms such as **Rhizobium, Azotobacter, Azospirillum, and blue-green algae** fix nitrogen and improve soil fertility.

3. Pest & Disease Management

Pest Type	Examples
Fungal	Powdery mildew (*Uncinula necator*), Root rot (*Armillaria mellea*)
Bacterial	Crown gall (*Agrobacterium tumefaciens*), Pierce's disease (Xylella)
Viral	Tobacco mosaic virus, Yellow vein mosaic virus
Insects	Leafhoppers, Twig borer, Cutworms
Non-insect	Rodents, Nematodes (*Meloidogyne incognita*), Snails, Crabs
Weeds	Bermudagrass, Pigweed, Amaranthus spp.
Parasitic Plants	Dodder (Cuscuta), Mistletoe (Phoradendron), Squawroot (Conopholis)

4. Pest Control Methods

Control Type	Methods Used
Cultural	Crop rotation, intercropping, trap crops, resistant varieties.
Physical	Mechanical removal, temperature control, CO_2 fumigation.
Biological	Using natural predators (e.g., ladybugs for aphids), parasites, and genetic modification.
Chemical	Use of insecticides, fungicides, herbicides.

5. Other Factors Affecting Cultivation

Factor	Impact
Air Pollution	Causes leaf necrosis, discoloration, metabolic disorders in sensitive plants
Herbicides	Misuse damages crops → stunting, defoliation, chlorosis
	Pre-emergent: Before germination; Post-emergent: After weed emergence

➤ Plant Hormones and Growth Regulators

➤ Introduction

- **Plant hormones (phytohormones)** are chemical messengers controlling **growth, development, germination, rooting, flowering, fruit ripening, and senescence.**
- They also respond to **environmental stimuli** like **drought, temperature, light, and stress.**
- **Plant growth factors** are external substances that mimic hormone effects and **synchronize plant growth** for agricultural efficiency.
- **Two types:**
  - **Endogenous (natural):** Produced within plants.
  - **Exogenous (synthetic):** Artificially made for agricultural use.
- Five **major classes: Auxins, Cytokinins, Gibberellins, Abscisic Acid, and Ethylene.**

Hormone / Regulator	Discovery & Origin	Biosynthesis & Transport	Major Functions	Applications
Auxins	Darwin (1880), Went (1926), Kogl (1931)	Synthesized from Tryptophan; transported via vascular tissues (polar transport)	Cell elongation and division. Apical dominance Tropisms (phototropism, gravitropism). Root initiation. Vascular tissue differentiation.	Rooting agent, parthenocarpy, weed control
Cytokinin	Haberlandt (1913), Miller (1955), Overbeek (1941)	Produced in roots; transported upward via xylem	Stimulates cell division. Promotes shoot and bud formation. Encourages leaf expansion. Delays leaf senescence. Promotes chloroplast development.	Tissue culture, vegetative propagation, anti-aging
Ethylene	Crocker (1935)	Synthesized from Methionine via SAM → ACC → Ethylene; requires oxygen	Induces fruit ripening. Promotes senescence and abscission. Triggers flowering in some species. Regulates triple response in seedlings.	Artificial ripening, flower induction, degreening

Gibberellins (GA)	GA_3 isolated in 1938 from Gibberella fujikuroi	Synthesized via mevalonic acid pathway; transported in xylem and phloem	Stimulates stem elongation. Induces bolting in rosette plants. Breaks seed dormancy. Stimulates enzyme production in germinating seeds. Promotes parthenocarpy and maleness.	Malting, fruit enlargement, seed germination
Abscisic Acid (ABA)	Identified in 1963 (Abscisin II/Dormin)	Formed in chloroplasts from carotenoids; moves via xylem and phloem	Closes stomata during stress. Promotes seed dormancy. Inhibits growth. Regulates abscission. Delays ripening and senescence.	Stress tolerance, dormancy induction, water conservation
Polyamines	-	Synthesized from ornithine via ODC; modified by dcAdoMet	Enhances cell division and differentiation. Promotes flowering and tissue regeneration. Binds to DNA/RNA for stability. Regulates gene expression.	PCR reagent, tissue culture growth promoter
Brassinosteroids (BRs)	Brassinolide discovered in 1979	Found in all plant tissues; active in low concentrations	Stimulates shoot elongation. Enhances xylem differentiation. Increases stress resistance. Promotes DNA, RNA, and protein synthesis. Induces epinasty and ethylene biosynthesis.	Yield enhancement, stress protection, nutrient uptake
Salicylic Acid (SA)	-	Synthesized from phenylalanine	Promotes flowering. Induces systemic acquired resistance (SAR). Inhibits ethylene and ABA. Enhances flower longevity. Suppresses wound response.	Disease resistance, flowering control, stress recovery
Jasmonates	Isolated from Jasmine	Formed from linolenic acid	Induces senescence and tuber formation. Inhibits root and seedling growth. Promotes dormancy and defence protein synthesis. Triggers tendril coiling and stomatal closure.	Plant defence, stress adaptation, growth regulation

➤ Collection of Crude Drugs

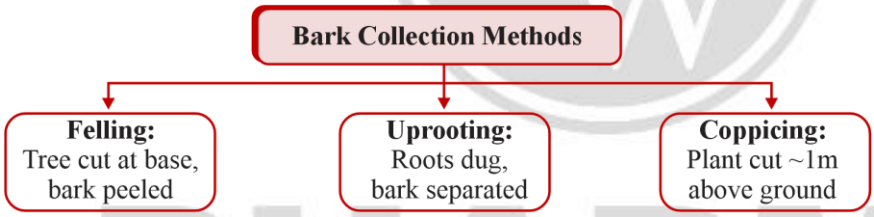
✷ Definition:

Crucial post-cultivation step. Quality depends on **season, plant age,** and **method.**

✷ Factors Affecting Collection

Factor	Details / Examples
Season	Rhubarb in summer → anthranols → anthraquinones Metabolite levels vary day/night
Age	Young peppermint- High pulegone - later menthol Aged Datura → ↓ alkaloids
Plant Part	**Leaves:** Before flowering (Digitalis, Vasaka) **Flowers:** Before full bloom (Clove, Saffron) **Roots:** After aerial death (Liquorice) **Fruits:** At/full ripeness **Barks:** Spring **Unorganized:** Immediately after secretion (resins, latex)

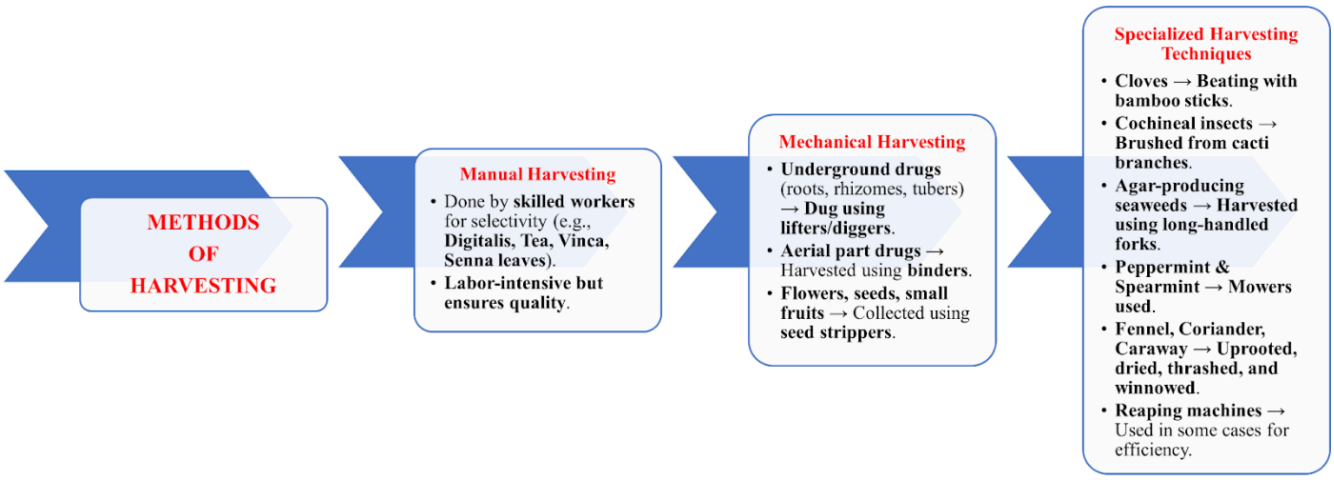
➤ Bark Collection Methods



➤ Harvesting of Crude Drugs

✷ Definition:

Efficient removal of crude drug from plant, must meet **pharmacopoeial standards.**



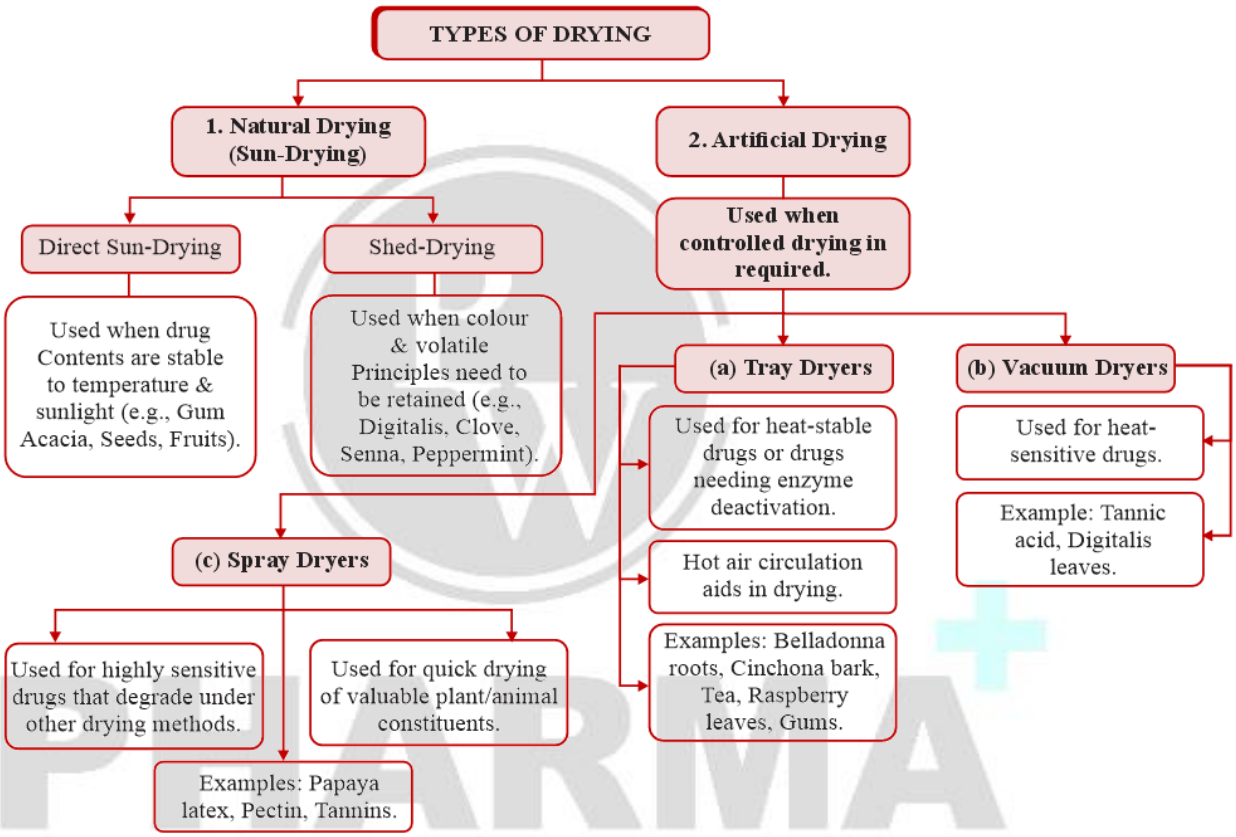
➤ Drying of Crude Drugs

✷ Definition:

- Drying is the process of **removing moisture** from crude drugs to **preserve** them, **prevent microbial growth,** and **enhance pharmaceutical quality.**
- It also **reduces enzymatic activity** and facilitates **grinding or pulverizing.**

✷ Special Considerations

- **Fermentation** - Required for **Cinnamomum zeylanicum bark, Gentian roots** before drying.
- **Slicing/Cutting** - Enhances drying efficiency (e.g., **Glycyrrhiza, Squill, Calumba).**
- **Flowers - Shade drying** to **retain color** & **volatile oil content.**



➤ Garbling (Dressing) of Crude Drugs

✷ Definition:

Post-drying **removal of unwanted matter** to improve purity & meet standards.

Garbling Methods	
Method	**Example/ Use**
Manual separation	Remove stalks/stems (Clove, Lobelia, Stramonium)
Rhizome cleaning	Remove roots/rootlets from rhizomes
Magnetic separation	Remove iron from Castor seeds
Shifting	Vinca & Senna leaves - separate impurities
Peeling method	Remove bark from Gum Acacia

➤ Packing of Crude Drugs

✷ Definition:

Packing is an essential step to ensure the **safety, potency, and quality** of crude drugs during **transportation and storage** by considering **morphological, chemical, and climatic factors.**

Drugs	Packing Method
Aloe	Packed in goat skin
Colophony, Balsam of Tolu	Stored in kerosene tins
Asafoetida	Packed in well-closed containers to prevent volatile oil loss
Cod Liver Oil	Stored in light-resistant containers to prevent sunlight damage
Leaf Drugs (Senna, Vinca, etc.)	Pressed & baled
Moisture-sensitive & costly drugs (Digitalis, Ergot, Squill)	Packed with desiccating agents to absorb moisture
Colophony (Rosin)	Packed in large masses to prevent auto-oxidation
Cinnamon Bark (Quills)	Quills packed inside each other to prevent volatile oil loss
Roots, Seeds, etc.	Packed in gunny bags, sometimes polythene-lined
Indian Opium	Packed with fixed weight per lot

➤ Storage of Crude Drugs

✷ Definition:

Storage is a **critical step** in preservmg crude drugs by preventing **physical, chemical, and biological degradation.** Proper storage **maintains quality, potency, and safety.**

✷ Key Storage Guidelines & Risks

Factor	Effect on Crude Drugs	Preventive Measures
Moisture	Promotes microbial growth, enzymatic reactions, and bulk increase	Store in well-closed, moisture-proof containers
Light (Radiation)	Destroys active constituents (e.g., ergot, cod liver oil, digitalis)	Use light-proof containers
Form/Shape of Drug	Powdered drugs degrade faster (e.g., colophony oxidizes, squill turns rubbery, ergot oil becomes rancid)	Store in entire form when possible; defat ergot before storage
Oxygen (Air Exposure)	Causes oxidation & rancidity	Replace air with inert gas (e.g., nitrogen) for shark liver oil, papain

Insects & Mould Infestation	Pests like Coleoptera, Lepidoptera, Archnida damage drugs	Dry thoroughly before storage, fumigate (methyl bromide, carbon disulphide, hydrocyanic acid)
Temperature	Heat accelerates chemical decomposition	Store at low or refrigerated temperature
Special Treatments	Some drugs require extra protection (e.g., liming of ginger, nutmeg coating)	Apply traditional preservation methods
Container Type	Poor packaging leads to moisture absorption & degradation	Use airtight, moisture-proof, light-proof containers (e.g., tin cans, amber glass)

➤ Quality Management of Crude Drugs

✴ Definition:

Quality management in herbal drug production **ensures standardization, safety, and efficacy** through **strict supervision and testing** at all stages.

✴ Instrument & Equipment Standards

Aspect	Requirement
Precision & Calibration	Instruments like balances, meters, weighers must be regularly calibrated
Performance Indication	Each instrument should have clear performance status labels
Conformance to Standards	All instruments should meet national & industry requirements

➤ Documentation of Crude Drugs

✴ Definition:

Proper **documentation** ensures **traceability, quality control, and regulatory compliance** throughout the production of crude drugs.

✴ Key Aspects of Documentation

Aspect	Details Recorded
Standard Operating Procedures (SOPs)	Maintain written protocols for production & quality management
Production Records	Document the entire process with photos/images if necessary
Seed & Propagation Details	Origin, strain, propagation method
Cultivation Process	Sowing time, quantity, area covered, transplantation
Fertilizers & Chemicals	Type, quantity, application schedule of fertilizers, pesticides, herbicides, microbicides
Harvesting Details	Collection time, yield, fresh weight, drying loss
Processing & Storage	Transport, storage conditions, drying process
Quality Evaluation	Macroscopic characteristics, test results
Administrative Records	Production plans, contracts, agreements