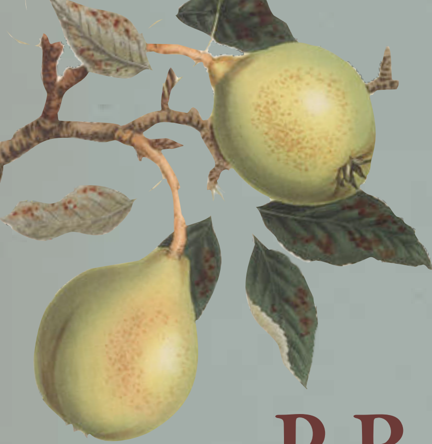
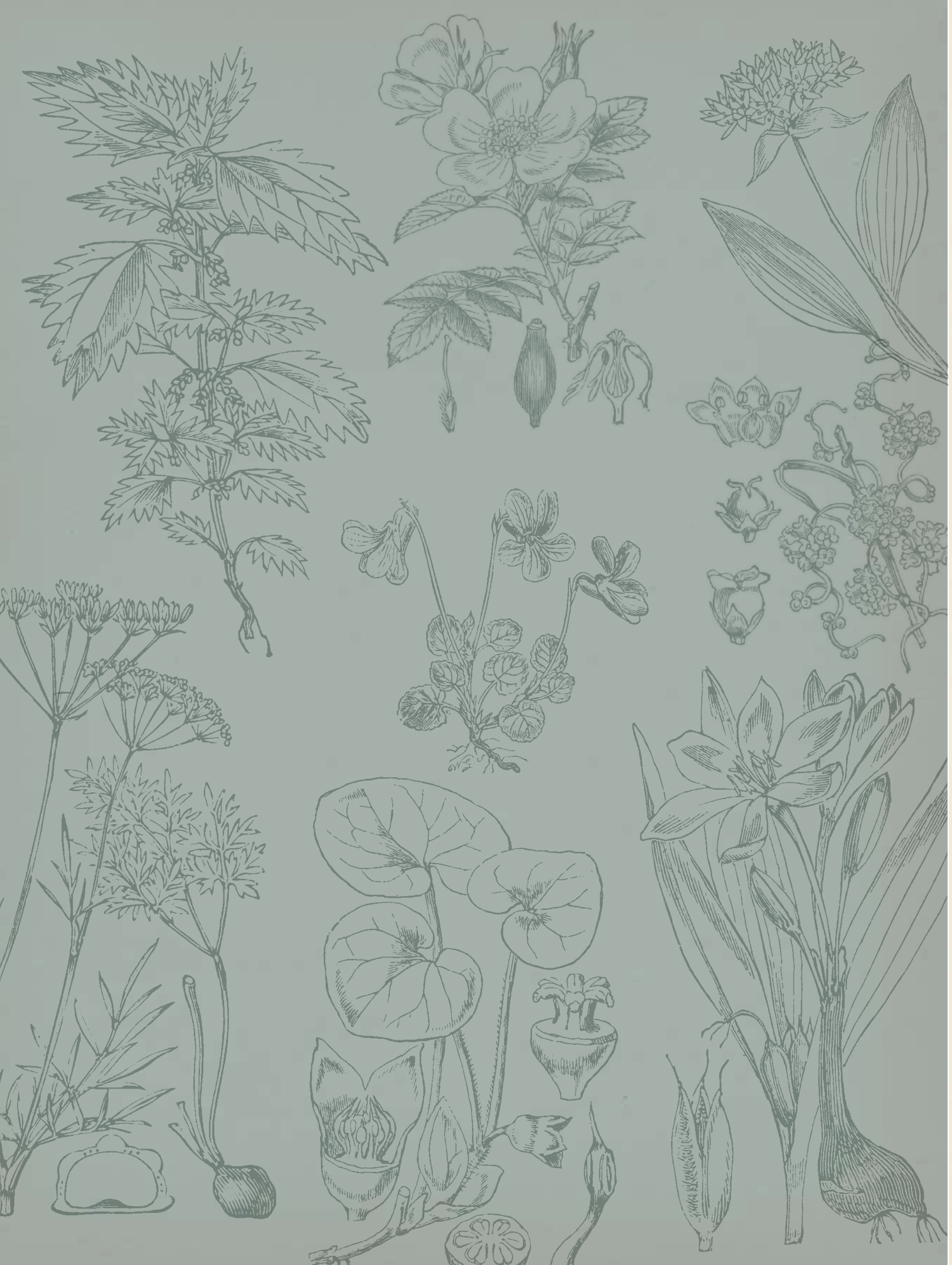


PRACTICAL BOTANY *for* GARDENERS

Over 3,000 Botanical Terms Explained and Explored

GEOFF HODGE



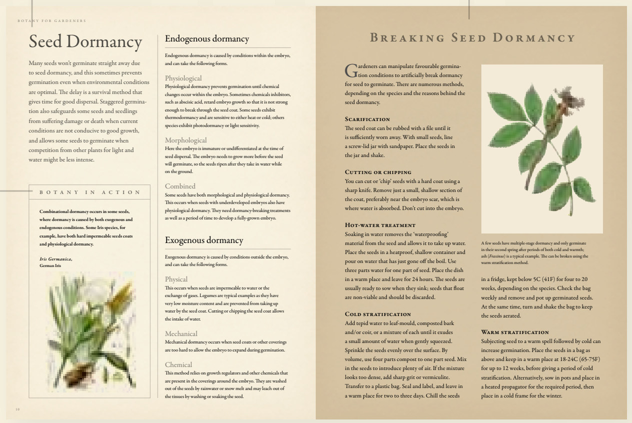
How to use this book

LISTING PAGES

Background information provides context, but the core of each section is a list of botanical word and terms, with definitions, making it easy to understand the terminology of botany.

TECHNIQUE PAGES

Feature pages focus on practical applications, such as Breaking Seed Dormancy or Pruning, providing a range of different techniques to help the gardener.



BOTANY IN ACTION

Short feature boxes placed throughout the book demonstrate ways in which the theory can be turned into practice, providing gardeners with practical tips.

DIAGRAMS

As well as dozens of attractive botanical illustrations and etchings, the book includes numerous simple annotated diagrams to clarify technical aspects.

BOTANISTS & BOTANICAL ILLUSTRATORS

Feature spreads profile notable men and women from the history of botany, exploring their lives and explaining the ways in which their work was influential.

Contents

Rosa sp.
Rose

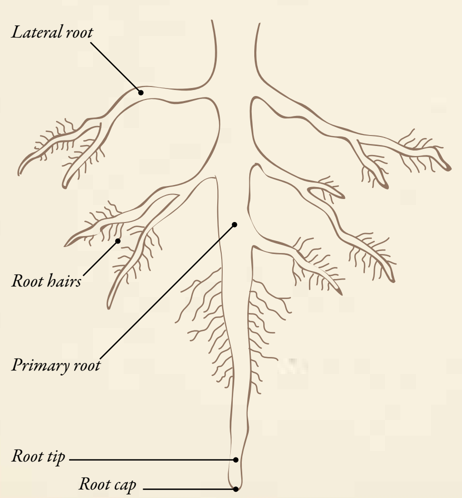
Rhyncholaelia
Orchid

Roots

In many respects, the roots are the most important part of vascular plants. Not only do they anchor the plant in place and provide support, they also absorb water and numerous plant nutrients from the soil. The roots of many perennial plants are also used to store food reserves, allowing them to survive cold winter weather and other extremes of environmental conditions. If you look after the roots of your plants, ensuring the soil is in good condition and well prepared, so that the roots grow and establish quickly, the rest of the plant will also grow strongly. To better understand how to achieve this, it is first necessary to develop an understanding of root types and terminology.

Root structure

A true root system consists of a primary root and secondary (or lateral) roots. The primary root is not dominant, so the whole root system is fibrous in nature and branches in all directions to produce an extensive rooting system. This allows it to provide excellent anchorage and support, and to search out water and nutrients over a large area.



Specialized roots

The roots, or parts of the roots, of many plant species have become specialized to serve other purposes besides their primary functions.

Adventitious roots

These arise out of sequence from the more usual root formation, and instead originate from stems, branches, leaves, or old woody roots. They are important when propagating plants from stem or leaf cuttings. Most aerial roots and stilt roots (see below) are adventitious. Adventitious roots can form the largest part of the root system of some conifers.

Aerating roots

Also known as "knee roots" or "pneumatophores," aerating roots rise above the ground, especially above water such as in some mangrove genera. In some plants they have breathing pores for the exchange of gases in swamp or waterlogged conditions.

Aerial roots

Roots that grow entirely above the ground, such as those of ivy (*Hedera*) or "epiphytic" (tree-growing) orchids. They provide support and anchorage, or function as prop roots, as in maize or as the trunk in the strangler fig (*Ficus* species).

Contractile roots

These roots pull bulbs or corms, such as hyacinth and lily, and some taproots, such as dandelion, deeper in the soil by expanding and contracting.

Coarse roots

Roots that have undergone secondary thickening and have a woody structure. They have some ability to absorb water and nutrients, but their main function is to provide a structure to connect the smaller diameter, fine roots to the rest of the plant.

Fine or fibrous roots

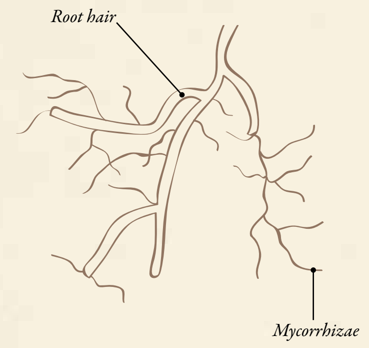
Primary roots, usually less than 2 mm in diameter, that are responsible for water and nutrient uptake. They are usually heavily branched and support mycorrhizas (see box). They may be short lived, but are regularly replaced by the plant.

Haustorial roots

These are produced by parasitic plants, such as mistletoe (*Viscum album*) and dodder (*Cuscuta species*), that can absorb water and nutrients from another plant.

BOTANY IN ACTION

In order to function properly, the roots of most vascular plants enter into a symbiotic relationship with a soil fungus called mycorrhizae, which comes from the Greek meaning "fungus root." It is now possible to buy mycorrhizal fungi, which can be added to the soil at planting time to help improve root growth and overall plant health, strength and disease resistance.



Propagative roots

Roots that form adventitious buds that develop into above ground shoots, called suckers, which then form new plants.

Stilt roots

Adventitious support roots, common among mangroves, for example. They grow down from lateral branches, branching in the soil.

Storage roots

Roots modified for storage of food (nutrients or water), such as in numerous root crops. They include some taproots and tuberous roots.

Structural roots

These are large roots that have undergone considerable secondary thickening and provide mechanical support to woody plants and trees.

Surface roots

These roots proliferate close below the soil surface, exploiting supplies of water and nutrients. Where optimal growth conditions prevail they commonly become the dominant roots.

Taproot

An enlarged root that grows downwards, generally straight and tapering slightly towards the bottom, from which other roots sprout laterally.

Tuberous roots

These roots occur when a portion of a root swells for food or water storage, such as in sweet potato (*Ipomoea batatas*). They are a type of storage root, distinct from taproots.

Taraxacum officinale,
common dandelion

Plants with taproots, such as the dandelion (*Taraxacum officinale*), are hard to kill off because the taproot remains in the ground when the top is removed and the plant re-sprouts.

Robert Fortune

1812–1880

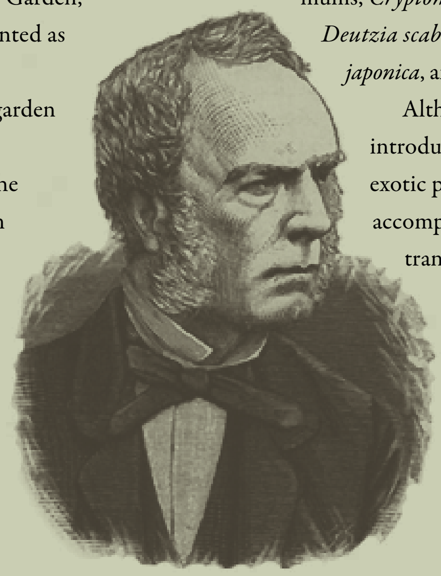
Our gardens would be much the poorer if it weren't for the brave exploits of the enigmatic and notoriously surly botanist, Robert Fortune. During several trips—mainly to China, but also Indonesia, Japan, Hong Kong and the Philippines—Fortune brought back more than 200 ornamental plants. These were mainly trees and shrubs, but also included climbers and herbaceous perennials.

He was born in Kelloe in what is now County Durham in the northeast of England, and was first employed in the Royal Botanic Garden, Edinburgh. Later he was appointed as deputy superintendent of the Hothouse Department in the garden of the Horticultural Society of London (later to be renamed the Royal Horticultural Society) in Chiswick. A few months later, Fortune was granted the position of the Society's collector in China.

He was sent on his first journey in 1843 with little pay and a request to "collect seeds and plants of ornamental or useful kind, not already cultivated in Britain," as well as to obtain information on Chinese gardening and agriculture. He was especially tasked to find any blue-flowered peonies and to investigate the peaches growing in the Emperor's private garden.

Each trip enriched Britain's gardens and greenhouses with plants covering nearly the whole A to Z of genera, from *Abelia chinensis* to *Wisteria sinensis*, including *Camellia reticulata*, chrysanthemums, *Cryptomeria japonica*, Daphne species, *Deutzia scabra*, *Jasminum officinale*, *Primula japonica*, and various Rhododendron species.

Although his travels resulted in the introduction to Europe of many new and exotic plants, probably his most famous accomplishment was the successful transportation of tea from China to the Darjeeling region of India in 1848 on behalf of the British East India Company. Unfortunately, most of the 20,000 tea plants and seedlings perished, but the group of trained Chinese tea workers who came back with him—along with their technology and knowledge—may have been instrumental in the later flourishing Indian tea industry.



A great explorer of the Far East in the mid 1800s, Robert Fortune returned to Britain with over 200 species of ornamental plant. He died in London in 1880, and is buried in Brompton Cemetery in London.

"The art of dwarfing trees, as commonly practised both in China and Japan, is in reality very simple . . . It is based upon one of the commonest principles of vegetable physiology. Anything which has a tendency to check or retard the flow of the sap in trees, also prevents, to a certain extent, the formation of wood and leaves."

Robert Fortune in **Three Years' Wanderings in the Northern Provinces of China** ***(1847)***

***Camellia sinensis*,**
tea plant

Robert Fortune was instrumental in introducing tea to India from China, establishing the Indian tea industry that we know today.

***Rhododendron fortunei*,**
rhododendron

Fortune found this plant growing at 3,000 feet in the mountains of eastern China. It was the first Chinese rhododendron introduced to Britain.

He was generally well received on his travels, but did experience hostility and was once threatened at knife point by an angry mob. He also survived killer storms in the Yellow Sea and pirates on the Yangtze River. He became proficient enough with speaking Mandarin that he was able to adopt the local dress and move among the Chinese people largely unnoticed, enabling him to visit parts of the country that were restricted to foreigners. By shaving his head and growing a ponytail, he was able to effectively blend in.

The incidents of his travels were related in a succession of books, which include *Three Years' Wanderings in the Northern Provinces of China* (1847), *A Journey to the Tea Countries of China* (1852), *A Residence Among the Chinese* (1857), and *Yedo and Peking* (1863).

Seed Dormancy

Many seeds won't germinate straight away due to seed dormancy, and this sometimes prevents germination even when environmental conditions are optimal. The delay is a survival method that gives time for good dispersal. Staggered germination also safeguards some seeds and seedlings from suffering damage or death when current conditions are not conducive to good growth, and allows some seeds to germinate when competition from other plants for light and water might be less intense.

BOTANY IN ACTION

Combinational dormancy occurs in some seeds, where dormancy is caused by both exogenous and endogenous conditions. Some Iris species, for example, have both hard impermeable seeds coats and physiological dormancy.

Iris Germanica,
German Iris

Endogenous dormancy

Endogenous dormancy is caused by conditions within the embryo, and can take the following forms.

Physiological

Physiological dormancy prevents germination until chemical changes occur within the embryo. Sometimes chemicals inhibitors, such as abscisic acid, retard embryo growth so that it is not strong enough to break through the seed coat. Some seeds exhibit thermodormancy and are sensitive to either heat or cold; others species exhibit photodormancy or light sensitivity.

Morphological

Here the embryo is immature or undifferentiated at the time of seed dispersal. The embryo needs to grow more before the seed will germinate, so the seeds ripen after they take in water while on the ground.

Combined

Some seeds have both morphological and physiological dormancy. This occurs when seeds with underdeveloped embryos also have physiological dormancy. They need dormancy-breaking treatments as well as a period of time to develop a fully-grown embryo.

Exogenous dormancy

Exogenous dormancy is caused by conditions outside the embryo, and can take the following forms.

Physical

This occurs when seeds are impermeable to water or the exchange of gases. Legumes are typical examples as they have very low moisture content and are prevented from taking up water by the seed coat. Cutting or chipping the seed coat allows the intake of water.

Mechanical

Mechanical dormancy occurs when seed coats or other coverings are too hard to allow the embryo to expand during germination.

Chemical

This method relies on growth regulators and other chemicals that are present in the coverings around the embryo. They are washed out of the seeds by rainwater or snow melt and may leach out of the tissues by washing or soaking the seed.

Breaking Seed Dormancy

Gardeners can manipulate favorable germination conditions to artificially break dormancy for seed to germinate. There are numerous methods, depending on the species and the reasons behind the seed dormancy.

Scarification

The seed coat can be rubbed with a file until it is sufficiently worn away. With small seeds, line a screw-lid jar with sandpaper. Place the seeds in the jar and shake.

Cutting or chipping

You can cut or "chip" seeds with a hard coat using a sharp knife. Remove just a small, shallow section of the coat, preferably near the embryo scar, which is where water is absorbed. Don't cut into the embryo.

Hot-water treatment

Soaking in water removes the "waterproofing" material from the seed and allows it to take up water. Place the seeds in a heatproof, shallow container and pour on water that has just gone off the boil. Use three parts water for one part of seed. Place the dish in a warm place and leave for 24 hours. The seeds are usually ready to sow when they sink; seeds that float are non-viable and should be discarded.

Cold stratification

Add tepid water to leaf-mould, composted bark and/or coir, or a mixture of each until it exudes a small amount of water when gently squeezed. Sprinkle the seeds evenly over the surface. By volume, use four parts compost to one part seed. Mix in the seeds to introduce plenty of air. If the mixture looks too dense, add sharp grit or vermiculite. Transfer to a plastic bag. Seal and label, and leave in a warm place for two to three days. Chill the seeds in a fridge, kept below 5C (41F) for four to 20 weeks, depending on the species. Check the bag weekly and remove and pot up germinated seeds. At the same time, turn and shake the bag to keep the seeds aerated.

A few seeds have multiple-stage dormancy and only germinate in their second spring after periods of both cold and warmth; ash (*Fraxinus*) is a typical example. The can be broken using the warm stratification method.

Warm stratification

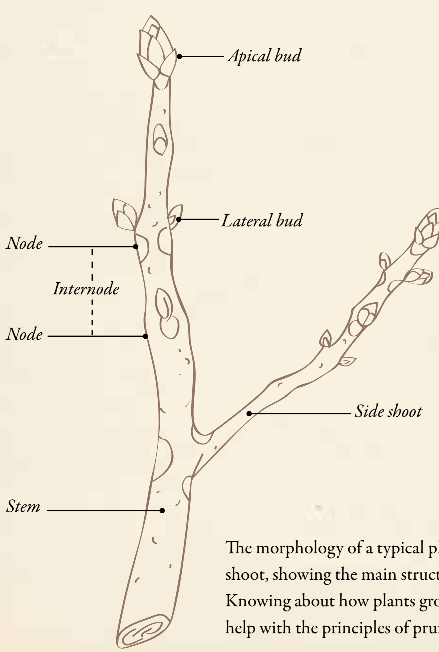
Subjecting seed to a warm spell followed by cold can increase germination. Place the seeds in a bag as above and keep in a warm place at 18–24C (65–75F) for up to 12 weeks, before giving a period of cold stratification. Alternatively, sow in pots and place in a heated propagator for the required period, then place in a cold frame for the winter.

Pruning

Many gardeners find pruning or cutting back plants confusing, complicated, and even daunting. The purpose of pruning is to influence the way plants grow. It doesn't only affect their size—it can also determine growth, and therefore their shape and their flower and seed or fruit production.

Pruning approaches

Some gardeners constantly cut off shoots, tidying up their plants to give them a neat overall appearance. Others prefer to cut them back hard, often down to or near ground level. For most plants, the first approach is usually not the best. Constantly tidying up and lightly tipping back plants may make the growth unbalanced, top heavy or lopsided and, if done at the wrong time of year, will also remove flower buds. For best results, you need to be somewhere in the middle: hard pruning those plants that need it, and just lightly cutting back those that will not re-shoot from old wood and will die.



The morphology of a typical plant shoot, showing the main structures. Knowing about how plants grow will help with the principles of pruning.

Plant response to pruning

Pruning is a mixture of both art and science: art in making the proper pruning cuts, and science in knowing how and when to prune for maximum results. A little knowledge of plant morphology and physiology, and how plants grow and respond to pruning, will help you understand pruning much better.

Bud

An embryonic shoot with an immature stem tip.

Apical or terminal bud

The uppermost bud on a stem; new extension growth is usually made just below this bud, and all new plant growth comes from apical buds.

Lateral bud

Buds growing on the side of the stem, below the apical bud; also know as axiliary buds.

Apical dominance

The apical bud produces plant growth hormones that suppress the growth of the buds below the tip. This effect is called apical dominance. When the apical bud is removed, stopping hormone production, this dominance is lost and the lateral buds at the nodes closest to the cut start to grow, producing new stems and resulting in denser growth.

BOTANY IN ACTION

Pruning is not always the answer to reducing the size of a plant, since it produces stronger regrowth. When a plant is growing naturally, it produces top growth and root growth in balance. When you cut back the plant it becomes imbalanced and the roots provide excess water and nutrients that cause a surge of new stem and leaf growth. The vigour of the new growth is also influenced by where you cut: the farther back you cut a shoot, the more vigorous the new growth. Pinch out the growing tip of a stem and the effect is modest, but cut back a shoot by two-thirds and the result is a preponderance of shooting lateral buds.

Side shoot

In some plants, a single lateral bud may grow away strongly to produce just one side shoot, which takes on the apical dominance. In others, two or more side shoots share the dominance and produce bushier growth.

Node

The points on a stem that hold buds are called nodes. The space between two nodes is called an internode.

Dormant bud

A lateral bud that for some reason doesn't come into growth. Pruning a nearby apical bud is likely to stimulate it into growth, producing new leaves or stems.

Adventitious bud

These are only produced when needed (such as after damage or pruning) and there are no dormant buds nearby. They will produce new leaves or stems, and are often the buds that come into growth when hard, renovation pruning is carried out. In some trees, several buds break at the same point, producing a profusion of thin stems called water shoots.

Vegetative, flower, and fruit buds

Vegetative buds are usually small and thin and produce leaves. Flower and fruit buds are fatter and contain the embryo flowers. By careful pruning at the right time of year, it is possible to change vegetative buds into fruiting buds—important when pruning fruit trees.

BOTANY IN ACTION

It is possible to break apical dominance in climbers and wall-trained plants by carefully pulling down a vertical shoot training it horizontally. Side shoots are then produced along the shoot, and these are much more likely to flower and fruit. This technique is particularly useful when training climbers, wall shrubs and several trained fruit shapes in order to encourage extra flowering and fruiting instead of vegetative growth.

***Malus domestica*,**
apple

Growing apple trees as espaliers, and training their branches horizontally, produces side shoots that flower and fruit more profusely than upright trees.

Nutrition & Growth

Numerous chemical elements are essential for plant growth. These are divided into the macro-nutrients and micronutrients (sometimes referred to as trace minerals). The roots, especially the root hairs (see page 40), are responsible for nutrient uptake from the growing medium (see page 136). The nutrients are then transferred to the conducting tissues, xylem (see page 80), and transported around the plant to wherever they are needed.

Macronutrients

Macronutrients are present in plant tissue in quantities from 0.2–4% (dry matter weight). They are carbon and oxygen, which are absorbed from the air through the leaves, and nitrogen, phosphorous, potassium, calcium, sulfur, magnesium, and silicon, which are absorbed from the growing medium.

Carbon

Carbon (C) forms the backbone of most biomolecules, including cellulose and starches.

Hydrogen

Hydrogen (H) is necessary for creating sugars and building the plant. Hydrogen ions are essential for photosynthesis and respiration.

Oxygen

Elemental oxygen (O), in water or carbon dioxide, is necessary for respiration, which creates the energy-rich adenosine triphosphate (ATP) via the consumption of sugars made in photosynthesis.

Nitrogen

Nitrogen (N) is an essential component in all amino acids and proteins, a vital part of chlorophyll and for producing strong, green leaves. Nitrogen deficiency results in stunted or slow growth and chlorosis. Nitrogen is very mobile in the plant and older leaves exhibit symptoms of deficiency earlier than younger ones.

Phosphorus

Phosphorus (P) is needed for the conversion of light energy to ATP during photosynthesis and is used by numerous enzymes. It is important for plant growth as well as successful flower, seed and root formation. Phosphorus deficiency is characterized by intense green leaf coloration and, because it is a mobile nutrient, older leaves show the first signs of deficiency.

Potassium

Potassium (K) is needed for photosynthesis, controlling water uptake by the roots and reducing water loss from the leaves and so increases drought tolerance. Because it promotes flowering and fruiting, it is needed by all flowering plants and it increases general hardiness. Potassium deficiency may cause necrosis or interveinal chlorosis and result in greater damage from pathogens, drought, frost and heat.

Sulfur

Sulfur (S) is a structural component of amino acids and vitamins, and is essential in the manufacture of chloroplasts and so sulfur is vital for photosynthesis. It is immobile and so deficiency affects younger tissues first, including yellowing of the leaves and stunted growth.

Helleborus atroubens, Lenten rose

About the Author

Geoff Hodge BSc, MI Hort has always been interested in plants and gardening. He has a degree in Agricultural Botany from Reading University, UK, but veered more toward horticulture after graduating. He started his career managing garden centers, learning about garden plants, and gardening by handling a huge number of cultivated plant species. For the last 23 years, he has communicated this love by writing about gardening for national newspapers, gardening magazines and websites. He has written seven books on gardening, including four for the Royal Horticultural Society. He regularly talks to gardeners and helps them with their gardening questions and problems on BBC radio, at gardening question times at flower shows across the country and at talks to gardening clubs and horticultural societies.

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Sunday Times

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The Bookseller

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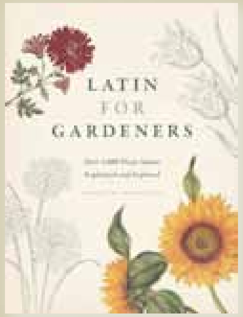


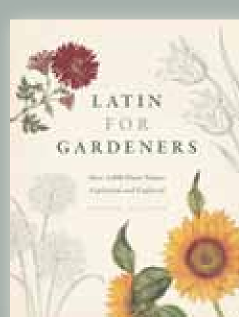
PRACTICAL BOTANY *for* GARDENERS

is more than just a useful reference book on the science of botany and the language of horticulture—it is a practical, hands-on guide that will help gardeners understand how plants grow, what affects their performance, and how to get better results.

Illustrated throughout with beautiful botanical prints and simple diagrams, *Practical Botany for Gardeners* provides easy-to-understand explanations of over 3,000 botanical words and terms, and shows how these can be applied to everyday gardening practice. For easy navigation, the book is divided into thematic chapters covering everything from Plant Parts to Plant Pests, and further subdivided into useful headings such as "Seed Sowing" and "Pruning." "Botany in Action" boxes provide instantly accessible practical tips and advice, and feature spreads profile the remarkable individuals who collected, studied and illustrated the plants that we grow today.

Aided by this book, gardeners will unlock the wealth of information that lies within the intriguing world of botanical science—and their gardens will thrive as a result.

Also available:



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