LEVEL 2

PRINCIPLES OF HORTICULTURE

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ROUTLEDGE

Contents

CHAPTER 4

Level 2

Classification and naming of plants

Figure 4.1 A range of plants found in the plant kingdom, including moss growing between stones, a fern and a seed-producing plant (ivy), in their natural habitat

This chapter includes the following topics:

- What is a plant?
- Plant classification – families, genera and species
- Plant names – the binomial system and cultivars
- Gymnosperms and angiosperms
- Monocotyledons and dicotyledons
- Further classifications of plants used in horticulture
- Fungal groups

What is a plant?

The world of living organisms can be grouped in many ways. One such classification is the five kingdom system:

- Plantae (plants)
- Animalia (animals)
- Fungi
- Prokaryota (bacteria)
- Protoctista (all other organisms that are not in the other kingdoms, including algae and protozoa).

What distinguishes the plant kingdom from the other four kingdoms? Plants are largely sedentary and live on land (albeit some in aquatic environments such as ponds and rivers). They are multicellular and their cells have cellulose cells walls and a nucleus. Most importantly, they are **autotrophs** (the 'producers' described on p. 38), organisms that are able to convert energy from one form, that is light, into a chemical form stored in organic molecules such as sugar and starch through the process of photosynthesis (see Chapter 9). Animals, among other things, have no cell walls and are **heterotrophs** (the 'consumers' described on p. 38). They rely on eating ready-made organic molecules for their nutrition and feed on plants and other organisms. Fungi do not photosynthesize and although some algae and bacteria do so, the former are aquatic organisms and the latter do not have a nucleus.

The plant kingdom contains a range of plant groups which reflect their evolutionary pathway from simple organisms, such as mosses and liverworts, to the more advanced conifers and flowering plants. Mosses and liverworts are the most primitive and are termed '**non-vascular**' plants as they have no specialized tissue for conduction of water and minerals (Figure 4.2). This, together with the need for water for reproduction, limits their size and restricts them to damp shady habitats. Mosses may be a problem weed in some circumstances, particularly in shaded and poorly drained lawns, but may also be used as an ornamental feature in Japanese gardens.

Figure 4.2 A feathery green moss and a purple liverwort growing on a wet rock. The liverwort structures are approximately 1 cm long

Figure 4.3 Hart's tongue fern (*Asplenium scolopendrium*) a native British fern

The '**vascular**' plants contain conducting tissue (xylem and phloem) (see Chapter 6) and range from ferns to higher plants such as gymnosperms, which include conifers, and angiosperms (the flowering plants). The '**lower vascular plants**', of which ferns are an example (Figure 4.3), spread by means of spores, in common with the non-vascular plants. They also require water for reproduction so tend to be found in damp places. Ferns provide a wide range of decorative plants in the garden and as houseplants, with many attractive leaf shapes and forms and a variety of sizes. They are especially useful for planting in shade.

In contrast, the '**higher vascular plants**', the angiosperms and the gymnosperms, which are more evolutionarily advanced, produce seed and spread by this means rather than by spores. It is mostly the higher plants which will be examined in this book as they represent by far the biggest and most diverse group of plants used in horticulture.

Plant classification – families, genera and species

Classification involves putting objects or organisms into groups based on characteristics which the members of the group share, it is something we do all the time and it is very useful. For example, the fresh produce section of the supermarket contains a salad section, a vegetable section and a fruit section. The fruit section in turn is subdivided into smaller groupings such as citrus (oranges and lemons), top fruit (apples and pears) and soft fruit (strawberries, blackberries and raspberries).

This enables us to find what we want quickly and know that what we are buying has particular characteristics. In the same way, the plant kingdom is classified into major groups, such as vascular and non-vascular plants described above, which are in turn subdivided into smaller groups. For gardeners, the groupings of plants which are most commonly encountered are **family**, **genus** and **species**.

Plant families were first described comprehensively by the Swedish botanist Linnaeus in the eighteenth century. His classification was originally based on flower structure, although nowadays many other factors such as plant chemistry and genetics are used in addition to their external features. Many of Linnaeus' original family names and groupings still stand. Currently about 240 plant families are recognized. Plant family names always end in –aceae for example, Lamiaceae (the nettle family) or Poaceae (the grass family). The family is an important grouping in horticulture as all plants within a family have certain characteristics in common, so predictions can often be made about other family members. For example, many members of the family Rosaceae (the rose family) are susceptible to the disease fireblight, aiding identification and enabling prediction of the spread of this disease.

Within a family, plants are organized into groups of similar plants called **genera** (sing. genus). A family may contain many genera, such as the Asteraceae (the daisy family) with 1,317 genera including *Lactuca* (lettuce), *Taraxacum* (dandelion) and *Dahlia,* or a few such as Geraniaceae with just five including *Geranium* and *Erodium*.

A genus is made up of groups of similar plants called **species**. A species is a group of individual plants which show the greatest degree of mutual resemblance, and which, most importantly, are able to breed among themselves but not with plants from another species.

Carl Linnaeus – the Father of Classification (1707–1778)

Carl Linnaeus (also known as Carolus Linnaeus or Carl Linné) (Figure 4.4) worked as an assistant and later as professor of botany at Uppsala University in Sweden. He brought together all recorded knowledge of the natural world known at that time and classified it into three kingdoms: minerals, plants and animals. He named some 7,700 plants and 4,400 animals in his lifetime and used an innovative classification system which was first set out in his *Systema Naturae* in 1735. Each kingdom was subdivided into a hierarchy of classes, orders, genera and species which replaced existing classification systems and is still in use today. For plants, he used the structure of flowers, in particular the male and female parts, as the basis of his classification. This 'sexual system' was a practical and easily learned approach which enabled him and his students to study a large number of species, although the florid way in which he described it caused an uproar at the time!

In addition, Linnaeus is credited with establishing the binomial system of nomenclature. Although the use of binomials for plants was not new, Linnaeus applied them consistently to all plant species alongside the cumbersome many-worded 'phrase names' which were current at the time and thus laid the foundation for a simple and universal naming system which has been adopted ever since. As such, Linnaeus' work *Species Plantarum*, first published in 1753, forms the basis for plant nomenclature right up to the present day.

Figure 4.4 Carl Linnaeus dressed as a Laplander from a painting by Hendrik Hollander in 1853. He explored Lapland in 1732, collecting plants, birds and rocks and used the 600-mile trip to apply his ideas of classification and nomenclature. He described 100 newly identified plant species in his book *Flora Lapponica*

A **genus** is a group of individuals within a family that have characteristics in common. A **species** is a group of individuals within a genus that have characteristics in common and are able to breed among themselves.

Plant names – the binomial system and cultivars

The name given to a plant species is very important and is the key to identification in the field or garden. Botanical plant names are stable and unambiguous; therefore their use avoids confusion. They are an international form of identity used by researchers and gardeners alike, in an internationally understood language. Armed with the botanical name, information on a specific plant can be sourced from books and the internet. A botanical name is required before breeders can legally protect the new plants they have bred and also means that the correct plant can be selected and identified in planting schemes. When dealing with medicinal plants and herbs, poisonous plants can be avoided.

Common names that we use for plants, such as daisy, potato and lettuce, are, of course, acceptable in English, but are not universally used. Common names may vary with location – for example, *Caltha palustris* has 140 names in Germany, 60 in France and 90 local names in Britain and Ireland including marsh marigold, kingcups and Mayblobs (Figure 4.5).

Alternatively, the same common name can describe several different species. Bluebell is the local name for *Campanula rotundifolia* in Scotland, *Hyacinthoides non-scripta* in England, *Wahlenbergia saxicola* in New Zealand, *Clitoria ternata* in West Africa and *Phacelia whitlavia* in the USA, none of which are related (Figure 4.6).

Figure 4.5 *Caltha palustris*

Figure 4.6 Two plants known as bluebells: (a) *Hyacinthoides non-scripta* (English bluebell); (b) *Campanula rotundifolia* (known as bluebell in Scotland and harebell in England)

Common names may be in a variety of languages and scripts and often plants are introduced without a common name (e.g. *Camellia sinensis*) or with one invented by the seller. A scientific method of naming plants therefore enables every plant to be unambiguously identified with an accurate name that is universally recognized.

The name can also provide information about a species, such as its relationship with other species, and can give clues about its origin, its preferred habitat or its characteristics such as its colour, size or form. See 'Plant Names' on the companion website. Linnaeus utilized a naming system which included the name of the genus to which a plant belonged followed by its individual species name written in botanical Latin. This is called a **binomial** after the two named

parts. For example, the chrysanthemum used for cut flowers (*Chrysanthemum morifolium*) is in the genus *Chrysanthemum* and is the *morifolium* species; note that the genus name begins with a capital letter, while the species has a small letter. Other examples are *Ilex aquifolium* (holly), *Magnolia stellata* (star-magnolia) and *Ribes sanguineum* (redcurrant). The genus and species names must be written in *italics*, or underlined where this is not possible.

Plants within a species can vary genetically in the wild, giving rise to a number of naturally occurring individuals with distinctive characteristics, much as people vary in their appearance. Where these differ significantly from the original species they may be given an additional name after the species name and are called a subspecies (subsp.), varietas (var.) or forma (f.) depending on the degree of difference (forma being the least different and subspecies the most). These extra names are written in botanical Latin and are italicized. They follow the species name, beginning with a small letter and with the category abbreviated and unitalicized in front of them – for example, *Hydrangea petiolaris* subsp. *anomala, Ceanothus thyrsiflorus* var. *repens, Primula sieboldii* f. *lactiflora*.

In addition, cultivation, selection and breeding by humans have produced variations in species referred to as **cultivated varieties** or **cultivars**, which are distinguished from naturally occurring variants because they have not usually arisen in the wild and must be maintained in cultivation either by specific breeding programmes to produce seed or by vegetative propagation. The cultivar is given a name, often chosen by the plant breeder who produced it, such as *Rhododendron arboreum* 'Tony Schilling' or *Cornus alba* 'Sibirica', and is always a non-Latin (vernacular) name, unitalicized and enclosed in single quotation marks. Cultivar names can also provide information about a plant's characteristics, for example, a dessert apple that is suitable for small gardens, 'Red Devil', produces bright red fruit; a thornless blackberry, 'Loch Ness', was raised in Scotland and shows considerable winter hardiness. This information is useful for gardeners. *Penstemon* and *Pelargonium* genera have the cultivars 'Apple Blossom', which describe well the pale pink and white of the flowers. Cultivar names can also be written, where applicable, after a common name, often for fruits and vegetables – for example, tomato 'Ailsa Craig' and apple 'Bramley's Seedling'.

The general term 'variety' (which is not the same as 'varietas' described above) is often used to refer to any plant type which varies from the original species. As such, it is frequently used interchangeably with 'cultivar'. In this publication, however, the correct term 'cultivar' will be used throughout.

A **cultivar** is a variation within a species that has usually arisen and has been maintained in cultivation. A horticultural **variety** is a general, non-botanical term for plants that vary from the species.

Examples of plant groupings and how they are named in the family Rosaceae are shown in Figure 4.7.

Plant groups of importance in horticulture

Gymnosperms and angiosperms

Two of the most significant groups in the plant kingdom, the angiosperms and the gymnosperms, are distinguished from all other plants by their reproductive behaviour. These are the seed-bearing plants which spread by dispersal of seeds rather than by spores as in more primitive plants such as mosses and ferns.

Gymnosperms characteristically produce male and female cones which bear only partially enclosed 'naked' seeds, hence the name 'gymnosperm'. By far the largest gymnosperm group is the **conifers**, which include many hundreds of species such as the pines, junipers, spruces and yews (Figure 4.8) and form the vast boreal forests of the northern hemisphere. They are also found in Australia, Papua New Guinea and South America. The Chilean pine or monkey-puzzle tree (*Araucaria araucana*) was once widely planted in Victorian gardens. Conifers have the following characteristics:

- primarily perennial, woody trees and shrubs
- have male and female cones
- male cones produce prodigious amounts of pollen which is spread by the wind
- seeds, which are borne on female cones
- often found in a limited range of habitats where water is in scarce supply either due to low rainfall or because the ground is frozen for much of the year
- frequently display structural adaptations to reduce water loss, for example, needles or scale leaves (Figure 4.9) and branches designed to shed snow
- may contain resin in their wood which acts as an antifreeze
- mostly evergreen to take full advantage of the short growing season and avoid expending unnecessary energy on producing new leaves each year, although a few genera such as *Taxodium*, *Metasequoia* and *Larix* are deciduous.

Family
A group of one or more genera which share underlying common features. Names end in -aceae

Rosaceae

Genus (pl. genera)
A group of one or more plants with features in common. Printed in italics with a capital initial letter

Rosa *Pyrus* *Alchemilla* *Kerria*

Species
A group of plants which can interbreed. The two part name (binomial), which is written in italics consists of the genus to which they belong and the species name

Rosa canina

Pyrus communis

Alchemilla mollis

Kerria japonica

Cultivar (cultivated variety)
These are variants of species which are selected or artificially created. They are given a vernacular name enclosed in single quotation marks which is not italicised. Where the parentage is obscure the species name may be dropped

Rosa 'Roseraie de l'Hay'

Pyrus communis 'Conference'

Kerria japonica 'Simplex'

Figure 4.7 Some plant groups within the family Rosaceae

Figure 4.8 (a) Yew (*Taxus baccata*) with 'berry'-like arils – a conifer

Figure 4.8 (b) conifer cones

Figure 4.9 Conifer leaves: (a) needles in *Pinus* spp; (b) scale leaves in *Thuja*

Figure 4.10 *Ginkgo biloba* leaf in autumn

There are very many important conifers. Some are major sources of wood or wood pulp, but in the garden many are valued because of their interesting plant habits, foliage shapes and colours. The cypress family Cupressaceae, for example, includes fast-growing species (e.g. ×*Cuprocyparis leylandii*), which can be used as windbreaks, and small slow-growing types very useful for rock gardens (e.g. *Juniperus procumbens*). The yews are a highly poisonous group of plants that includes the common yew (*Taxus baccata*) used in ornamental hedges and mazes.

One division of the gymnosperms is represented by a single surviving species, *Ginkgo biloba* the maidenhair tree, which has an unusual slit-leaf shape and distinctive bright yellow colour in autumn (Figure 4.10). It is a survivor from the Carboniferous era and fossils are found dating back 270 million years.

The **angiosperms**, or **flowering** plants, encompass the greatest diversity of plant life with adaptations for the vast majority of global habitats. There are estimated to be some 400,000 species of flowering plant on earth and they represent the most advanced plant life forms. Angiosperms have the following characteristics:

- unique in having flowers, usually hermaphrodite, which are pollinated by wind, insects and other agents and, in many cases, these flowers are highly adapted to their specific pollinators
- flowers produce seeds inside a protective fruit
- life cycles encompass the full range of ephemerals, annuals, biennials and perennials
- can be both herbaceous and woody in structure
- can be evergreen or deciduous in behaviour
- occupy the greatest range of habitats.

Many flowering plants are important in gardens, as crop plants, ornamentals and weeds. Chapters 5 to 10 will focus mainly on the angiosperms.

Monocotyledons and dicotyledons

The angiosperms are split into two main groups generally known as the **monocotyledons** and the **dicotyledons**. The main differences are given in Table 4.1 and are further described in Chapters 6, 7 and 8.

Monocotyledons include some important horticultural families – for example, Poaceae (formerly Graminae) the grasses and bamboos; Alliaceae, the onions; bulbous plants such as Liliaceae, which includes lilies and tulips and Amaryllidaceae which includes daffodils; Orchidaceae, the orchids and some food plants such as Musaceae, the bananas (Figure 4.11).

Dicotyledons have many more families significant to horticulture, including Magnoliaceae, the magnolias; Caprifoliaceae, the honeysuckles; Cactaceae, the cacti; Malvaceae, the mallows; Ranunculaceae, the buttercups; Theaceae, the teas; Lauraceae, the laurels; Betulaceae, the birches; Fagaceae, the beeches; Solanaceae, the potatoes and tomatoes; Nymphaeaceae, the water lilies; and Crassulaceae, the stonecrops (Figure 4.12).

Table 4.1 Differences between monocotyledonous and dicotyledonous plants

Monocotyledons	Dicotyledons
One seed leaf (cotyledon)	Two seed leaves (cotyledons)
Parallel veined leaves, usually alternate and sword-shaped with smooth margins	A variety of leaf vein patterns e.g. reticulate (net) veined and many different shapes and margins
Vascular bundles in stem scattered	Vascular bundles in stem arranged in rings
Vascular tissue (stele) in the root has many arms	Vascular tissue (stele) in the root with up to seven arms
No vascular cambium	Vascular cambium
Fibrous root systems	Both fibrous and tap root (primary) systems
Flower parts usually in threes or multiples thereof, also three seed chambers in fruit	Flower parts usually in fours or fives or multiples thereof, often four or five seed chambers in fruit
Small non-woody herbaceous plants (except palms and bamboos)	Both small and large, woody and herbaceous species with woody stems showing annual rings and bark

Further classifications of plants used in horticulture

Plants can be grouped into other useful categories. A classification based on their life cycle (ephemerals, annuals, biennials and perennials) has long been used by both botanists and growers. Many naturally perennial plants, such as *Pelargonium zonale*, *Lobelia*

Figure 4.11 Monocotyledonous angiosperms: (a) a fragrant orchid (*Gymnadenia conpsea*); (b) a bamboo

erinus or *Erysimum cheiri* (wallflower) may be grown as annuals or biennials that are removed and replaced after their first or second season of growth. These may be referred to as 'annuals' and 'biennials' by horticulturists – an example of where botany and horticulture disagree!

A distinction can also be made between the different types of woody plants such as trees and shrubs. Another classification can be made based on a plant's temperature tolerance, separating those plants that are able to withstand a frost (hardy), those that cannot (tender) and those which can withstand a few degrees of frost but may need some winter protection (half-hardy). Plants can be grouped according to their degree of hardiness and various scales are available; the one in Table 4.2 is produced by the Royal Horticultural Society (RHS). It must be remembered that, while withstanding cold conditions is the main factor in a

Figure 4.12 A dicotyledonous angiosperm: rose flower with five petals and a succulent fruit (hips)

Table 4.2 Some commonly used terms that describe the life cycles, structure, leaf retention and hardiness of plants

	Description	Example(s)
Life cycles		
Ephemeral	A plant that has several life cycles in a growing season and can increase in numbers rapidly.	*Senecio vulgaris* (groundsel)
Annual	A plant that completes its life cycle within a growing season.	*Limnanthes douglasii* (poached-egg flower)
Biennial	A plant with a life cycle that spans two growing seasons.	*Digitalis purpurea* (foxglove)
Perennial	A plant living through several growing seasons.	*Quercus robur* (oak), *Vibumum opulus*, *Acanthus spinosus*
Plant structure		
Herbaceous perennial	A perennial that is non-woody and generally loses its stems and foliage at the end of the growing season. They do not undergo secondary thickening. A few may be evergreen e.g. *Liriope muscari, Euphorbia characias, Ajuga reptans*.	*Aster* spp. (michaelmas daisy), *Humulus lupulus* (hop)
Woody perennial	A perennial that maintains a live woody framework of stems at the end of the growing season. They undergo secondary thickening.	Bush fruit, shrubs, trees, climbers (e.g. *Vitis vinifera*, grape)
Shrub	A multistemmed woody perennial plant having side branches emerging from near ground level. Up to 5 m tall.	*Hydrangea macrophylla*
Tree	A large woody perennial unbranched for some distance above ground, on a single stem. Usually more than 5 m tall.	*Aesculus hippocastanum* (horse chestnut)
Leaf retention		
Deciduous	A plant that sheds all its leaves at once, often at the end of the growing season.	*Philadelphus delavayi* (mock orange)
Evergreen	A plant retaining leaves in all seasons.	*Aucuba japonica*
Semi-evergreen	A plant that retains some of its leaves through the year but may shed most leaves under severe weather conditions such as extreme cold or drought.	*Lonicera nitida*
Hardiness*		
Hardy (H4 to H7)	A plant able to survive temperatures below -5°C. Will survive freezing temperatures although some plants may suffer foliage damage or require protection if in pots. Can be divided into further categories depending how far below -5°C the plant can survive.	*Cornus alba* 'Sibirica', *Erica carnea*, *Magnolia* 'Susan', *Bergenia cordifolia*
Half-hardy (H3)	A plant able to survive freezing temperatures between 1°C and -5°C. Tolerant of a few degrees of frost. Will survive a mild winter but generally requires an unheated glasshouse over winter.	*Pittosporum crassifolium*, *Petunia* spp., *Plumbago auriculata*, *Clianthus puniceus*
Tender (H2)	A plant able to survive low temperatures between 1°C and 5°C. Tolerant of low temperatures but will not survive frost. Requires a cool or frost-free glasshouse in winter. Can be grown outside after danger of frost is over.	*Citrus meyeri* 'Meyer'
Heated glasshouse (H1)	A plant requiring temperatures above 5°C to survive. Some can be grown outside in summer when daytime temperatures are high enough or in a sheltered position. Some must be grown under glass or as houseplants all year. Can be divided into further categories depending on the plants requirements for temperatures above 5°C.	*Pelargonium* cvs, *Solenostemon* cvs, *Brugmansia* spp., *Monstera deliciosa*,*Anthurium andraeanum*

* See Table 2.1. These definitions correspond with current RHS hardiness categories.

plant's hardiness rating, other factors, such as wind and soil conditions (relating to the species origins), will play a part. Table 4.2 brings together these useful terms, providing definitions and some plant examples.

The following terms are derived from the use of plants:

- **Bedding**: a fast-growing species, often flowering, used to make a temporary, often formal, display, e.g. *Petunia*, *Pelargonium*, *Sedum, Viola x wittrokiana* (pansy).
- **Tropical**: a non-native, usually exotic, tender plant used for indoor, or seasonal outdoor, display, e.g. *Canna*, *Hibiscus*.
- **Edging**: low and often, slow-growing species grown in similar groups to create an edge to a path or boundary between planted areas, e.g. *Thymus*, *Viola*, non-spreading hardy geraniums, and many low-growing, compact perennials.
- **Dot plant**: a single plant, usually tall, planted to create a focal point within a bedding scheme, e.g. *Eremurus* (foxtail lily), standard rose, *Phormium*, *Acer palmatum* (Japanese maple).

- **Ground cover**: low growing, usually evergreen plants designed to completely cover the soil, e.g. *Hedera* (ivy), *Vinca* (periwinkle), *Epimedium*.

Fungi

The kingdom Fungi is a very diverse group about which much remains to be studied. It has been estimated that there are 1.5 to 5 million species of which only 5% has been classified to date! Some fungi are single celled (such as yeasts), but others are multicellular, such as the moulds and the more familiar mushrooms and toadstools (Figure 4.13). Most are made up of a mycelium, which is a mass of thread-like filaments (hyphae) which generally remains hidden from view. The mushrooms we see at certain times of year are the spore-producing part of the life cycle. Fungal cell walls are made of chitin not cellulose as in plants.

Fungi obtain their food directly from other living organisms (heterotrophic nutrition), sometimes causing disease (see Chapter 19), or from dead organic matter, so contributing to its beneficial breakdown in the soil (see Chapters 3 and 13). They achieve this by secreting digestive enzymes onto their food source and absorbing the soluble products.

In horticulture, fungi (mushrooms) are also important as a food crop. Mycorrhiza and lichens are examples of a mutualistic relationship between fungi and other organisms (Figure 4.14).

See 'Non-Plant Kingdoms' on the companion website.

Figure 4.13 Shaggy ink cap, a fungus showing its fruiting bodies

Figure 4.14 Lichens – a combination of a fungus and a cyanobacterium: (a) *Xanthoria* spp.; (b) *Parmelia* spp.; (c) *Usnea* spp.

Fungal classification

Fungi are classified into four groups (Figure 4.15):

- **Zygomycota** (mitosporic fungi) have simple asexual and sexual spore forms. Damping off, downy mildew and potato blight belong to this group (see p. 251).
- **Ascomycota** have chitin cell walls, and show, throughout the group, a wide variety of asexual spore forms. The sexual spores are consistently formed within small sacs (asci), numbers of which may themselves be embedded within flask-shaped structures (perithecia), just visible to the naked eye. Rose black spot (see p. 255), apple canker, powdery mildew and Dutch elm disease belong to this group.
- **Basidiomycota** have chitin cell walls, and may produce, within one fungal species (e.g. cereal rust), as many as five different spore forms involving more than one plant host. The fungi within this group bear sexual spores (basidiospores) from a microscopic club-shaped structure (basidium). Carnation rust, honey fungus and silver leaf diseases belong to this group (see p. 259).
- **Deuteromycota** are an artificially derived fourth grouping which is included in the classification of fungi. It includes species of fungi that only very rarely produce a sexual spore stage. As with plants, the sexual structures of fungi form the most reliable basis for classification. But, here, the main basis for naming is the asexual spore and mycelium structure. Grey mould (*Botrytis*) (see p. 256), *Fusarium* patch of turf and *Rhizoctonia* rot are placed within this group.

Figure 4.15 Classification of fungi: (a) damping-off disease – a zygomycota; (b) a courgette with powdery mildew – an ascomycota; (c) pear rust – a basidiomycota; (d) Fusarium wilt – a deuteromycota

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Please visit the companion website for further information: **www.routledge.com/adams**

PRINCIPLES OF HORTICULTURE

This colourful guide will introduce you to the fundamentals of horticulture, whether you are taking a Level 2 course of study, are a keen amateur or a seasoned gardener.

- Written alongside the new RHS specifications and other qualifications
- Extensive coverage of the many sectors within horticulture, including several gardening examples
- The latest developments in the field explained by experts

Written in a clear and accessible style, this book explains the principles that underlie the cultivation of flowers, fruits, vegetables, turf and ornamental planting in the outdoors and in protected culture. This is achieved through the study of plant growth in the domestic garden and allotments. In this context the book explores the world of plants, plant growth and the development of plants, maintaining plant health, soils and alternatives to soils, plant propagation and gardens. Topics covered include:

- the horticultural industry that supports the gardener
- sustainability and conservation
- plants of the world
- garden ecology and wildlife
- classification and naming of plants
- plant life cycles
- internal and external features of plants
- plant reproduction
- plant growth
- propagation of plants
- physical properties of soils
- organic matter in the root environment
- plant nutrition
- growing in containers
- garden weeds, pests and diseases
- maintaining plant health.

Updates are in line with the current Level 2 Horticulture syllabuses and align closely with that of the RHS Certificate in the Principles of Plant Growth, Propagation and Development. The Level 1 practical certificate is also covered.

A companion website with extended horticultural information, questions and exercises to test your knowledge, syllabus cross-referencing and downloadable tutor and student support materials, including all the colour artwork from the text, is available at **www.routledge.com/cw/adams**

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