10–6–4 fertilizer in the spring. Unless it is applied carefully when the grass is dry and unless the application is followed by rain or thorough sprinkling, "burning" of the grass is likely. It is much better to split the applications into two or three lighter ones over an interval of some weeks. You can buy a slowly available but high-analysis nitrogen fertilizer that does not burn the grass but gives a slow, continuous supply to the plants throughout the growing season.

In warm, humid areas, however, spring applications of nitrogen often stimulate fungus diseases, especially on clayey soils. Bluegrass, for example, responds readily to nitrogen fertilizer. The plants are luscious and tender. Then during hot, humid days in late May or June, damping-off and brown patch may nearly destroy these susceptible plants. Under such conditions, the main application of fertilizer can be made in early autumn, after the danger of these diseases is past. The grass plants go into the winter with good root reserves and should be given only very light applications of nitrogen during the remainder of the year, except in the shade under the trees, where they should have light to medium applications in spring and summer.

CLOSE CLIPPING with the mower is a common cause of poor lawns, especially in warm places where the hot rays of the sun fall directly on the crowns of the plants. With the mower set high, the clipped plants can stand more heat. A mixture of clover helps to shade the crowns of bluegrass. In cool regions, the grass may be clipped down to 1 inch, but in warm areas 1.5 or 2 inches is better.

Frequently it is wise to leave the clippings on the lawn, because the clippings help to maintain organic matter and nutrients in the surface soil. Heavy clippings from infrequent mowings, however, should be removed to the compost pile and not left as a smothering mat over the grass.

Ornamental Plants

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The adaptation of ornamental trees, shrubs, bulbs, and flowering plants to a region is determined more by climatic conditions than by soil. Many varieties of such plants as camellias and azaleas can be grown only where the winters are mild.

Some herbaceous perennials, such as delphiniums, are satisfactory only in sections where cool summer temperatures prevail. Late-flowering varieties of such plants as chrysanthemums cannot be grown without protection in places where frosts come early.

One type of soil may be preferable to another for the growth of certain species of ornamentals, but there are no data regarding the best soil type for most ornamental plants. Recommendations are based almost entirely on observations of good growth in a particular type of soil, but plants of the same species often grow well in different types of soil.

ORNAMENTAL PLANTS often are planted in localities where the soil type is far from ideal. It is possible in most instances to replace or modify the physical characteristics and fertility of the soil for ornamentals. A deep, friable, well-drained, sandy loam that contains ample organic matter usually is considered suitable for most ornamentals, but some will thrive on soils less favorable.

Since some ornamental plants are

known to grow well in the same general soil type, we discuss such groups together in the paragraphs that follow. Information is usually available at State agricultural experiment stations as to what kinds of plants are best adapted in your climatic zone.

SHRUBS are widely grown throughout the United States for use in landscaping homes, gardens, streets, and parks. Their selection is usually governed by the color of flower, fruit, and foliage; time of blooming; ultimate size; and general availability. Environmental factors, such as temperature, light, water, and soil, however, determine the adaptability and amount of growth in a particular place.

THE NATURALLY occurring soil may limit growth because of poor structure and drainage, lack of essential nutrients, or unfavorable soil reaction. Many shrubs will tolerate or even thrive on a wide range of soils, but others are more exacting, particularly as to soil reaction.

Shrubs that require acid soil:
Rhododendron, Azalea (*Rhododendron* species)
Serviceberry (*Amelanchier* species)
Strawberry-tree (*Arbutus unedo*)
Heather (*Calluna* species)
Summersweet (*Clethra* species)
Broom (*Cytisus* species)
Heath (*Erica* species)
Wintergreen (*Gaultheria procumbens*)
Hollies (*Ilex* species)
Common Juniper (*Juniperus communis* and varieties)
Laurel (*Kalmia* species)
Box Sandmyrtle (*Leiophyllum buxifolium*)
Leucothoe (*Leucothoe* species)
Bayberry (*Myrica* species)
Blueberry (*Vaccinium* species)
Hobblebush (*Viburnum alnifolium*)

Azaleas, as typical of this group of plants, grow best at pH 4.5 to 5.5 in well-drained sandy loam that contains a plentiful quantity of organic matter, including partly rotted oak leaves, twigs, bog peat, and old sawdust. Soil structure is most important and must permit ample aeration in the root area and high water-holding capacity. (Some shrubs, such as juniper and bayberry, require an acid soil but tolerate dry sites.) A mulch of peat moss or oak leaves maintained throughout the year at a depth of 2 to 3 inches tends to control soil reaction, provide some nutrients, and maintain iron availability. The main nutrient required is nitrogen, which can be supplied in organic form from cottonseed and soybean meal or as ammonium sulfate.

CHLOROSIS—a yellowing—of azalea leaves, which results from iron deficiency caused by root injury, lack of acidity, use of excessive amounts of lime and phosphorus, poor drainage, and certain nutrient deficiencies, can be corrected temporarily by spraying the plants with ferrous sulfate or by applying chelated iron to the soil. These treatments cannot substitute for good soil and growing conditions, however.

Certain shrubs, such as the barberry, daphne, and lilac, grow well under neutral or slightly alkaline conditions sometimes found in the humid regions. They and many other species will grow in slightly acid soils, however. Their growth is generally influenced more by light, fertility level, and water than by soil reaction.

SHADE AND ORNAMENTAL TREES, within their climatic limitations, in most instances grow best on a fertile, well-drained loam, but they will tolerate a wide variety of soil conditions.

A poor internal soil drainage, with resulting poor aeration, is detrimental to the growth of most species of trees, but some kinds will grow on wet sites.

Poor soils unsuited for satisfactory growth of shade trees usually may be modified by the addition of sand, peat, or decayed leaves or by installing drains, so that good growth can be obtained.

Before selecting shade trees, you will do well to consult your State agricultural experiment station, or other local

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authorities, about the kinds best suited for your locality.

In the following list we give examples of kinds of trees that require special types of soil for good growth or that will grow in certain types of soils:

Trees that need an acid soil:
- Pin Oak (*Quercus palustris*); becomes chlorotic on neutral or alkaline soil.
- Strawberry-tree (*Arbutus unedo*)

Trees that will grow on relatively dry soils:
- Velvet Ash (*Fraxinus velutina*)
- Acacia (most species)
- Tree-of-Heaven (*Ailanthus altissima*)
- Boxelder (*Acer negundo*)
- Chinaberry (*Melia azedarach*)
- Smooth Arizona Cypress (*Cupressus arizonica bonita*)
- Carob (*Ceratona siliqua*)
- Giant Evergreen Chinquapin (*Castanopsis chrysophylla*)
- California Peppertree (*Schinus molle*)
- Eucalyptus (most species)
- Green Ash (*Fraxinus pennsylvanica lanceolata*)
- Hop Hornbeam (*Ostrya virginiana*)
- Pignut Hickory (*Carya glabra*)
- American Hornbeam (*Carpinus caroliniana*)
- Eastern Redcedar (*Juniperus virginiana*)
- Jujube (*Zizyphus jujube*)
- Pacific Madrone (*Arbutus menziesi*)
- Mimosa (*Albizzia julibrissin*)
- Chestnut Oak (*Quercus montana*)
- Oregon White Oak (*Quercus garryana*)
- White Poplar (*Populus alba*)
- Fremont Cottonwood (*Populus fremonti*)
- Jerusalem-thorn (*Parkinsonia aculeata*)
- Blue Paloverde (*Cercidium floridum*)
- Ponderosa Pine (*Pinus ponderosa*)
- Brazil Peppertree, Christmas-berry Tree (*Schinus terebinthifolius*)
- Torrey Pine (*Pinus torreyana*)
- Virginia Pine, Scrub Pine (*Pinus virginiana*)
- Pitch Pine (*Pinus rigida*)
- Russian Olive (*Elaeagnus angustifolia*)
- Sassafras (*Sassafras albidum officinale*)

Trees that will grow on wet soils:
- Alders (several species)
- Baldcypress (*Taxodium distichum*)
- Cajeput Tree (*Melaleuca leucadendron*)
- Dahoon (*Ilex cassine*)
- Eastern Larch, or Tamarack (*Larix laricina*)
- Poplars (*Populus*)—most species will grow on wet soils.
- Whitecedar Falsecypress (*Chamaecyparis thyoides*)
- Red Maple (*Acer rubrum*)
- Pin Oak (*Quercus palustris*)
- Water-elm (*Planera aquatica*)
- Sweetbay Magnolia (*Magnolia virginiana*)
- American Sweetgum (*Liquidambar styraciflua*)
- Willow (*Salix*) (most species)

Trees that will grow on gravelly soils:
- Tree-of-Heaven (*Ailanthus altissima*)
- Dahurian Birch (*Betula davurica*)
- Common Honeylocust (*Gleditsia triacanthos*)
- Nordmann Fir (*Abies nordmanniana*)—will grow on gravelly hardpan.
- Mimosa (*Albizzia julibrissin*)
- Oregon White Oak (*Quercus garryana*)
- Mugho Pine, or Swiss Mountain Pine (*Pinus mugo*)
- Common Paper-mulberry (*Broussonetia papyrifera*)
- Common Sassafras (*Sassafras albidum* (*officinale*))

Trees that will grow on dry, alkaline soil in the West:
- Fremont Cottonwood (*Populus fremonti*)
- Jujube (*Zizyphus jujube*)
- Velvet Ash (*Fraxinus velutina*)

Trees that grow well on alkaline soils in the East:
- Eastern Redcedar (*Juniperus virginiana*)

Franklinia (*Franklinia alatamaha*)—prefers slightly alkaline, moist, but well-drained soil.
Beech (*Fagus*)

Trees that will grow on very sandy soil:
Australian Tea-tree (*Leptospermum laevigatum*)
Ailanthus (*Ailanthus altissima*)
Smooth Arizona Cypress (*Cupressus arizonica bonita*)
Pfitzer Juniper (*Juniperus chinensis pfitzeriana*)
Savin Juniper (*Juniperus sabina*)
Creeping Juniper (*Juniperus horizontalis*)
Shore Juniper (*Juniperus compacta*)—on sandy shores.
Jerusalem-thorn (*Parkinsonia aculeata*)
Mimosa (*Albizzia julibrissin*)
Silk-oak Grevillea (*Grevillea robusta*)
Pitch Pine (*Pinus rigida*)
Scotch Pine (*Pinus sylvestris*)

FLOWERING BULBS prefer a friable, fertile, and well-drained soil.

They perform very well on sandy loams, loams, and even clay loams if drainage is good. The prevailing soil and air temperatures are greater limiting factors than soil type, because the type of soil may be amended, but we can do little about the weather.

High soil fertility is important with all flowering bulbs. Even in sandy soils, good results may be had if the soil is fertile. There is considerable evidence, however, that high levels of nitrogen (especially from organic sources such as animal manures) increase the activity of some soil fungi that attack and destroy flowering bulbs.

The problem of drainage is important with some bulbs. Many of the lilies (such as testaceum, candidum, and auratum) will not tolerate poor drainage. Others (such as pardalinum, parryi, and canadense) perform very well in wet soils if the soil moisture is not stagnant. Such conditions are provided at the edge of running streams or on slopes fed by springs.

There is very little evidence as to the acidity or alkalinity preferences of flowering bulbs. In general it appears that most bulbs perform well when the soil is slightly acid. Some lilies, such as speciosum, auratum, and philadelphicum, prefer soils more acid than candidum or longiflorum.

Until more acceptable evidence is available, it is impossible to make any definite recommendations regarding either optimum fertilizer or pH requirements of flowering bulbs.

HERBACEOUS PERENNIALS grow very well on a wide variety of soil types, if the soil is well drained. Sandy loams, loams, and silt loams usually meet the requirements of good drainage. Sands and loamy sands also are satisfactory, but they may require frequent applications of water.

Since the perennials will occupy the space for several years, it is important to put the soil in a good state of fertility before the plants are set out.

Unfortunately, little scientific data are available as to the preferable soil types or fertilizer requirements for the numerous kinds of perennial ornamental plants available to gardeners.

More information is available as to the effect of acid or alkaline soils on growth of some perennials. Even here, however, there is very little in the way of experimental data comparing plant response when grown under a wide range of acid or alkaline soils. Most perennials appear to perform best when the soil is slightly acid.

GOOD ANNUAL FLOWERS may be grown on a wide range of soil types. Because many of these plants are shallow rooted, good drainage is less essential for them than for bulbs and perennials. Light, friable soils, such as sandy loams and loams, will produce good annuals.

The length of the growing season and the air temperatures are of prime importance in growing many annuals. The range of such annuals as stocks (*Matthiola incana*) and sweetpeas (*Lathyrus odoratus*), depends on cool air temperatures rather than soil type.