Planting in Urban Soils

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Preface

Planting in Urban Soils was designed and compiled to supply basic soils and plant information for the industrial or municipal landscape gardener and for the homeowner. This bulletin will also be helpful to those instructing classes in plant handling techniques. Heretofore, agricultural extension publications and similar bulletins have covered only one aspect of soils or planting procedures. The publication gathers together information on soil sampling and landscape planning, climate, plant selection, planting and maintenance.

Park gardeners and the homeowner have need for more inclusive information on this topic. In addition, urban soils are generally of very poor quality, and to have green grass and trees around us there is a great need to provide the best possible environment for the plants. To this end this bulletin is dedicated.

Introduction

Plants and trees play an important role in the urban environment. Americans in increasing numbers are becoming more aware of their natural surroundings. In a response to a Louis Harris survey (*Life*, Vol. 68, No. 1, January 9, 1970), Americans voted overwhelmingly in favor of green grass and trees when asked what they wanted most in the areas where they live. Here are the six components Americans consider most important, according to this poll:

Green grass and trees around me	95%
Neighbors with whom I feel comfortable	92%
A church of my faith nearby	86%
A first rate shopping area nearby	84%
A kitchen with all the modern conveniences	84%
Good schools nearby	81%

Urban ecologists must make sure that green grass and trees are cultivated wherever possible. A fundamental reason for the poor condition of plants and trees in the urban environment is the extreme conditions encountered. Therefore, a coordinated effort is desirable. If green grass and trees are to survive within the urban ecosystem, the urban soils must be modified to enhance these greenbelts.

Management and maintenance people who are responsible for making the decisions as to where, when, and how to plant must prepare themselves to meet this need. Cooperation among city engineers, landscape architects, horticulturists, botanists, ecologists, highway engineers, and related personnel is essential in order to achieve these goals. Urban residents and professionals have a common goal—a more pleasant, livable urban ecosystem.

1. Urban Soils

Soils in the urban environment are one of the greatest problems facing the landscape gardener. Construction work has usually altered the ground around buildings so that the soil resembles its natural counterpart only slightly. Subsoil has been mixed with topsoil, topsoil has frequently been removed altogether, and much soil has been badly adulterated with such building debris as bits of stucco, brick, wire, nails, and wood.

Such soil is not really "soil" at all, at least in the sense of being a good medium in which to grow trees, shrubs, and flowers. It is almost devoid of the mineral nutrients necessary for healthy plant growth. It may suffer from extreme compaction, overheating from nearby buildings, pavement and pesticide accumulation. More often than not, it lacks good air-moisture relationships, has poor structure and texture, and is poorly drained. Sometimes the soil retains so much moisture that plant roots drown during the first wet period.

These are some of the conditions which result in "soils" that are nearly incapable of supporting plantlife. If trees and other plants are to thrive in and around our cities, good soil practices must be followed by gardeners. This bulletin discusses the basic steps that must be taken to modify or amend the poor soil left behind after construction.

Initial Study of Soil Sites

The first step in any program of landscape planting is to find out what kind of soil you are working with. Dig a hole or small trench. If the soil has not been disturbed by building activity, it will show a profile of two distinct layers, the first topsoil, the second subsoil (Fig 1.). The topsoil should be darker in color and have a different appearance than the sub-

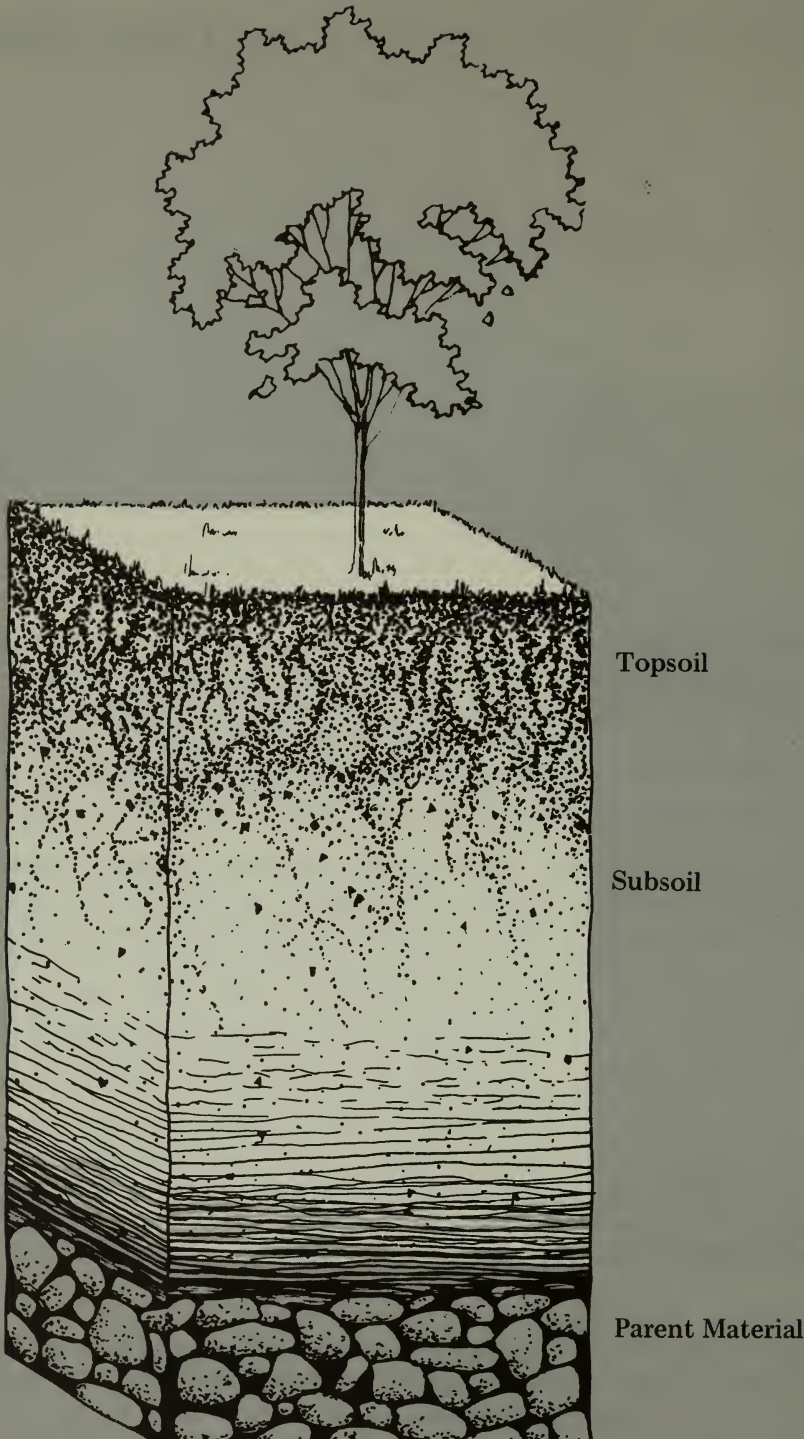


Figure 1. Ideal soil profile.

soil. If your planting site shows such a profile and is not littered with building debris, you are ready to take samples for a soil test, a method of chemical analysis to determine soil quality which will be described below.

If the sampling does show considerable building debris, the individual planting sites (not the whole area!) should be dug up to a depth of 3 or 4 feet and the debris removed or separated. Samples can now be taken for testing.

Soil Sampling and Testing

For a good composite sample, take random borings of the planting area, 8 to 10 borings for a small lawn or a yard to be planted in trees, 10 to 20 borings for an area of several acres. A small park may have to be divided into several sampling areas, depending on the landscape plan. (See Figure 2). Chemical analysis of the composite sample will show where the soil stands on the acid-alkaline scale and what fertilization and other soil improvement practices are needed for healthy plant growth.

For large-scale commercial jobs, landscape planners should supervise the sampling and see that they are sent to a reliable soil-testing laboratory, usually at the State agricultural college. The laboratory or your county agricultural agent can supply you with mailing containers and full instructions. If you've never taken soil samples before, follow these steps:

1. Determine the number of samples which must be taken and the sampling pattern. Be sure to sample non-uniform areas separately from other locations so that each is considered as an individual location, and to divide very large areas and take smaller individual samplings.
2. Avoid sampling when the soil is excessively wet or frozen, and avoid taking clods or debris in the sample. If moist soil samples are taken, do not dry them on radiators or in ovens, but allow them to air-dry before sending them to the laboratory. Tests will be processed more quickly with dry soil samples.
3. Take uniform soil cores or borings to a depth of 6 inches and from random locations. Or, if you use a spade or shovel, dig a slice of soil one half inch thick from a V-shaped trough. From this take a one-inch strip and place in a bucket for the composite sample (Fig.3). Select and sample the other areas to form the composite sample, thoroughly mix the samples, and take an aliquot or representative sample of the soil to be tested and place it in the carton supplied by the laboratory. About one pint is required for a soil test. Several kinds of tools may be used (Fig.4).
4. Label each sample clearly and affix your name and address. Be sure to keep a record for yourself!

5. Fill out the information sheet so that complete and appropriate recommendations can be made for the plant type you wish to grow.
6. Forward the sample and the information sheet to the local soil testing laboratory, which is usually located within the State college or university. Normally, it requires about two weeks for processing the sample, and about one week for recommendations to be made. Therefore, plan accordingly and submit samples early. Assistance can be obtained from your local county agent or agricultural experiment station.

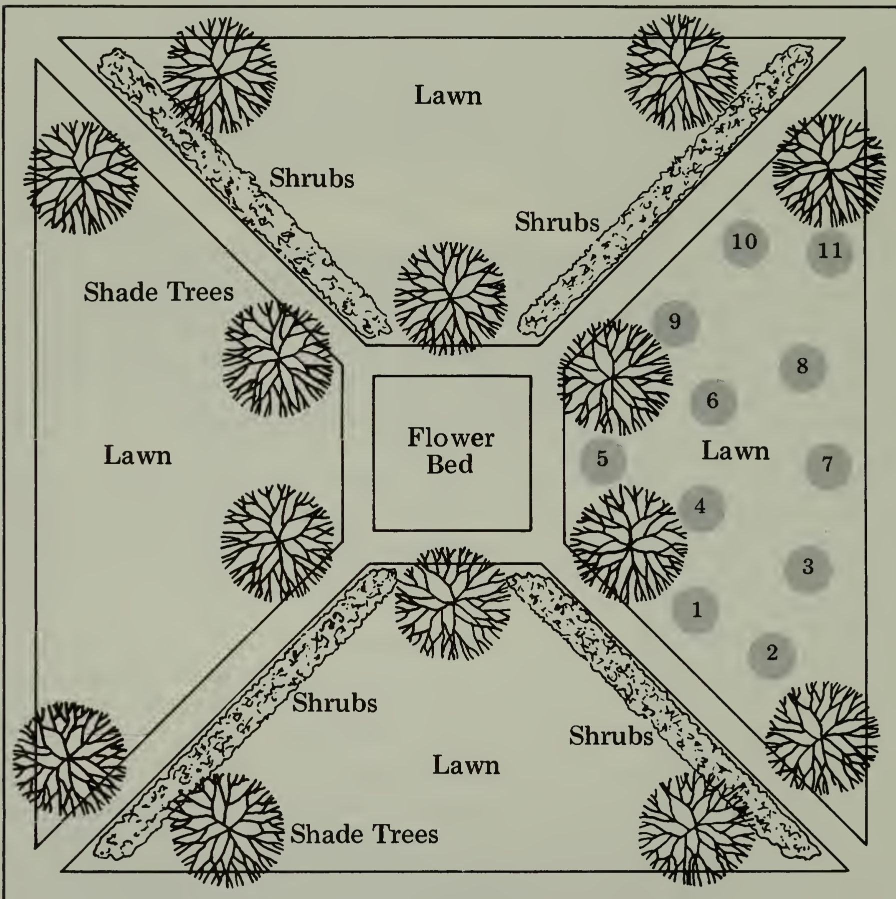
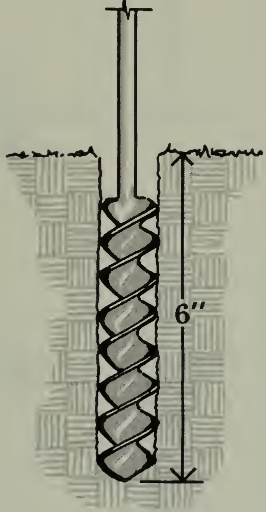
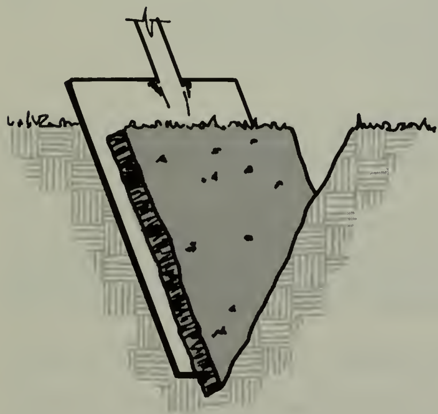


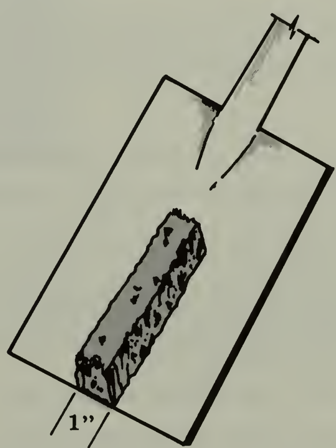
Figure 2. Areas for composite sampling. In a small park, as shown above, proper sampling areas are easily recognized. The size and number of lawn areas here indicate the need for four lawn soil samples. Note the scattered positions of borings (circled numbers) that should be made to comprise one soil sample for one of the four lawn areas. One composite soil sample each should also be made for the areas of flower beds, shrubs, and trees.

Figure 3. Taking soil samples with an auger, probe, or shovel. Approximately 1 pint of air-dry soil is necessary for each soil sample.



A probe or auger should penetrate the soil for approximately 6 inches for each boring. Several such borings will be necessary for each soil sample consisting of 1 pint.





A suitable soil sample can also be made by making several V-shaped trenches. A half-inch thick slice is first cut from one side of the V.

The slice is then trimmed to a strip, one-inch wide, and added to a bucket. Several such strips will make up a single soil sample.

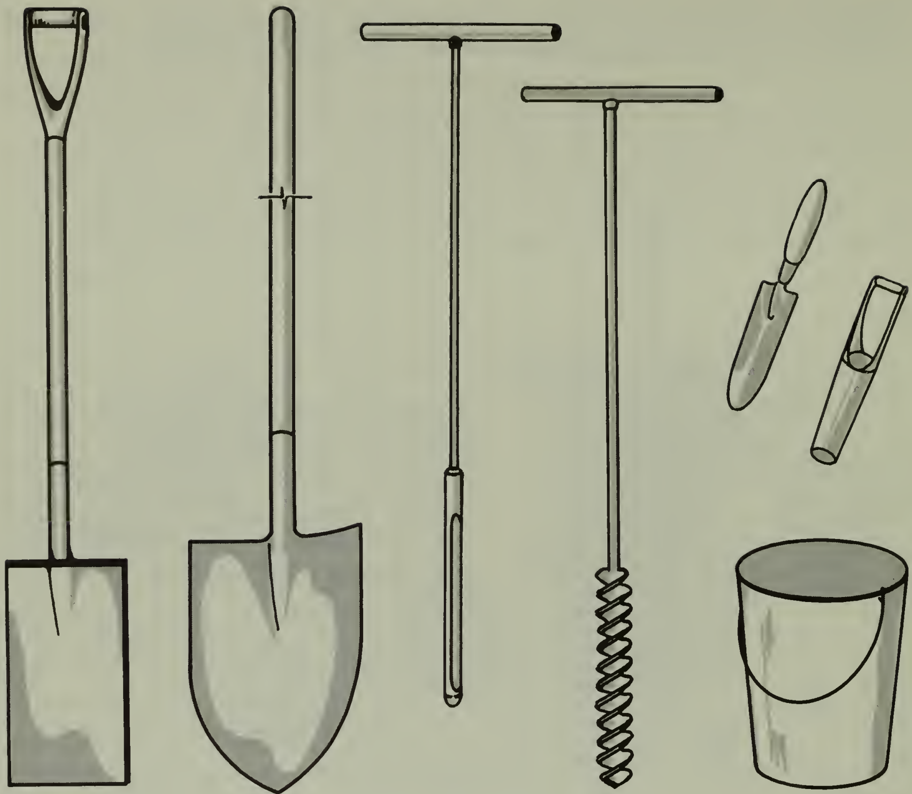


Figure 4. Soil sampling tools, from left: soil spade, garden shovel, soil probe, soil auger, trowel, flower bulb planter, and bucket.

The best time for sampling is probably summer or fall when the soil's nutrients are most stable. Never sample just after fertilizing, applying lime, or within a day of heavy rain.

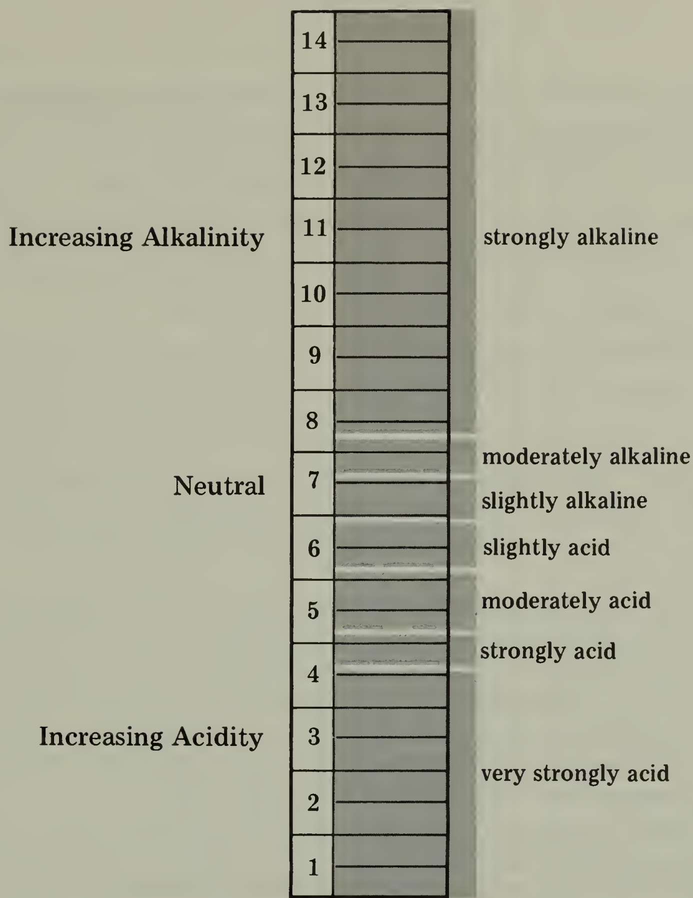
From this composite sample, the laboratory can tell you:

—your soil pH (whether the sample is acid, neutral, or alkaline);
—the percentage of available magnesium (Mg), phorphorous (P), potash (K), and texture;
—the percentage of organic matter present, and mechanical analysis.

Knowledge of the pH scale is essential in dealing with soil problems (Fig.5).

Other tests will show soluble salts present and the lime requirements of the site. For the initial planting, all of these tests should be made. Afterwards, resampling needs to be done only every 3 to 5 years for lawns, shrubs, and small trees and 5 to 10 years for large trees. Beds for annual plants need to be sampled every year.

Figure 5. The pH scale.



6.9 to 1.0
As the pH number decreases, the soil acidity increases, becoming progressively unfavorable for plant growth. Toxic substances will generally inhibit plant growth in soil with pH readings below the 4.5 to 5.0 range.

Neutral. Most plants perform best when the pH is between 6.0 and 7.0. The maximum amount of desirable plant nutrients is realized in this range.

7.1 to 14.0
As the pH number increases, the soil alkalinity increases, becoming unfavorable for plant growth. A pH above 7.5 is generally unsuitable.

2. Landscape Planning

Planning and thorough site preparation is the key to good landscaping. An old saying among nurserymen is that if the budget allows $20 for a new tree, $1 should be spent on the tree and $19 on the hole to receive it. In urban areas this is true. Considering the life of a shade or ornamental tree, the cost of planting is small when divided by the number of years the tree will stand. It is only sensible to do a good job of planting and reap the dividends from low maintenance costs and increasing economic value as the years pass.

The following two examples will illustrate the costs of poor planning. The first concerns some 300 junipers which were set out in mid-summer (not the recommended planting season) near a public building. An examination would have revealed a layer of soil (hardpan) impermeable to roots near the surface, and that the soil was "heavy" (it had a large percentage of fine clays and silts which tended to hold excessive moisture). The ground sloped toward a wall along which the junipers were planted.

When the junipers were placed, a heavy layer of pine-bark mulch was put over the soil surface for aesthetic appeal and to retain moisture (a recommended practice under normal conditions). The turfgrass around the shrubs was watered daily for several hour-long periods, thus complicating the situation and saturating the root zone, causing death of the plants. When last surveyed, three-fourths of the junipers were dead and the survivors looked as if they would soon succumb.

The second example concerns a combined athletic field and park. After several out-of-date buildings on the site had been demolished, additional "soil" required to level the field was obtained nearby. This "soil," derived from river deposits, building debris, and incinerator materials, was toxic to plantlife because it had both a highly acidic pH and soluble salt content. Because a soil test had not been run, these factors went unnoticed. After trying for more than 5 years to vegetate the area (seed death resulted from the high acidity and soluble salts), a soil test showed what was wrong.

It was no easy matter to reconstitute the 4-acre field. Either the top 12 inches of soil had to be removed and replaced with topsoil, or enough finely ground limestone had to be added to correct the abnormal acidity. The latter course was followed, and 75 to 80 tons of limestone per acre were worked into the soil to a 12-inch depth. The renovation cost was great, but the problem was corrected. A little planning and professional consultation in both cases could have saved much time and money.

The next step in landscape planning is to lay out the area to be planted, showing exactly where each plant will be placed. From careful testing, we already know whether the site needs such major treatment as tile drainage, deep tillage, an irrigation system, and structural modification, or only some form of soil amendment or top dressing.

If much construction work must be done at the site, the topsoil should be removed and stockpiled nearby. Large areas planted in turf or ornamental flowers (either annual or perennial) should have irrigation systems for use during dry seasons. The extreme heat and dryness of many urbans soils make irrigation important for urban plantings and greenbelts. For shade trees, this addition may seem costly, but future maintenance will be greatly reduced, and the appearance of the trees will be significantly enhanced. Many subsurface irrigation systems, which have pop-up sprinklers and automatic control devices, can be installed economically. They are great labor savers. The topsoil should not be put back until irrigation, electrical, and drainage systems are checked to insure proper working conditions.

Only upon completion of all installation and subsoil treatment should the topsoil be replaced. In the process, remove any debris (roots, twigs, cans, bottles, wire, wood) from the topsoil. Plowing or raking will break up unwanted sod clumps and help spread the topsoil evenly.

Often it is necessary to obtain more topsoil. Good fertile topsoil of the best type (sandy loam, loam, or silt loam) is difficult to find and, if found, is costly. The topsoil should be a natural friable loam, contain 2 percent or more organic matter, and be free of stones, hardpan materials, and non-soil matter. It should be free of noxious and such undesirable plants or plant parts as Johnsongrass, quackgrass, Canada thistle, Bermudagrass, nutsedge, poison ivy, or any other species that the buyer may specify. Loam soil is defined as having 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. Most soils of agricultural importance are some type of loam. The topsoil must be given the full line of tests by a recognized soil testing laboratory. The pH must range between 4.5 and 7.5. The soluble salt content must not exceed 500 parts per million (ppm). Topsoil specifications must be precisely written and the contractor or supplier should be held to the specifications.

Topsoil may also be useful for topdressing a site. Here are the approximate amounts required for a job:

Table 1. *Topsoil requirements.*

Depth in Inches	Square Feet Covered by 1 Cubic Yard	Cubic Yards Required per 1,000 Square Feet
2	162	6.2
4	81	12.3
6	54	18.5

Many soil amendments are available for modifying existing soil or for combining in varying proportions to produce a good soil. Amendments can be grouped into two classifications: organic and inorganic. Some of the organic materials are compost (good compost consists of organic matter, soil, fertilizer and sand) bark, hay or straw, hulls, aged sawdust, peat moss, pine needles, shredded bark, vegetable and animal waste, manures, activated sewage sludge, and wood chips. Inorganic materials that can be used are sand, gravel, vermiculite, and sintered fly ash. (See Table 2). Soils are so variable that each must be modified or amended according to its individual soil test results, and in accordance with the plant's growing requirements. Plant species also vary greatly in their tolerance to soils. Site characteristics, such as topographic exposure, slope, amount of shade, amount of sun, and similar factors, must be considered. Fertilizer and lime must be incorporated into the soil as the soil test results dictate, the area must be smoothed and plant locations designated on the site, and the plant or tree holes must be dug and properly prepared to receive the plants.

Table 2. *Volume of topdressing material required for applications of various depths.*[1]

Depth of Topdressing Desired (in inches)	Approximate volume of material needed for: 1,000 sq. ft. cu. ft.	1,000 sq. ft. cu.yd.	3,000 sq. ft. cu. ft.	3,000 sq. ft. cu.yd.	5,000 sq. ft. cu. ft.	5,000 sq. ft. cu.yd.	7,000 sq. ft. cu. ft.	7,000 sq. ft. cu.yd.	one acre cu. ft.	one acre cu.yd.
1/8	10.4	0.4	31.2	1.2	52.0	1.9	72.8	2.7	453	17
1/4	20.8	0.8	62.4	2.3	104.0	3.9	145.6	5.4	906	33
3/8	31.2	1.2	93.6	3.5	156.0	5.8	218.4	8.1	1,359	50
1/2	41.7	1.5	125.1	4.6	208.5	7.7	291.9	10.8	1,813	67
3/4	62.5	2.3	187.5	6.9	312.5	11.6	437.5	16.2	2,719	100
1	83.5	3.0	250.0	9.2	417.0	15.5	584.0	21.5	3,626	134

When sawdust is used:

(a) Add about 30 lbs. of ammonium nitrate for each 500 lbs. of sawdust.

(b) Add 30 to 50 lbs. of lime for each 500 lbs. of sawdust to neutralize acidity; apply 6 months after the sawdust is applied.

[1] From *Turfgrass Management*, by H. B. Musser. Copyright 1962, United States Golf Association. Used with permission of McGraw-Hill Book Co.

3. Climate and the Urban Soil

Though climate is a very important consideration in planting, it is not a particularly restricting one. The general climatic zones or areas of the United States are large, and within them grow a great variety of plants, sufficient for almost any landscape plan. Most plants within the warm humid regions have subregions where the climate is optimum for their best growth, and other sections, usually contiguous, where the climate is tolerable and they survive and grow, but less well. Temperature and moisture are the principal considerations, provided that soil conditions are similar. Since moisture can be provided by watering, in urban settings, if nature is scanty, the remaining control is temperature.

Plants that thrive in the South Carolina tidelands may find locations tolerant as far north as the Virginia tidelands, but they will not survive outdoors in Boston. They cannot tolerate freezing winter temperatures. Plants from Oregon, east of the Cascade Mountains, that are accustomed to many days of sunshine and little rain may not survive the wet, cloudy weather of Rochester, N. Y.

These are major climatic matters that constitute a *macroclimate.* There is another kind of climate that is just as important for urban plantings. This has to do with the immediate environment that is influenced by structures or activities nearby. Since this bulletin is concerned with relatively small areas, we are dealing with *micro*climate. Some elements influencing microclimate include exhaust from a steady stream of traffic, a wind tunnel effect caused by the position of buildings, or lack of air movement for the same reason, excessive light and/or heat reflected from building surfaces or rising from sidewalk grills, and city dust and general pollution.

We have learned to live with our macroclimates, but the problems of urban *micro*climates are found everywhere in America. Special care must be given to these problems. Consultations are needed between the involved professionals *prior to the selection of planting sites* and early in the location of building sites and the design of buildings. For example, a large office building in San Francisco was designed so that the entrance and its landscaped plaza face southwest instead of northwest onto Market Street. This siting minimized traffic fumes and air currents and created a roomy and sunny plaza. Shade trees, flowering shrubs, and seasonal flowers make this a haven for employees and tired visitors. A brightly tiled reflecting pool and the steady splash of a fountain add to the comfort of both people and plants. Concrete boxes of generous size were filled with well-conditioned soils that were treated with lime and fertilizers to suit the variety of plants that could thrive in this microclimate. The San Francisco Peninsula has its own local version of the Pacific Coast climate, and it is one where a very wide variety of plants will grow and prosper. Therefore, in this instance, the microclimate was an important design consideration.

4. Selection of Plants

Trees and shrubs cannot simply be placed in the ground in urban areas and be expected to thrive as they do in forests. Trees growing in forests usually have much going for them—good soil conditions, adequate moisture and soil nutrients, and clean air, while urban trees are subjected to opposite conditions. Nevertheless, all of us want the trees that grace our cities to show such healthy signs as fullness of canopy, full leafing for shade, and resistance to insects and diseases. The first step toward successful landscaping is to purchase all plants from reputable, established nurseries. Quality stock is imperative for successful growth and endurance.

Once you have found a good source, you are ready to select the right plant for your project. You must now consider several other pertinent qualities: *hardiness*, *form and size*, *undesirable characteristics*, *variety*, and *availability*.

Hardiness means the degree to which a plant can adapt and thrive in less than its most suitable environment. Some plant species, and some varieties within species, are more hardy (adaptable) than others. Therefore, we must select for hardiness on the basis of advice from competent nurserymen. The climatic conditions described earlier have to do with hardiness. Of course, to those must be added soil conditions, growth space, and careless maintenance, plus the degree and kind of human use. Concerning the latter, some plants will survive an unintended "mulch" of such things as plastic candybar wrappings, crushed paper cups, cigarette butts, and used lipstick casings that is cleared away at endurable intervals. Other plants will slowly die under such "cultivation."

Form and size refers to shape and the amount of space a plant will occupy at maturity. Some plants, particularly shade trees, vary greatly in the amount of space they require for vigorous growth. Consequently, when selecting a plant you must consider growth rate, longevity, size at maturity, and available space.

Undersirable characteristics are those that create special maintenance problems or human hazards. For example, a female gingko produces a fruit which has an offensive odor. The sweet gum is not recommended because its limbs are brittle (the result of rapid growth) and it produces a fruit that is dangerous underfoot. Weeping willow and some maples have vigorous waterseeking root systems which tend to clog sewers and other waterpipe systems.

On the other hand, Zelkovas, the male gingko, the lindens, and some species of elm and oak are excellent selections because they are relatively trouble-free and do fairly well in the urban environment.

Variety is needed not only for the pleasing effect of landscaping, but also because a large planting of one kind of tree is an "invitation to a feast" for insects, fungi, and other diseases that are the natural prey of that species. In the past we have seen chestnut blight and Dutch elm disease nearly eradicate pure stands of these trees in natural forests and some city plantings. Choosing a variety of plants adaptable to the urban environment will help prevent such disasters.

Entomologists, plant pathologists and other specialists on plant diseases can advise on this matter or can refer you to the necessary reference books.

Availability is a major consideration in plant selection. If the desired plant cannot be obtained locally (within the general topographic and climatic area) this may mean its species or variety does not do well there. To import it, therefore, would risk problems of hardiness or some other requirement for thriving growth of the plant. Certainly, if the desired plant is to be procured from a distant nursery, the climatic conditions of both areas must be considered. What counts is the highest and lowest temperatures experienced over a span of several years, not merely the average summer and winter temperatures. A plant which is adapted to a moderate winter may not survive through even a few very cold periods. Of course, if the distant nursery reports climatic and other environmental conditions similar to that of the planting site, you can be the first to introduce it to a new locality.

Having selected appropriate sites for landscaping, prepared the urban soils, considered the climate, and selected the plants, you now need to consider the requirements for planting.

5. Planting

Season

The best time for planting and transplanting is early spring while the plant is still dormant. This is true for all kinds of evergreens, trees and shrubs. The second best time is late summer or early autumn. Through careful preplanning, one can reduce to a minimum the time between digging plants at the nursery and replanting. The soil site can be made ready to receive the transplants *before* a definite shipment date is given to the nursery. Next to timing, proper handling is of the utmost importance.

Handling

Nurseries generally use one of the three methods of packing: bare root, balled and burlapped, and container grown.

Bare root means that a ball of soil is not associated with the roots during transplanting. Evergreens can be handled this way only as seedlings, and other plants only when small. Bare root planting can be made in early spring, late autumn, or winter if the plants are dormant. (Fig. 6)

Balled and burlapped is the preferred way to handle almost any size plant. Most deciduous trees are transplanted this way. The majority of the roots remain intact within the ball, and only a few small roots need to be cut in the digging process. Plants which are balled and burlapped can be successfully transplanted throughout the year except during freezing weather. (Fig. 7)

Container-grown plants are shipped in the containers and the plant roots remain intact. They can be planted throughout the year, but only relatively small plants can be handled this way, since large plants would have containers of unmanageable size. (Fig. 8)

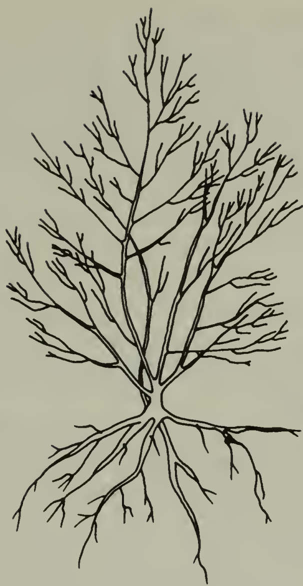


Figure 6. Bare root stock.

Bare root stock is free of nearly all soil or soil material on its roots.

Figure 7. Balled and burlapped stock.

Such transplants have the majority of their roots intact within the burlap ball. Only a small number of feeder roots have been removed.

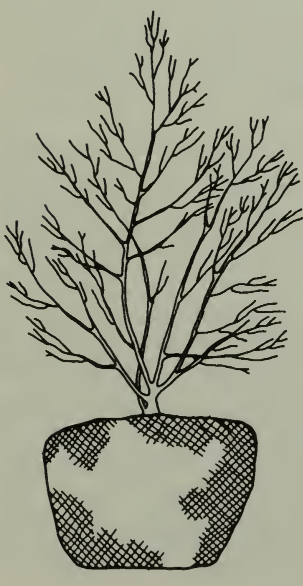


Figure 8. Container grown stock.

These transplants are similar to balled and burlapped plants. The total root systems of these plants are within the container.

Transplanting

Regardless of the method used, all transplants must be protected from drying wind and sun during transportation. Moving by night is therefor recommended. Should the transplants arrive before site preparation is complete, they should be stored in a cool, humid place and the root ball covered with moist sand, sawdust, peat moss, or soil, to prevent dehydration. In addition, about half of the foliage should be pruned to reduce the evapotranspiration rate during the transplanting and adjustment phase. Consequently, by pruning the top growth the plant's roots are quite capable of supplying adequate moisture to the new foliage. The leafy branches as well as the roots should be watered. The storeage area should be adequately lighted, naturally or by electricity, or the transplants will not remain healthy.

Bare-root transplants. Dig a hole at least twice the diameter of the transplant's root system to avoid crowding of the roots. Because the soil at the new site is likely to be poor, fill the extra space around the roots with compost and enriched topsoil.

Dig the planting hole deeper than the root system and lay down a foot or more of enriched topsoil. Make sure that the plant will sit at the same level at which it originally grew in the nursery. When placed in the hole, the root system must be spread out by hand in its natural pattern, not left confined or twisted. Prune any broken roots. Now fill the hole half way with soil and pack it sufficiently to insure soil-root contact. Soak the soil to bring about natural packing and to reduce air pockets. Then fill the rest of the hole, pack lightly, and build a soil dike on the perimeter. Soak the whole planting for a second time to get rid of remaining air pockets.

All of the above procedures will prevent root decay and will encourage rapid increase of the root system as the newly installed plant strives to become firmly established. Vigorous and healthy growth will improve the plant's appearance and will reduce maintenance problems and expense.

Balled and burlapped and container-grown transplants. Dig the hole at least twice the diameter of the root ball or container, and sufficiently deep for 1 or 2 feet of enriched topsoil over the bottom before the plants are placed. However, for large shade and ornamental trees, the size of the planting hole should be increased to at least one-half the diameter of the mature crown. Containers must be removed, but the burlap may be buried since it will decay. Turn the burlap covering back to expose the top of the rootball after the plant is firmly in place. The transplants should rest at the same depth as they did in the nursery. Enriched topsoil should be put around the rootball, packed and watered to provide soil-root contact and remove air pockets. Build the dike on the perimeter and again saturate with water. After this has percolated, add a top dressing of mulch within the perimeter. This is especially needed for winter plantings to reduce, or avoid, damage by freezing. Normally, 1 to 4 inches of mulch will help prevent rapid temperature changes. Mulches most used for this purpose are the organic materials such as bark, hay or straw, hulls, aged sawdust, peat moss, pine needles, shredded bark, vegetable and animal waste, manures, activated sewage sluge, and wood chips. The mulch layer must not be so thick as to prevent evaporation from the soil and thereby cause excessive moisture to build up in the root zone.

Fertilizing

Fertilization is not usually recommended for new plantings, and is normally done 1 to 2 years after planting, since fertile topsoil should have been used. But if soil at the transplant site has not been improved, some street tree transplants in poor soils will need fertilizer thoroughly mixed with the topsoil. A good rule is 2 pounds of a commercial fertilizer of a 5-10-5 formulation for each inch of diameter at breast height (DBH) of the tree. The 5 refers to percentage of total nitrogen (N), the 10 to percentage of available phosphoric acid (P_2O_5) and, the last 5 to the percentage of available potash (K_2O). These percentages will be shown on the bag.

When the transplants have been set, they should be properly pruned to reduce the evaporation rate.

Supporting

Young trees and some large shrubs should be supported for a year or two until they become firmly established. The two most-used methods of supporting new plantings are guy-wiring and staking.

Guying is the best method for tying down large trees (Fig. 9a). Drive three short stakes into the ground near the base of the tree. Then attach wire encased in a piece of garden hose from the stake to the trunk just above the first branch. The guy-wires should be arranged in a triangular fashion, using equally spaced stakes. This procedure is widely used for larger woody shrubs and trees.

Staking is similar and is generally used for smaller trees (Fig. 9b). The stakes are driven into the soil adjacent to and on opposite sides of the trunk, which can then be fastened to the stake by wire encased in a length of garden hose or by cloth straps.

Wrapping the trunk of the tree to a point just above the first branch will protect the tender bark from sun scalding, excessive loss of water and reduce borer infestation. Usually, the tree is wrapped in a spiral fashion with each turn overlapping the previous turn by one half, thus protecting the trunk with a double thickness. The wrap should remain in place for one or two seasons.

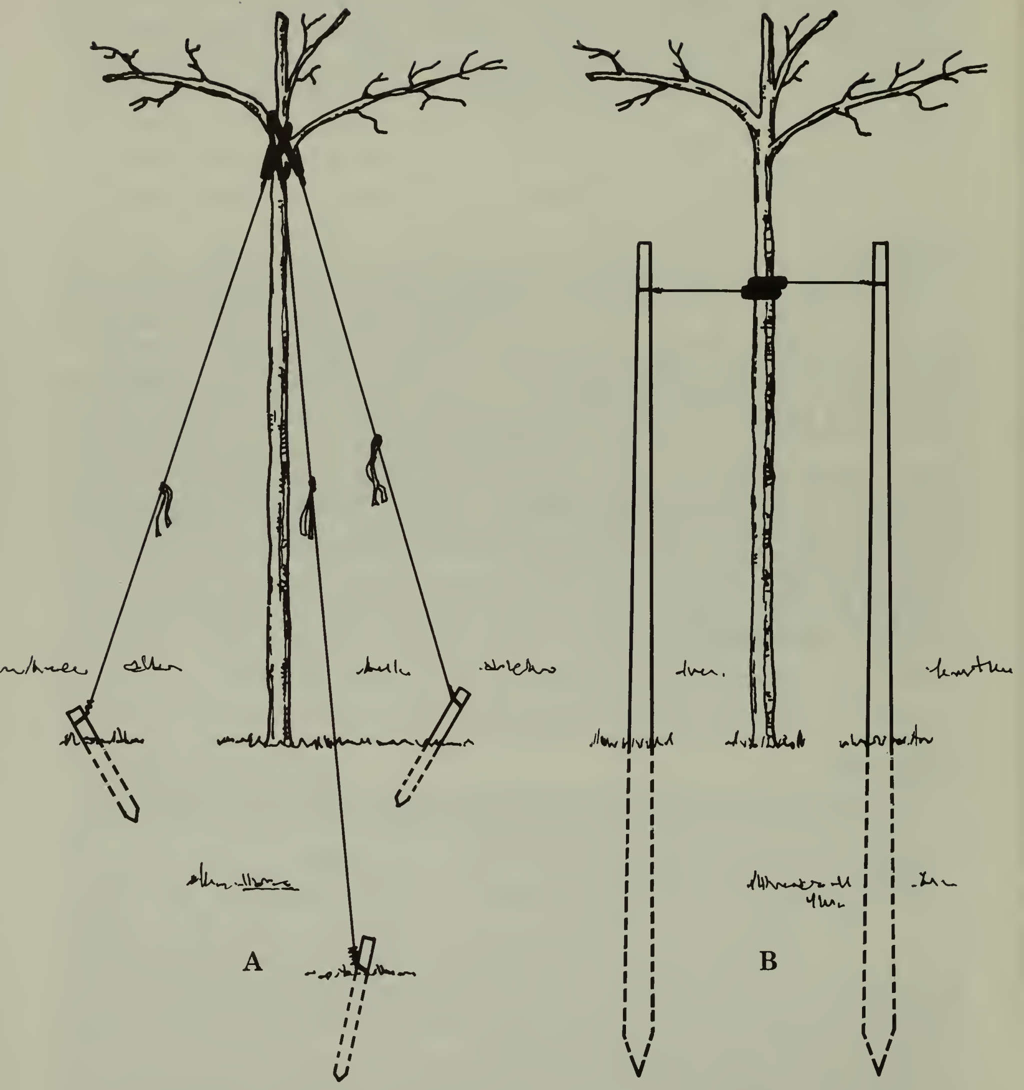


Figure 9. Guying and staking.

The principle of guy-wiring, used when large trees are transplanted, is illustrated in A above. Staking of smaller trees is depicted in B. Each procedure supports the tree until its root system is well established. Usually these supports remain in place for one to two years.

6. Maintenance

The newly sited plants require periodic care to insure growth and to maintain virgorous health, particularly in urban ecosystems. The many hazards which directly or indirectly affect urban plantings present problems that good maintenance can offset. Good maintenance is just as important as soil sampling, site preparation, and proper planting procedures, yet all too often city landscape departments as well as homeowners stint this aspect of planting.

Good maintenance requires four principal operations: watering, fertilizing, pruning (general pruning, shaping, and repair of plants), and replacement.

Watering, or lack of it, has been blamed for most plant failures. Water is needed for all functions of plants. Yet in many city plantings, extremes of heat, excessive air movement, and poor soil moisture relationships make it difficult for plants to make efficient use of whatever moisture is present.

It is true that adequate moisture may be present in the city, but it does not always find its way to the roots of plants. Pavements, roofs, and extensive systems for surface and subsurface runoff carry away much rain water that would normally percolate into the soil. Trees and plants in such an environment must be watered by hand. Very young plants and trees in particular need slow yet thorough soaking at regular intervals.

Fertilizing is not always necessary at planting, but each soil site should be considered individually. Fertilizing will probably be needed when the young plant's roots are well established, usually about 1 year after planting.

Fertilizing a tree is easy. Holes 6 to 18 inches deep should be punched or drilled at 1 foot intervals circling the trunk beneath the outer branches. These holes should be randomly spaced within the tree's drip-line. (See figure 10.) A good grade fertilizer, such as 10-6-4 or 10-10-10, should be applied early each spring at a rate of 2 pounds for each inch of trunk diameter at breast height. Grass should not be allowed to grow within a 2 to 3 foot radius of young trees for several years.

Fertilization of larger shrubs is the same as that for trees. Other plantings, such as small perennials, need a broadcast application of fertilizer. Vary the amount and type according to the soil test results. Water the fertilizer into the soil so that there is no chance for fertilizer burn.

Annual bedding plants or seasonal plantings should not be broadcast fertilized after planting. Rather, these areas should be fertilized several months prior to planting and in accordance with the soil test results. This method allows the soil and fertilizer to react in advance and will reduce the risk of damage to the young plants.

Pruning and other repair operations are also essential for vigorous growth. In street tree plantings, "V" crotches near the base of the tree should not be permitted because they are a major cause of structural weaknesses as the tree grows. For the best growth, trees should be relatively straight stocked, with fairly high branching. Periodic and selective pruning of trees will cause them to grow into more pleasing forms and will reduce the hazards from falling limbs.

The reason for pruning transplants is to compensate for the root loss which the plant invariably suffers no matter how carefully the plant was moved. Properly grown nursery stock with vigorous fibrous root systems will not require severe pruning, although the chances for success in transplantings are increased by judicious pruning.

The degree of pruning will depend a great deal upon the condition of the transplants when received from the nursery and the kind of maintenance they will receive. The better the care, particularly regular and sufficient watering, the less pruning will be required. Except for the removal of dead or broken branches, transplant pruning is not a matter of thinning, but of reshaping the tree so that the dripline is about the same as the perimeter of the root ball.

Shrub pruning, on the other hand, should remove the older canes and intersection branches. Shrubs which have dried out somewhat or those which have a poor root system may be more severely pruned. If in a bad condition, they have to be cut to the ground at planting time. Cutting even healthy transplants to a formal outline is rarely desirable because their recovery is more assured if the shrub is allowed to take its natural form for a year or two.

Unless a low-headed tree is desired, the leader of a single-stemmed deciduous tree should not be cut (unless the tree is excessively spindly). Such pruning tends to spoil the ultimate shape of the tree. Lateral branches of small trees can be cut back to bring the remaining branches closer to the trunk to provide a compact head, which readily branches out when growth starts. Small twigs and buds in the center of the crown and along the stem should not be pruned—especially on oaks and maples—as their leaves are needed to shade the trunk. Under-pruning will do much less damage to a transplant than over-pruning.

Branches that are too large to be removed by heavy duty shears should be pruned with a saw. Cut a foot or so from the base of the branch, the first cut being on the underside, about one-third through. Make the second cut on the upper side of the branch about one-half inch out from the first cut. This will permit the branch to fall away without stripping the bark from the trunk. The stub of the branch can then be cut away flush with the trunk. (Fig. 11)

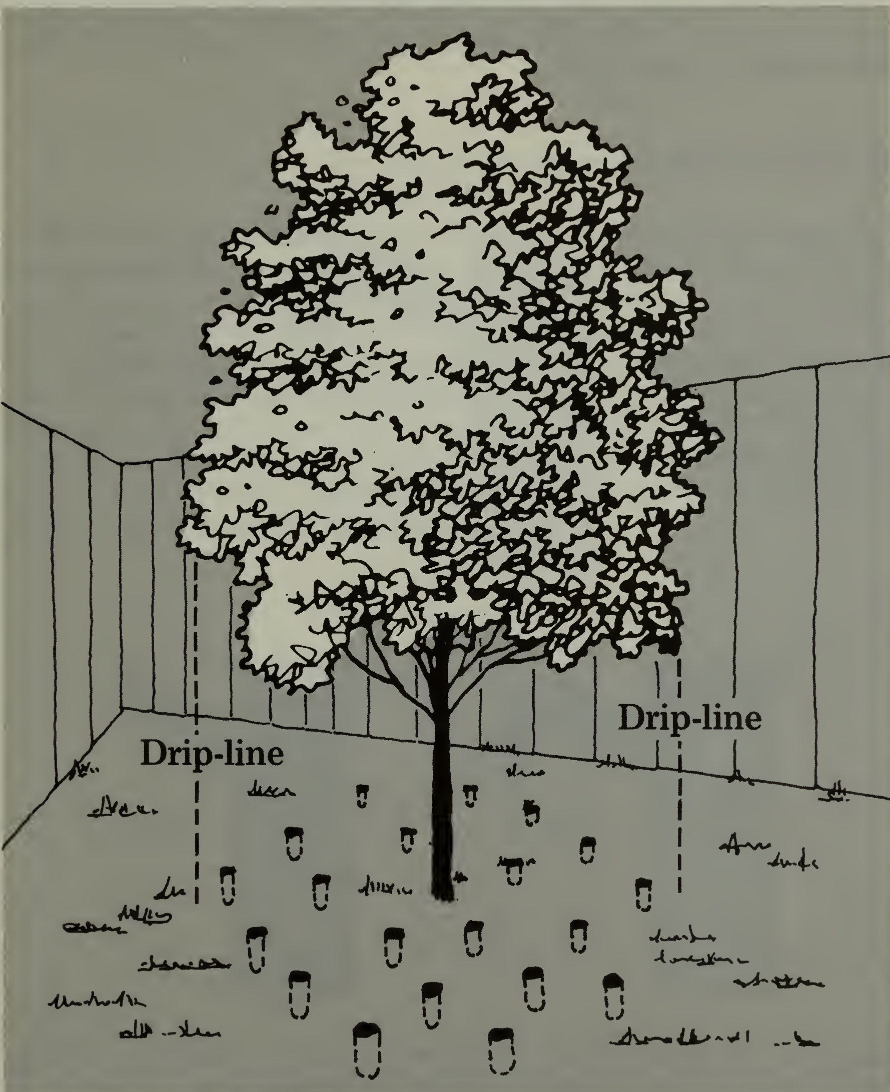


Figure 10. Fertilizing large, established trees. Randomly spaced holes are first made in the turf around the base of the tree, within the drip-line. Fertilizer is then placed within these holes which are closed up with topsoil.

All cuts or scars greater than 1 inch in diameter should be treated immediately with a wound dressing or tree paint.

Replacement of dead or dying plants is one solution to problems of planting. But before action is taken, you should find out why the plant did not survive. Did it fail because of disease, the soil, the climate, or maintenance or perhaps some combination of these causes? Without knowing what went wrong and why, time and money will be wasted if the dead plant is merely replaced by one certain to succumb to the same inhospitable environment.

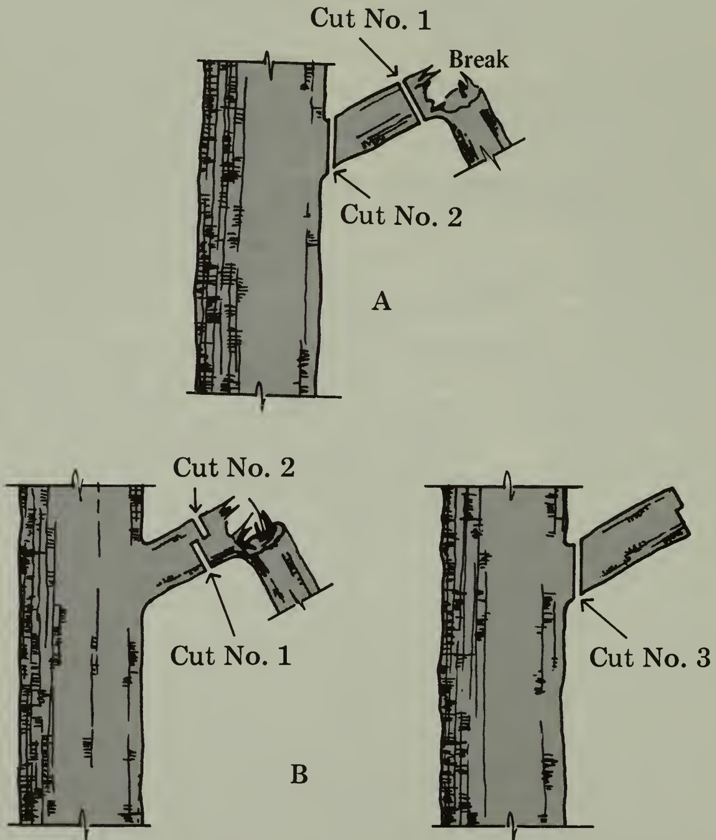


Figure 11. Pruning. The procedure used to remove a broken or undesirable limb which has received mechanical damage is shown in A above. B illustrates the pruning operation used in maintenance work. The process is completed in two steps to reduce possible stripping of bark from the trunk. Stubs of limbs larger than 1 inch in diameter should be treated with tree wound paint.

7. Conclusion

Planting and growing in urban soils require that soil deficiencies be remedied and that the plantings be maintained in an environment conducive to their growth and continued existence. The principles laid down in this bulletin, supplemented when necessary with specific professional advice for specific problems, will help to attain that end.

8. For Professional Advice

The best local source of advice is the local county extension agent or his representative, or a reliable local nurseryman. Should these avenues of advice not be available, write or contact your State college of agriculture. These experts, along with the extension agents, can supply bulletins on landscape planning, plant varieties which are suitable for your area, and specific details of these suitable plants. Local or metropolitan arboretums are ideally suited to assist homeowners in finding landscape ideas and are good places to see the wide variety of plant materials available for your location. Landscape gardening is a very rewarding profession and will provide a satisfying pastime.

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