

Connecticut Agricultural Experiment Station New Haven

Turf Management

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A SMOOTH green lawn is a desirable setting for any home and the ambition of most householders. Maintaining a good turf is the constant concern of those responsible for the care of parks, playing fields, golf courses and cemeteries. When problems in management arise, frequently the Station is called upon for help. In many cases soil conditions are far from ideal, and in dry summer periods the turf is damaged severely, particularly when it is not well fertilized or watered. In addition, there are invasions by the Japanese and Asiatic beetles and other insects, and by plant diseases that have caused trouble in recent years.

To provide in concise form the best available information, the Station has prepared the instructions given in the following pages. This circular supersedes Circulars 48, 77, 83 and 113, which are now out of print.

SOIL CONDITIONS

No DESIRABLE species of turf grass, regardless of fertilizer treatment, rolling, watering, etc., can be produced satisfactorily on sand, gravel or raw subsoil devoid of humus. During the construction of new houses, excavating frequently leaves the area upon which the lawn is built in an unsatisfactory condition in this respect. There should be a depth of at least four inches of settled surface loam containing a sufficient amount of organic matter to give it a rich, dark brown color. Solid rock, gravel or "hardpan" should be 20 inches or more below the surface.

Many lawns must be developed on soils that are excessively sandy or poor in organic matter. Frequently the top soil is very thin, especially where much grading has been done. The best opportunity for soil improvement is in the preparation of the ground for new seeding. At this time additional soil of the satisfactory loaminess and organic content can be added where the top soil is too shallow. Good loam is expensive, but the measures that must be followed to keep good grass on poor soils are even more costly in the long run. If the soil is of fair depth, but is too sandy, lacks organic matter, or is inclined to become excessively hard when dry, the following humus materials give significant benefit, when worked into the soil to the depth of three or four inches:

TABLE 1. BENEFICIAL HUMUS MATERIALS

Stable manure, rotted for several months to destroy weed seeds.	½ cord
Granulated moss peat, dry	4 bales
Native moist peat, swamp muck or humus	2 to 3 cubic yards

In the above table, and throughout this circular, recommended quantities are usually per 1000 square feet of area. A lawn 80 feet long and 25 feet wide contains 2000 square feet (multiplying length by width) and requires twice the stated amounts. Large areas are more commonly considered in terms of acres. One acre contains 43,560 square feet. In round numbers, 40 times the amount specified per 1000 square feet is a suitable "per acre" rate. Occasionally certain treatments, used chiefly on small sections of turf, are given as per 100 square feet, equivalent to an area 10 feet square.

Lime

A moderate degree of soil acidity is not harmful to turf grasses adapted to this region. In fact, it appears to help check the invasion of numerous weed species, such as dandelion, broad-leaved plantain and chickweed. However, strong degrees of acidity have been found in many lawn soils, as indicated by pH tests below 5.0. Under such extremes of acidity, the vigor of the turf is reduced and moderate liming is beneficial. An application of 100 pounds of limestone per 1000 square feet is desirable when it is worked into the soil for new seedings. One-half of this amount, applied as a top-dressing to established turf, is usually ample. This treatment should not be made more than once in five years.

Many fertilizers tend to make the soil more acid. This is especially true of sulfate of ammonia, which consumes the equivalent of one pound of lime (as limestone) for each pound of the fertilizer. The use of such materials for several years helps to drive out weeds that thrive on less acid soils. However, they eventually do harm to turf grasses, especially Kentucky blue grass, unless some lime is used to counteract them. The effects of fertilizers with respect to acidity are indicated in the fertilizer table.

Fertilizers

Until the last decade the materials most commonly used in fertilizing lawns were dried sheep manure and bonemeal. Both were safely used in indiscriminate amounts. However, they are slow in action, and there is evidence that the delayed availability of nitrogen supplied from these sources is apt to prove stimulating to midsummer weeds, such as crabgrass, at the expense of the desirable species.

Available plant food elements are now more effectively and economically provided in the various fertilizer materials and complete factory-mixed fertilizers now on the market. However, since most of these are more soluble and concentrated, they must be used with caution because of their possible harmful effects when applied at too great a rate, or when spread carelessly. Fertilizers containing more than 10 percent of nitrogen, such as sulfate of ammonia, nitrate of soda or uramon, should be mixed with sifted loam or sand before spreading, or they may be dissolved in water and sprinkled on the turf, followed by liberal watering.

Turf grasses are usually most benefited by the nitrogen component of fertilizers. However, newly built lawns are often on soils that are too poor in phosphorus and potash. Grass clippings, when removed, tend to deplete the soil. In general, well balanced, complete fertilizers best serve to maintain the turf in a vigorous condition. Suitable grades for new seedings or for top-dressings on turf of unsatisfactory growth are the 7-7-7 and 5-8-7 (the numbers refer to percentages of nitrogen, phosphoric acid, and potash, respectively, in the order stated). The 10-5-5 grade is well adapted to general top-dressing treatments.

Common fertilizers that may be used on lawns are shown in the following table, with approximate concentrations and rates of application for early spring treatment:

TABLE 2. COMMON LAWN FERTILIZERS

FERTILIZERS	Nitrogen %	Phosphoric acid %	Potash %	Equivalent acidity (A) or alkalinity (B), in lbs. of limestone per 100 lbs. of material	Rate of application per 1000 sq. ft.
Complete factory-mixed fertilizers					
10-5-5	10	5	5	30-40 A	10
7-7-7	7	7	7	20-30 A	15
5-8-7	5	8	7	15-20 A	20
4-12-4	4	12	4	10-15 A	25
Organic, chiefly sources of nitrogen					
Tankage, animal	7.5	9	0	—	25
Cottonseed meal	6.5	3	2	10 A	30
Castor pomace	5	2	1	6 A	35
Soybean oil meal	7	1.5	2	10 A	25
Milorganite	5	2	1	10 A	25
Dried cow manure	1.8	1	2	—	100
Dried sheep manure	1.9	1.5	2	—	100
Dried poultry manure	2.5	2	1	—	75
Organic, chiefly sources of phosphorus					
Bonemeal, steamed	3	24	0	25 B	35
Bonemeal, raw	4	22	0	20 B	30
Inorganic, sources of nitrogen					
Nitrate of soda	16	0	0	29 B	5
Sulfate of ammonia	20.5	0	0	110 A	4
Calnitro	20.5	0	0	0	4
Uramon	42	0	0	75 A	2
Inorganic, sources of phosphorus					
Superphosphate, 20%	0	20	0	0	10
Superphosphate, concentrated	0	44	0	0	5
Inorganic, sources of potassium					
Muriate of potash, 60%	0	0	60	0	3
Wood ashes, unleached	0	2	6	60-80 B	40

In preparing the soil for new seedings, the fertilizer should be worked into the soil to the depth of three inches or more. Heavier rates of application, up to about twice the quantities recommended above, may be used at this time if the seeding is delayed for a few days after applying the treatment.

On established turf, fertilizer should be applied in early spring, not later than May 10, at the recommended rate. It is frequently desirable to make an additional top-dressing in the early fall, especially if the turf has deteriorated during the hot summer months, at about half the spring rate.

Golf fairways, athletic fields, parks, etc., may be fertilized similarly to lawns. Golf and bowling greens must be kept in an active vegetative condition throughout the season in order to withstand close clipping and excessive wear, as well as to maintain an attractive appearance. Hence, fertilizers are used more frequently at lighter rates. As a general rule, the following program of treatment is suggested:

April	—5 lbs. of 10-5-5 per 1000 sq. ft.
May	—2 " " sulfate of ammonia per 1000 sq. ft.
June	—1 " " " " " " " " " "
August	—1 " " " " " " " " " "
September	—4 " " 10-5-5 per 1000 sq. ft.

SEEDING

EARLY fall, during the month of September, is an especially good time for turf seeding. Annual weeds offer less competition, and the sod is older and more resistant when the adverse conditions of the following mid-summer are encountered. Seedings in early October are frequently successful if cold weather comes late, but there is considerable risk involved. Spring seeding, between April 1 and May 15, is a common practice. Moisture conditions are usually favorable, but the grass is slow in starting and weeds often severely handicap the establishment of the turf.

The ground should be spaded or plowed, limed if necessary, fertilized, and thoroughly raked and rolled to a firm, smooth surface before the seed is sown. The seed should be lightly covered by scratching the surface with an iron rake or by sifting loam over it. Unless the soil is kept moist by rains, it should be sprinkled thoroughly and frequently after seeding.

The choice of seed depends upon soil, shade conditions and the type of turf desired. There are many good grades of commercial seed mixtures available to meet different requirements in these respects. The buyer can be informed as to the proportions of the various grasses, the germination test, and freedom from chaff and weeds, by carefully reading the label which is required by law to be on each container. The same information is required for unmixed seeds. The quality of the seed is an important consideration, whether a prepared mixture is used or seed of the various species is purchased separately. Numerous weeds of many kinds may appear conspicuously in newly seeded areas, and the seedsman is often blamed unjustly for supplying contaminated seed. Such weeds almost invariably start from seed already in the soil or otherwise introduced.

This is especially true of crab grass which is a common native grass and is very rarely present in commercial lawn grass seed.

Pertinent characteristics of various species that are most likely to be of value in connection with turf building are stated briefly in the following paragraphs, with suggestions as to their employment.

Kentucky blue grass (*Poa pratensis*): Rich green color; vigorous growth in early spring and late fall; somewhat dormant during midsummer; leaves one-quarter inch wide, keel-shaped at tips; injured by very close clipping; severely browned by droughts, but with rapid recovery; hardy and resistant to diseases; thrives best on loamy soils that are well supplied with lime and fertilizer constituents, in moderately sunny or slight shade locations. This species is most generally suited to average lawn conditions. It is rather slow in developing a solid turf; hence should be sown mixed with a short-lived "nurse crop" species, such as red top, with or without other permanent grasses.

Chewings Fescue (*Festuca rubra*): This grass is a blue green color; fine awl-shaped leaves of stiff, wiry texture; moderately slow growing, especially in midsummer; very hardy and resistant to diseases and insect pests; does fairly well on poor sandy soils of low fertility, in both open, sunny locations and in moderate shade; withstands considerable wear. This species is especially suited to sandy soils, sunny slopes, moderate shade, for planting near the shore, and for playing fields. The seed is usually of lower germination than other grasses and the sod is slow to form a dense turf; hence more seed must be used and the results may be disappointing during the first year or two. It is best seeded with red top or other nurse crop grass, but without other permanent lawn grasses except for special conditions, such as playing fields, etc. **Sheep's fescue** (*Festuca ovina*) is frequently used to cover rough spots that are not to be clipped with a lawn mower, as in the case of "the rough" on golf courses. It grows in tussocks ill-suited to lawn turf, and seed mixtures containing this species should be avoided.

Bent grasses (*Agrostis* spp.): A number of types of the bent grasses are commonly used for lawns and various strains of creeping bent and velvet bent are favored for golf putting greens and bowling greens. Leaves of various strains differ in color and size, but all are sharply pointed at the tips. In general, they form dense, fine textured turf of attractive, rich green color, thriving on moderately acid soils of fair fertility, except on badly shaded areas. However, under average lawn care, bent grass turf is soft, loose, and readily attacked by diseases and insects. Unless frequent top-dressing, careful watering, regular clipping and rolling, such as practiced by golf greenskeepers, is followed, lawns containing more than a small proportion of bent grass are likely to be disappointing in many respects. **Astoria bent** and **Colonial bent** are suitable for lawn seeding, both clear and in mixtures with blue grass and red top. **Piper velvet bent** is especially resistant to "brown patch" and similar diseases. The seed is expensive, but it may be seeded at about half the rate used for other bents. **Creeping bent** and **velvet bent** are commonly planted on greens as chopped sections of the stolons (creeping stems) from turf stock grown in grass nurseries.

Rough blue grass (*Poa trivialis*): Often called "rough stalked meadow

grass", this is especially adapted to damp, shady locations; of light green color; low growing and creeping in habit of growth. In shady spots, where other grasses fail, it may be seeded with red top only. For moderate shade conditions, it should be mixed with Kentucky blue grass and red top.

Red top (*Agrostis alba*): This species is a "nurse crop" for practically all lawn grasses. It produces a fair turf in a short time, but under close clipping it soon disappears, rarely persisting for more than a year or so. As it disappears, grasses of various permanent species gradually thicken to replace it. As a rule, about one-fifth of the grass seeding should be red top.

Rye grass (*Lolium sp.*): American grown strains of domestic and English rye grass are suitable for use as "nurse crops" for permanent grasses, under conditions where very rapid soil coverage and considerable protection against erosion are desired. It does not blend with other grasses as well as does red top, since it grows much faster at first. Under average lawn clipping, it disappears in a year or so. It should not furnish more than 10 percent of the grass seed mixture, except for steep slopes, to provide maximum soil cover.

Timothy (*Phleum pratense*): This is primarily a hay grass. Its coarse texture and short life when clipped with the lawn mower make it ill suited for lawn turf. It may be suitable as a "nurse crop" grass under some conditions, especially for polo grounds, athletic fields, etc., where the rapid development of a deep-rooted sod is desired.

Canada blue grass (*Poa compressa*): Its color is closely similar to Chewings fescue. It is rather "scraggly" in habit of growth, and is an undesirable lawn grass. However, it is often useful on playing fields, polo grounds, etc., especially on poor soils, in a mixture with other grasses, including fescue.

Clover, white Dutch (*Trifolium repens*): This clover and its near relative, native wild white clover, are the only legumes that thrive under conditions of close clipping in New England. Clover is much more prevalent in some seasons than others for reasons that are not fully understood. However, when conditions are favorable for its growth, it spreads rapidly by runners to occupy large areas of the lawn, especially where the grass has been thinned by insects, diseases and previous crab grass invasion. It thus serves a useful purpose in the readjustment of turf to a change in conditions. Since clover leaves and white blossoms are in sharp contrast to the lawn grasses, especially when occurring in "patchy" spots, many persons object to clover in lawns, and on golf greens it is definitely condemned as a weed. Its growth is favored by lime, phosphate, and potash, and discouraged by nitrogen fertilization. It often develops from seed long dormant in the soil, or from other sources than sowing.

Seedings that are suitable for various conditions are indicated in the following table:

TABLE 3. SEEDINGS FOR VARIOUS CONDITIONS

Formula	Percentage of mixture, by weight	Lbs. of mixture per 1000 sq. ft.
1: Blue grass, suitable for average lawn and park conditions		
Kentucky blue grass	80	4
Red top	20	
2: Mixed grasses, for variable soils under average lawn conditions		
Kentucky blue grass	60	4
Astoria or Colonial bent	20	
Red top	20	
3: Fescue, for sandy soils, dry shady locations and badly trampled spots		
Chewings fescue	80	5
Red top	20	
4: Rough blue grass, for moist, heavily shaded areas		
Rough blue grass	80	4
Red top	20	
5: Mixed grasses, for variable shade conditions		
Kentucky blue grass	40	4
Rough blue grass	40	
Red top	20	
6: Mixed grasses, for playing fields, etc.		
Chewings fescue	40	4
Kentucky blue grass	25	
Canada blue grass	15	
Red top	15	
Timothy	5	
7: Mixed grasses, for steep slopes and elsewhere where rapid soil coverage is desired		
Kentucky blue grass	50	4
Chewings fescue	35	
Rye grass, domestic	10	
Timothy	5	
8: Mixed grasses, including bent grass, for lawns to be given special care		
Astoria or Colonial bent	50	3
Kentucky blue grass	35	
Red top	15	
9: Bent grass, from seed		
Astoria or Colonial bent	100	2
or Piper velvet bent	100	1

If clover is desired, white Dutch clover seed should be added at the rate of one ounce per 5 lbs. of seed mixture.

UPKEEP

Spring Renovation

MOST LAWNS present a rough appearance after the frost is out of the ground in early spring. After the customary raking to remove dead leaves and the usual accumulations of over-winter rubbish, foot marks and other depressions should be smoothed with screened loam, the spring top-

dressing of fertilizer applied, and bare patches should be reseeded. The lawn should then be rolled thoroughly. This is best done while the soil is still moist, but not so wet as to show a film of water on the surface when passed over by the roller.

Mowing

Very close mowing reduces the vigor of the turf especially when practiced in early spring. Blue grass is injured by short clipping. The first spring mowing should be deferred until the grass is at least two inches high. The height after cutting should be approximately one inch if the lawn contains much blue grass. When bent grasses or fescues are predominant, the height after cutting may be one-half inch if the lawn is smooth and properly graded. If mowing is done regularly, when the grass is not more than two inches high, the clippings may well be left on the ground.

Watering

Many lawns, especially when situated on light sandy soils, suffer severely from lack of moisture during the frequent dry periods that occur in the summer months. Sprinkling with the ordinary garden hose, nozzle held in the hands, is laborious and is rarely effective. Much of the water runs off without soaking in, and the temptation is to water every day or so, without doing much more than wetting the grass leaves at any one time. If watering is to be worthwhile, it should leave the soil in a moist condition to the depth of at least two inches. This can best be accomplished by the use of mechanical sprinkling nozzles that distribute the water as a gentle shower for at least one-half hour over a single area. After such a thorough watering there is no need for repetition within four or five days.

During hot, "muggy" weather, sprinkling should be done only when absolutely necessary. At such times there are certain disease dangers induced by having the grass wet, especially on warm nights. Morning watering is desirable in these periods.

Fall Repair of Lawns

In September all patches where the turf has been destroyed by weed invasion, diseases or pests should be spaded up, fertilized lightly and reseeded, using the same practices as for the seeding of a new lawn.

Thin turf, with no conspicuous bare spots, may be scratched deeply with an iron rake, all irregularities in the ground filled with screened loam, and seed scattered at about half the rate used for an initial seeding. Fertilizer used at this time should best be applied a few days beforehand.

Late Fall Treatment

Mowing should be discontinued sufficiently early to permit the growth of two or three inches of grass before cold weather sets in. This means that under average weather conditions the last cutting should be not later than October 15. Heavy accumulations of tree leaves must be removed to avoid smothering the grass. Scattered leaves usually do no harm.

Some lawns in this vicinity are top-dressed with stable manure during the late fall. If the manure is sufficiently well rotted to destroy weed seeds, this is a good practice. Fresh manure should not be applied to the lawn. When available, tobacco stalks and stems are often spread over lawns for the winter. It is doubtful if the plant food thus obtained is sufficient to justify the labor of spreading and spring removal.

Soils deficient in organic matter may be gradually improved by top-dressings of peat made in the late fall, so that it becomes incorporated into the soil during the winter season.

WEED CONTROL

IF PERMANENT lawn grasses can be kept in a healthy, vigorous condition, the turf is so dense that weeds have no chance to establish themselves. Successful weed control involves all possible steps in good turf maintenance. Yet, in spite of one's best efforts, the adverse effects of weather, insects, diseases, and damage by wear and other causes often give the weeds a foothold.

Crab grass: This is our most troublesome lawn weed. It is an annual grass which appears as tiny tufts of only two or three coarse blades about the first of July. During July and August, each plant rapidly builds up to a wide-spreading crown several inches in diameter, difficult to mow, and producing a multitude of short seed stalks that cling so closely to the ground that many of them may develop and shed their seed in spite of close clipping. In September the crab grass plants take on a reddish color, then rapidly die and turn brown, leaving unsightly bare patches that must be reseeded if grass is to be obtained during the next season.

This weed is most prevalent in moist soils, in open, sunny locations, especially adjacent to walks, driveways, etc., where rainwater is shed to the neighboring turf. It is not common where there is considerable shade, or in dry, sandy or gravelly areas where the growth of the lawn turf is unusually slow. It is frequently most abundant on the richest soils that have been stimulated by too liberal fertilization to a rank, succulent turf subject to sudden checks due to dry spells and to brown patch or lawn rot encroachment during hot, "muggy" weather. If the soil has become dry to the depth of several inches, light, intermittent showers and casual watering with a garden hose moisten only the upper inch or so. This is of little benefit to the permanent turf grasses, but is sufficient to keep the crab grass coming along at an ever-increasing rate. If there are long periods between rains, it is often best to let the soil remain dry, even if the grass turns brown. On the other hand, if rains come often but too light to soak the soil completely, supplemental hose watering is more apt to give the grass a chance to compete with the crab grass.

Vigilant removal of the crab grass plants as soon as they can be recognized is an effective, but laborious, method of control. If possible, the larger crowns of crab grass should be cut out before mid-August in order to prevent the plants from reseeding. Mowing the lawn closely after raking the prostrate stems to an erect position, with removal of grass clippings, helps to check reseeding of the weed to a considerable degree.

Repair reseedings on spots previously damaged by crab grass should be given special attention in order to produce a sod that will resist the return of the trouble during the following summer.

If the areas where crab grass is abundant every year are small, it is possible to destroy the seed by formalin sterilization. This is done by drenching the surface soil thoroughly with a 2 percent solution of 40 percent formaldehyde, at the rate of 2 quarts per square foot. The treated area may be seeded about ten days after treatment. Since this procedure costs one dollar or more per 100 square feet, it is too expensive for general use over much of the lawn area. There are newly developed chemical treatments for crab grass control that have given promising results elsewhere, but none of them has been sufficiently tested under Connecticut conditions to be recommended.

Moss: Unfavorable soil conditions are usually responsible for the weakening of the sod to the point where moss becomes troublesome. It is commonly believed that moss is an indication of a need for lime. However, many sweet soils are infested with moss. A lack of chemical fertility, especially with respect to phosphates and potash, is characteristic of most mossy areas. In some cases the soils are too leachy, due to an excessive content of sand and gravel in the subsoil. In others the soil is poorly drained or badly compacted, causing a poorly aerated condition for the grass roots. Improvement of the soil is the only real cure for moss competition.

Other weeds: Dandelions, plantain, chickweed and self-heal are at least partially kept in check by adequate fertilization, especially when the fertilizer contains the acid-forming sulfate of ammonia ingredient. When these weeds are particularly bad, some benefit is obtained by sprinkling the leaves with dry sulfate of ammonia when the dew is on them, or after watering. The weed-killing effectiveness of this material may be increased by mixing it with iron sulfate, at the rate of four parts of the former to one part of the latter chemical. Some damage will be done to the grass but the fertilizing effect will cause a speedy recovery if there is a fair amount present. Commercial "weed killer" chemicals may be used in extreme cases. However, when good lawn management is practiced, such weeds can usually be kept under control by a moderate amount of hand weeding at frequent intervals until the weed population becomes insignificant. Care should be taken to cut out dandelion, plantain and similar species below the crown, lest they come up again in increased numbers.

Weeds along gravel walks and driveways: Gravel walks and driveways often become infested with unsightly growths of such weeds as spotted spurge, crab grass, dandelions, etc. These may be eradicated by sprinkling the gravel occasionally with calcium chloride (road salt), which also serves to keep it from becoming dusty during dry periods. About 10 pounds of calcium chloride per 100 square feet of surface is a suitable dressing. Care should be taken to avoid applications too close to the margins of walks and driveways so that rains will not wash the salt over the adjacent turf. Copper sulfate (blue vitriol), dissolved in water at the rate of one pound per gallon and sprinkled liberally over the gravel, may also be used to advantage. (The material dissolves very slowly when the crystals are at the bottom; hence it should be suspended

in a loose cheese-cloth bag hung just below the surface of the water.) Commercial weed killers, of the "chlorate" type, must be used with great care since they may injure much of the grass adjacent to the gravel.

PEST CONTROL

Determine the cause of lawn injury before treatment

INSECTS and fungi usually cause injuries to turf typical of the causal organism. However, such injuries may appear similar in nature when superficially examined. Thorough examination and observation will generally determine the responsible pest.

Brown Patch: This disease occurs most frequently on newly seeded lawns in damp weather and on golf greens where heavy fertilizations and frequent waterings have promoted a luxuriant growth. The causal fungus is in the soil and attacks the roots, eventually killing them, after which the grass turns a characteristic brown color in definite round spots. In damp weather the fungus may develop as a white, mold-like growth on the surface of the soil and on the dead grass.

Drenching with Bordeaux mixture or commercial organic mercury compounds will usually prevent the spread of the disease if treatment is started as soon as the spots are noticed. On large areas it is more economical to use a home-made 4-4-50 Bordeaux than a commercial preparation of this material. If prepared Bordeaux or commercial organic mercury compounds are used, apply according to the manufacturer's recommendations. On a vigorous blue grass lawn it will take from 25 to 30 gallons per 100 square feet to get sufficient penetration and this amount would have to be doubled on a well established bent grass lawn. If the spots have already been killed, replace the turf with fresh soil and reseed.

Lawn Rot: This trouble is caused by a fungus which attacks the tops of the grass, producing a sudden rotting of the blades in irregular spots over the lawn during warm, rainy weather. The spots have a characteristic water-soaked appearance quite unlike brown patch. Lawn rot kills the blades of the grass first and if the lawn has a chance to dry out before the grass is entirely killed, it will usually recover and reseedling will be unnecessary. New seedlings and bent grass lawns are most likely to be attacked by this disease. Frequent sprayings with Bordeaux mixture when the disease appears will check its spread. On new seedlings it is best to anticipate the trouble and spray in late May or early June before the disease appears. Do not water an infected lawn except when absolutely necessary and then only in the morning so that the grass will dry off quickly.

Slime mold: Frequently in wet weather patches of a bluish gray mold appear on lawns. With continued dampness these spots may develop large masses of a yellowish fungous growth which is unsightly but does no harm unless it is sufficient to smother the grass. The mass of mycelial growth can be removed and the spot sprinkled heavily with sulfur or Bordeaux mixture if necessary.

White Grubs: The larvae of several insects—the Japanese beetle, Asiatic beetle, Asiatic garden beetle, the Western annual white grub and

several species of May beetles—are white grubs with six legs and brown or tan heads. With the exception of the May beetles, these grubs are usually found in the upper two inches of soil during the spring, late summer and fall seasons. Before changing into adults, the May beetle larvae pass at least two years in the soil where they feed through the spring into the late summer of the second season. All of the white grubs feed upon the roots of grass and other plants as well as on organic matter in the soil. The different species range in length from approximately one to one and one-half inches, and in diameter from three-sixteenths to three-eighths of an inch, when fully grown. They cause a typical injury to lawns which usually appears in September or October and in the spring. The grass roots are cut off during feeding, causing the grass to turn brown and die. Under these conditions the ground is usually soft and spongy and the turf lies loosely on the surface of the soil. May beetle grub injury usually appears immediately over the whole infested area, while that of the others first appears in small spots, eventually extending over an entire lawn if control measures are not taken.

The Japanese beetle and May beetles are found in practically all parts of Connecticut. The Asiatic and Asiatic garden beetles are found in the city of New Haven and westward along the shore towns into Westchester County, New York. The Western annual white grub is found particularly in the shore towns of Fairfield County, west of Bridgeport. The grubs of all these insects can be controlled by treating the turf with lead arsenate.

If numbers of Japanese or Asiatic beetles appear in a neighborhood, the turfs should be treated with lead arsenate as a precautionary measure. As the adult beetles of the other species mentioned are night flying insects, the presence of their grubs is not suspected until damage occurs. It is suggested that an examination of suspicious looking grass areas be made for grubs during the late summer or early fall by turning back the turf and examining the soil beneath.

Turf that is well established and not severely injured may be treated with lead arsenate any time when the ground is not frozen. **However, the best time for treatment is during the month of July before newly hatched larvae have grown to any extent.** When there has been sufficient rainfall and the soil is moist, the grubs feed very close to the surface, but when the soil is dry they feed lower down. Thus, when turf is treated during periods of drought, control is delayed until sufficient rain falls to bring the grubs up to feed in the soil strata containing the lead arsenate. Rainfall, freezing and thawing, and the movement of water in the soil are probably the main factors responsible for the lead arsenate permeating into the upper few inches of soil. Lead arsenate, when applied to turf, does not kill the grubs immediately but may take a few weeks to be effective. However, the residual effect of the poison lasts from three to five years during which additional treatment is not usually necessary.

The lead arsenate may be applied at the rate of 10 to 30 pounds to 1000 square feet of lawn. These figures are recommended as minimum and maximum amounts. Ten pounds will usually prevent injury to turf, while 30 will allow the minimum number of grubs to escape and emerge as adults. Quantities in excess of 30 pounds may injure the turf. After one application at this rate, no more lead arsenate should be applied for

several years, and then only when grubs again become injurious. If it becomes necessary to re-treat the turf, the minimum amount should be used.

The lead arsenate may be mixed in water at the rate of one pound to at least two gallons of water and applied with a watering can or power sprayer. Care should be taken to prevent run-off. A dry mixture, consisting of one part lead arsenate and five parts of fairly dry, sandy loam, may be used either broadcast, or applied by a hand fertilizer distributing machine. Regardless of the method of application, the insecticide should be distributed evenly over the turf at the desired rate. After treatment, the lawn should be sprinkled lightly in order to wash the insecticide off the grass into the soil. As lead arsenate is poisonous to man and domesticated animals, precautions should be taken to avoid unnecessary exposure to it.

If the grass has been killed and reseeding is necessary, the procedure to be followed depends on the time of seeding. In very early fall, the lead arsenate powder should be worked into the soil to a depth of three inches with an iron garden rake, and the area seeded at once. Fertilizer should not be applied until after two or three weeks or until the following spring. When seeding after the first of October the lead arsenate treatment should be delayed until early spring. In the case of spring seeding, fertilize the ground and sow the seed as early as possible. Apply the lead arsenate in water, as described above, after the first cutting of the grass.

Chinch Bug: Chinch bugs sometimes become injurious to lawns in June or late August and early September, particularly after a period of dry weather. Lawns consisting mainly of bent grass appear to be more susceptible to injury than those in which other species predominate. White clover is more or less immune to the chinch bugs, and parts of a lawn containing a mixture of clover and grasses have been observed to contain few if any bugs in the presence of a general heavy infestation.

The chinch bugs are sucking insects about one-eighth of an inch long when fully grown. Their feedings may cause the grass to die in spots or kill the entire lawn. The reddish nymphs (young bugs) and black and white adult bugs are abundant around the crowns of the grass plants, on the surface of the soil and in the lawn debris. They may be observed scurrying for cover if the grass is parted so that the surface of the soil is exposed to sunlight.

The chinch bug may be killed by applying either derris or cubé dusts (containing 1 percent rotenone) or tobacco dust (containing 1 percent nicotine) at the rate of 25 pounds to 1000 square feet of lawn area. A mixture containing one quart of nicotine sulfate and 4 pounds of soap (dissolved in water) to 100 gallons of water may also be used. It should be applied at the rate of 25 to 30 gallons to 100 square feet on a clear, warm day when the temperature is above 70 degrees F. As there are two generations of this insect each year, the young nymphs appear in the early part of June and again about the second week in August. Treatments should be made when the nymphs are present, and if the infestation is persistent, should be repeated a week to ten days later. As lead arsenate

and soap mixtures are incompatible and usually injure vegetation, insecticides containing soap should never be sprayed on a lawn previously treated with lead arsenate for grub control.

Sod Webworms: Sod webworms are whitish caterpillars about three-quarters to one inch long when fully grown. They live in small burrows, covered with bits of dirt and lined with silk, close to the surface of the soil. These caterpillars cut off and eat the grass blades, working a tortuous course for a short distance. The injury is not usually discovered until they are fairly well grown; hence, treatment should not be delayed.

Of the insecticides used by different workers for controlling sod webworms, two appear easy to handle and efficient: commercial pyrethrum extract and lead arsenate. The pyrethrum extract should be diluted in water at the rate of 1 part to 600, and 100 to 110 gallons of the mixture should be used on 1000 square feet of lawn. Lead arsenate should be used at the rate of 2 pounds in 20 gallons of water for each 1000 square feet. Either material should be sprayed under pressure with the spray nozzle close to the grass. The lead arsenate is by far the cheaper of the two treatments. Insecticides containing soap should not be applied after lead arsenate has been used, as lawn injury may occur.

Earthworms: Earthworms are not generally abundant in turf that has been treated with lead arsenate. This is usually applied at the rate of 10 pounds to 1000 square feet of turf area, following the procedure of application as described for the control of white grubs. Corrosive sublimate is exceedingly effective and very rapid in action. Dissolve this material at the rate of 2 to 3 ounces in 50 gallons of water and sprinkle over 1000 square feet. Do not use a higher concentration or a larger quantity. This treatment should be followed by a sprinkling with at least twice as much water. Corrosive sublimate is not only a dangerous poison but it is very corrosive to metals. There are also a number of commercial preparations which are very effective.

Ants: Ants may be controlled by the use of poison bait, derris powder (containing 4 percent rotenone), carbon bisulfide, or pyrethrum powder. Several commercially prepared poison baits may be purchased, most of them consisting of a sweet solution or paste containing small amounts of poison. All of these materials are poisonous to man and domesticated animals and should be used with care.

One of the most successful insecticides tried is a commercial preparation consisting of a paste containing thallium sulfate. This may be placed in a short length of garden hose, or in small pill boxes having holes punched in the sides, to keep it from animals and human beings. **Thallium sulfate is a violent poison.** The bait containers should be placed in the ant runs or where the ants are active.

Another mixture that has been used successfully consists of tartar emetic with about twice its bulk of sugar and enough water to make a thick syrup. This is also poisonous and should be handled in a manner to avoid accidents to man and animals.

Carbon bisulfide may be injected into the ant nests by using an oil can. About two tablespoonfuls are enough for a small hill. When large hills

are to be treated, a hole about 15 inches in depth should be made with a sharp instrument and the carbon bisulfide injected. In any case, all openings should be closed after the material has been applied. Carbon bisulfide is very inflammable and should be kept away from fire of any sort. As carbon bisulfide is also a fumigant with toxic properties, avoid unnecessary inhalation.

Pyrethrum powder has been used successfully against ants in a lawn. The powder should be dusted fairly heavily over and around the nest during dry weather. For small colonies this may be a very useful control method.

Derris powder (containing 4 percent rotenone) has been used successfully against the large black carpenter ant. A small handful placed in or around the nest or run when the ants are active will often exterminate a colony in a few days. Sometimes it is necessary to repeat the treatment after a lapse of a few days if the weather conditions are a deterrent factor.

Wasps: Oftentimes solitary wasps infest a lawn and create small, objectionable mounds of soil in the center of which is usually found an entrance hole to the tunnel. There are several species of these insects, varying in size from one-half to one and one-half inches in length. They may be black, or yellow and black, in color. These insects may be controlled by injecting carbon bisulfide into their nests in a manner similar to that used in treating small ant hills. A small amount of derris powder (containing 4 percent rotenone) placed in the entrance hole may be found effective for some species of this group of insects. Calcium cyanide dust is also effective when a small quantity is placed in the tunnels and the openings sealed. As calcium cyanide is poisonous to man and animals, precautions should be exercised to prevent their exposure to it.

Moles: Traps are an effective means of combatting moles. They should be used according to directions secured when the trap is purchased. Moles travel so close to the surface of the ground that their runways may be traced by the mounds of loosened soil. Sometimes they may be driven away from a lawn by opening the burrows every 10 or 15 feet and inserting a teaspoonful of flake naphthalene or paradichlorobenzene. It is possible in some cases to drown moles by inserting a garden hose and flooding the burrows with water. There are also poison baits prepared commercially that may be purchased and used as directed.