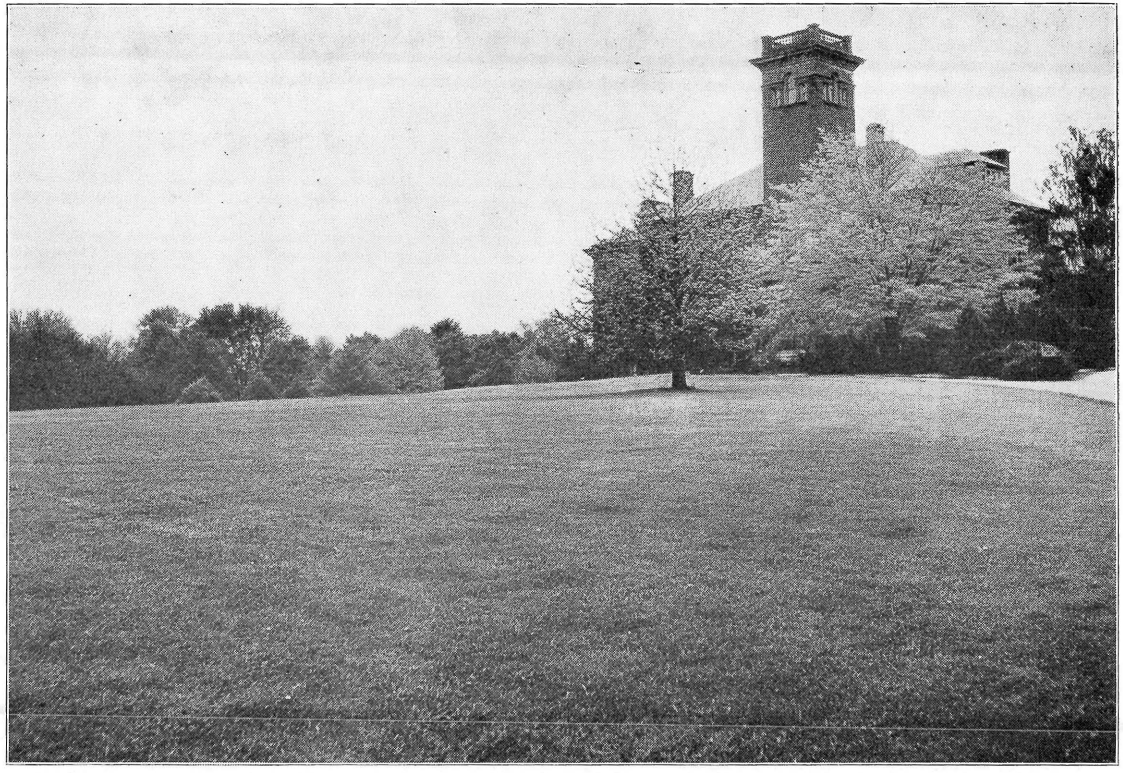
Special Circular 16 June, 1923

# Better Lawns

Ohio Agricultural Experiment Station
Wooster



**The Administration Building and Spacious Lawn**

Special Circular No. 18 June, 1929

# BETTER LAWNS

F. A. WELTON AND ROBT. M. SALTER

## ESTABLISHING A NEW LAWN

### SEED BED

**Grading.**—In starting the grading for a new lawn the surface soil should be piled to one side so that it will be available for use as a top coating after the grading is completed. It is most difficult and discouraging to try to develop a beautiful lawn when the seeding must be made on soil coming from the bottom of a cellar. In the construction of the general contour of the lawn, it is advisable, as far as possible, to avoid terraces, for these are not only difficult to build, but there are no grasses well suited to endure the arid soil conditions which prevail under such situations in dry weather. In finishing the grading care should be taken to leave no depressions. A 2-inch layer of good surface loam should be spread over clay wherever possible. The surface should be made smooth and to slope away from the house in order to insure good surface drainage.

**Drainage.**—On account of the impervious clayey nature of the subsoils over the greater part of the State, tile drainage may be expected to prove beneficial to many lawns, especially those built on subsoil and many of the larger ones in which wet, boggy places occur. Tile drains not only carry off surplus water rapidly, but in doing this they permit the easy entrance of fresh air into the soil. Both are important to the growth of grass. Lines of 4-inch tiles, spaced 20 to 30 feet apart, and laid 2 to 2½ feet deep with a fall of 3 or 4 inches for each 50 feet, will prove beneficial on the heavier clay soils.

**Pulverizing.**—In the preparation of a satisfactory seed bed, the ultimate goal is to have the soil firm, fine, and clean; free from weeds and free from all kinds of debris—sticks, roots, stones, broken pottery, etc. If the final preparation of the seed bed follows immediately after the grading, there will be no occasion for loosening up the surface soil by spading or otherwise. On the other hand, the problem in this case is to compact the soil. In doing this, the element of time is important. A few good soaking rains are more effective in settling the soil than is the extensive use of tillage implements. In the absence of timely rains, much can be accom-

plished toward obtaining a properly packed seed bed by the liberal use of a good roller. Whenever the grading is not followed shortly by seeding, as is usually the case where grading is done in the fall and seeding deferred until spring, the surface should be loosened up to a depth of 4 to 6 inches in order to get sufficient fine soil with which to level the surface and to cover nicely the seeds.

If one is so unfortunate as to have a heavy clay, excavated from the basement of a new house, on which to build a lawn, the condition of such a subsoil can be somewhat improved by the admixture of certain porous materials, such as cinders or granulated slag. If one of these is used, it should be incorporated with the subsoil to a depth of 8 to 12 inches and enough added to constitute approximately one-fourth of the total volume. The incorporation of liberal quantities of stable manure is also excellent practice on such soils. It is always desirable, wherever possible, to cover soils of this character with a 2-inch layer of good surface soil in which to sow the seed. In case surface soil is used, great care should be exercised to avoid soil contaminated with weed seeds. Good weed-free garden loam is excellent. Black mucky soil is not so satisfactory for it does not seem well adapted to the growing of grass. On the more open and friable subsoils, like those which underlie the Wooster silt loam, it is probably not worth while to incorporate foreign material. In a test at Wooster on subsoil to which such materials as cinders, slag, sand, and muck were added, the growth of grass was not appreciably increased.

**Fertilizers.**—On heavy clayey subsoils, to which some material may or may not have been added to improve the physical condition, well-rotted stable manure is one of the best fertilizers to use. Fresh manure is usually contaminated with weed seeds and is less desirable unless measures are taken to kill out the weeds before seeding. The manure should be applied at the rate of 500 pounds per 1,000 square feet and incorporated to a depth of 5 or 6 inches. In the absence of manure, a good high grade commercial fertilizer, having a 4-12-4 or similar analysis, should be evenly distributed at the rate of 20 to 25 pounds per 1,000 square feet and worked in to a depth of 3 or 4 inches. The use of 12 to 15 pounds of such a fertilizer per 1,000 square feet is desirable even when manure has been applied.

On good surface soil the need for manure is not so imperative, and on account of the growing scarcity of this product and the danger of contamination from weed seeds, the enrichment of this kind of soil may well be confined to the use of the 4-12-4 mixture,

applied at the rate of 15 or 20 pounds per 1,000 square feet. The fertilizer treatments, whether manure or chemicals, are best made some few days in advance of seeding.

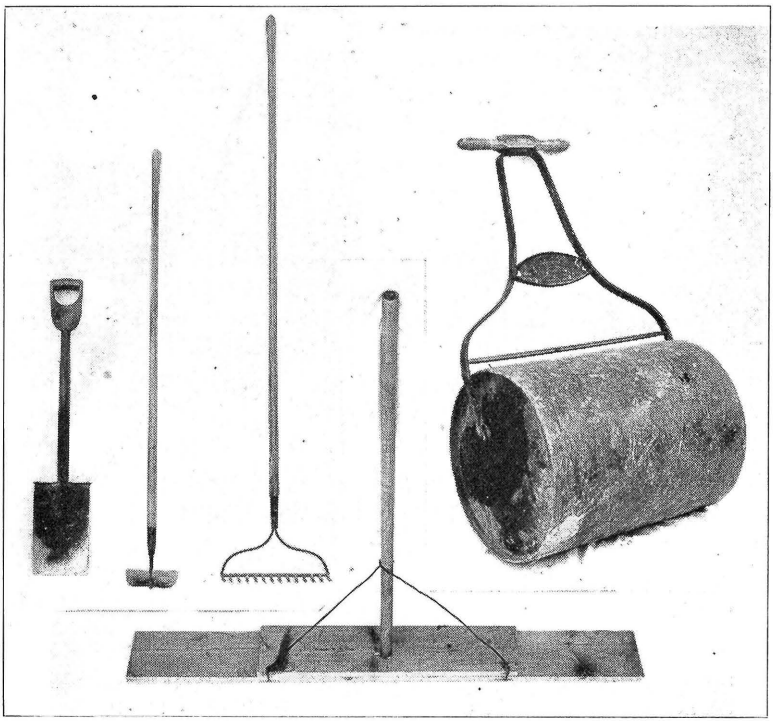


**Fig. 1—Tools useful in the starting of a lawn**

**Tools.**—In preparing and fertilizing the seed bed, a spade and iron garden rake are indispensable. A good roller is useful in packing the soil. A hollow metal roller is most satisfactory because the weight can be easily adapted to varying needs, simply by regulating the quantity of water carried. For leveling the seed bed a home-made smoothing board is useful. An inch board 4 feet long and 6 inches wide set on edge, in the middle of which is inserted a handle at the desired angle and supported by two braces at the base, is adapted to this purpose. Figure 1.

### SEED MIXTURE

**Standard.**—For the soil and climatic conditions which prevail in Ohio, there is nothing better for general use than Kentucky blue grass. It is slow, however, in getting established and for that

reason, it is well always to mix some redtop with Kentucky blue grass. These two grasses supplement each other nicely. The blue grass is a poor starter, but a good finisher, while the reverse is true of redtop. Under favorable conditions, the redtop will be crowded out in a few years by the Kentucky blue grass, but in the early stages of the lawn, it is an aid because it comes on more rapidly than the blue grass, and thus in a short time gives a green appearance to the lawn and by its presence tends to prevent the coming in of weeds. Where a green covering is needed quickly, the inclusion of a little Perennial rye grass or timothy is desirable, as these grasses start off even more promptly than redtop. For fall seedings the inclusion of such grasses is less urgent than in the spring, because in the fall there will be less competition with weeds. White clover may or may not be included. Its use is largely a matter of choice. The stems are coarse and for that reason lawns in which it is prominent are somewhat unsightly for a short time after they are mowed. Like all legumes, however, it can fix air nitrogen and for that reason most lawns built on poor soils are better with than without the clover. About 4 parts Kentucky blue grass, 1 part redtop, 1 part Perennial rye grass or timothy, and ¼ part white clover make a suitable mixture for ordinary conditions.

**Shade.**—Under large trees it is often difficult to grow grass successfully. So far as this is due to lack of light it can be improved by including in the seed mixture some of the more shade-tolerant grasses, like Chewing's fescue or rough stalked meadow grass (Poa trivialis). Experiments have shown that these grasses really possess some merit from the standpoint of enduring shade. About 2 parts of Kentucky blue grass, 1 part of redtop and either 3 parts of Chewing's fescue or 2 parts of rough-stalked meadow grass make a mixture as satisfactory as can be suggested. Except in the northern third of the State, the mixture containing the rough-stalked meadow grass is recommended in preference to that containing Chewing's fescue.

Under extreme conditions, however, no grass or combination of grasses can well endure. The difficulty is due not only to lack of light, but also to lack of soil nutrients and soil moisture. Growing trees not only take up the available plant nutrients, but large quantities of moisture are absorbed and transpired thru the multitude of leaves. In the hot dry weather of midsummer when the available supply of nutrients and moisture is low the shallow rooted grasses can not compete successfully with the relatively deep rooted trees and as a consequence, the grasses wither and die.

In 1927 determinations of nitrates and moisture were made on two sets of soil samples, taken at intervals during the months of August and September. One set of samples was taken under a group of pine trees and in an open space alongside; the other set from under a maple tree and in adjacent open space. The average amount of nitrates under the pines was 73 percent and under the maple tree 85 percent of that found in the corresponding open ground. The moisture under pines averaged 84 percent and under the maple 89 percent of that found in the adjacent unshaded soil.

For grass under trees, liberal watering and applications of sulfate of ammonia made at the rate of 2 pounds per 1,000 square feet every two weeks during the hot dry period of midsummer are very helpful. The watering should be started before the grass shows signs of injury.

Japanese Spurge *(Pachysandra terminalis)* is noted for its shade tolerance and can be used successfully as a ground cover in many places where grass does not thrive. Aside from shady places it is sometimes used on terraces and frequently as a border. It is not adapted to mowing, but it attains a height of 6 to 8 inches and remains green thruout the year.

**Acid vs. alkaline soils.**—Both grasses and weeds are responsive to the reaction of the soil. Some thrive best on alkaline, some on neutral, and others on acid soils. Fortunately, most of the important lawn grasses are more tolerant of soil acidity than some of the more troublesome weeds, including dandelions, chickweed, and crab-grass. By keeping the soil moderately acid, good turf can be established with less trouble from weeds. On soils rich in limestone, however, like many of those in western Ohio, it is not practical to control weeds thru making the soil acid by the use of fertilizers, since the quantity required on such soil is so great that at the normal rates of treatment, years must elapse before the desired reaction could be established. On such soils every effort should be made to prevent the coming in of weeds, for after they are once established, they are difficult to eradicate. The best procedure is to use a lime-loving grass and then keep it growing vigorously by the liberal use of fertilizers. Of the various lawn grasses, Kentucky blue grass is best adapted to limestone soils. Fortunately this grass is a good fighter and, if it is liberally fertilized at time of seeding and regularly thereafter, will, under Ohio conditions, compete successfully with most lawn weeds. Kentucky blue grass also makes a satisfactory growth on neutral or moderately acid soils. On such soils, therefore, it is usually a mistake to

apply lime because the grass itself is not in need of lime, while the addition of lime favors the growth of weeds. On highly acid soils, however, some lime should be added or else seed of the more acid-tolerant grasses, such as the bents or fescues, should be sown. About 3 parts of Chewing's fescue, 1 part of redtop, and 2 parts of South German mixed bent make a good seed mixture for use on acid soils.

The determination of the reaction of a lawn soil and a recommendation as to its need for lime can be obtained free of charge by submitting a sample to the Department of Soils, College of Agriculture, Ohio State University, Columbus, Ohio.

**Sandy soils.**—On extremely sandy soils, such as are often found in regions of lake ridges, it is frequently difficult to maintain a satisfactory lawn because such soils dry out quickly. Lawn grasses require an abundance of moisture. About 2 parts of South German mixed bent, 1 part of redtop and 2 parts sheep's fescue make a mixture as suitable as any for such a situation. Sheep's fescue is a little coarse, but it is among those most tolerant of arid conditions. Where available, the mixing of clay or loam soil with real sandy soil to the extent of 25 percent by volume and to a depth of 8 to 12 inches, is highly desirable. Such a treatment greatly improves the water retaining capacity of these coarse textured soils.

**Commercial seed mixtures.**—There are many lawn mixtures for sale on the market. Often times these are badly contaminated with weed and worthless grass seeds. Packages containing more than 1 percent of weed seeds or which are contaminated with such seeds as Canada blue grass or orchard grass or those containing more than 10 percent of timothy should be avoided. The seed law in Ohio requires that all packages containing 8 ounces or more shall bear a label giving the contents. Satisfactory results may be obtained from the use of ready-mixed seeds providing care is exercised to purchase them from reliable firms.

## SEEDING

**Time of seeding.**—Grass seeds may be sown any time during the season providing facilities are available for watering artificially. In the absence of such facilities, the seedings are best made either in the spring or fall, the seasons of the year in which rainfall is most likely to be abundant. The chief disadvantage of spring seedings is weed competition. Such seedings must compete with all the weeds of the season—the spring, the summer, and the fall

intruders. On some lawns this may be very troublesome. Where weeds are likely to be unusually bothersome, it is advisable to defer seeding until fall, except in the northern part of the State where seedings may be made successfully as late as the last of June, thus giving a few weeks before seeding in which to eradicate the weeds. It is always easier to handle the weeds before rather than after the seed is sown. The chief advantage of fall seeding is that weed competition is reduced to a minimum.

An excellent plan is to spade or plow the ground early in the summer and then work it frequently with harrow or rake to kill the weeds continuing until the first week in September, when the seed may be sown. If the seeding cannot be made before the middle of September in northern Ohio or the first of October in southern Ohio, it is usually better to defer it until early spring.

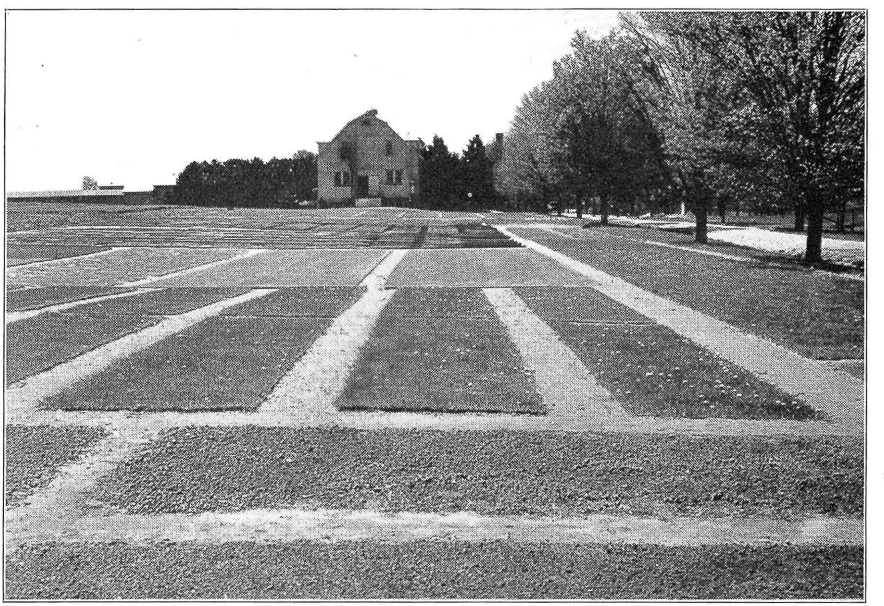
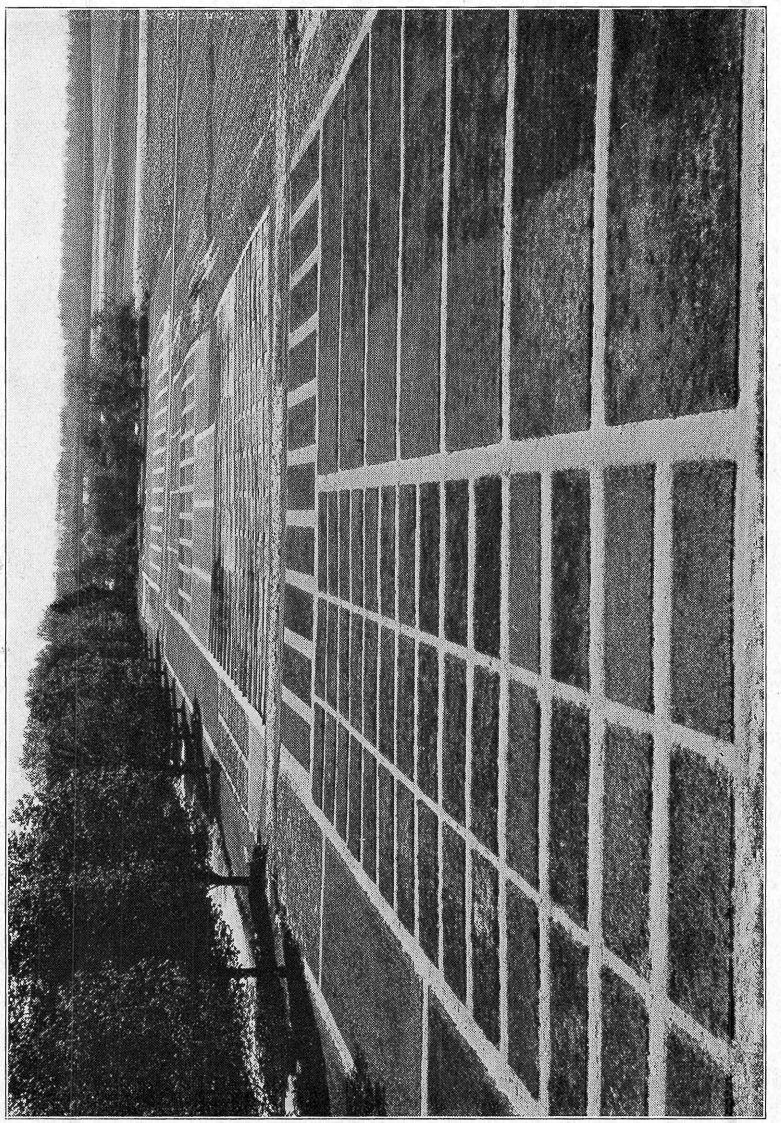


**Fig. 2.—Skimping the quantity of seed sown invites the coming in of dandelions and other weeds**

**Rate of seeding.**—To obtain quickly a thick stand of grass there should be used a liberal quantity of seed, 2 or 3 pounds per 1,000 square feet. More rather than less would be advisable. If less is used, there are likely to be many bare spaces, especially in the early stages of the lawn, and in these, weeds easily gain a foothold. This was well illustrated in the first two years of a rate-of-



General View of Lawn Plots

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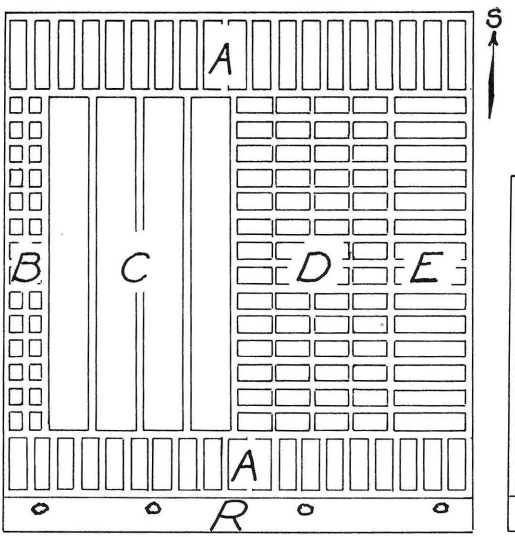
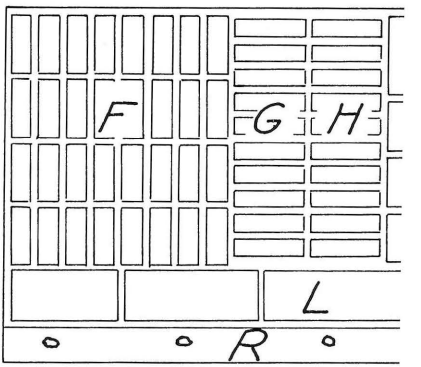



## Diagram o




A. Date of seeding. Seeds sown every week during the fall, September 1 to November 10 inclusive, and every month during the spring and summer.

B. Species of grass allowed to grow to maturity.

C. Fertilizer studies on different strains of creeping bent.

D. Nitrogenous fertilizers on lawn grass. Fourteen different carriers of nitrogen each applied at three different rates equivalent to 4, 8, and 12 pounds of sulfate of ammonia per 1,000 square feet. In each plot the west section is left without treatment to serve as a check.

E. Lawn mixtures.

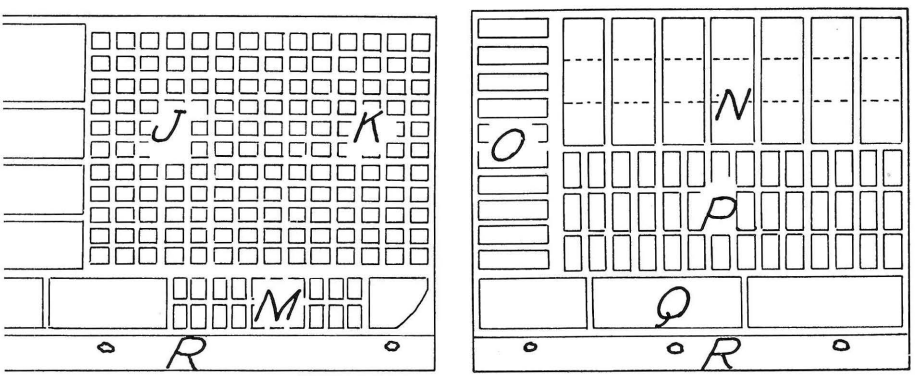
F. Species of grass and clover.

G. Rate of seeding. Quantity of seed ranging from approximately ¾ pound to 11 pounds per 1,000 square feet.

H. Establishment of sod on surface soil. Different kinds of fertilizers, also spring and fall seedings.

I. Creeping bent started from stolons. Different strains and different cultural methods.

# *Lawn Plots*




J. Reaction of soil in relation to growth of weeds.

K. Reaction of soil in relation to growth of grasses.

L. Tolerance of different species of grass to trees including shade and moisture relations.

M. Effect of sulfate of ammonia on new seedings; the applications being made at different rates and at different stages of growth.

N. Methods of watering. In this test not only the quantity of water used is varied, but also the time and frequency of application.

O. Establishment of sod on subsoil. Different kinds of fertilizers and different materials incorporated with the subsoil to improve the mechanical condition.

P. Maintenance of turf. Kinds of fertilizer; frequency of application; and different cultural methods, including frequency and lateness in season of mowing, disposition of clippings, composting and rolling.

Q. Same as L.

R. Rejuvenation of old and weedy lawns.

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seeding test at the Ohio Station. All of the seedings above 2½ pounds per 1,000 square feet gave satisfactory results. Where less than that amount of seed was used, the grass did not make a uniform and complete covering and there was a tendency for the encroachment of weeds. Figure 2.

**Method of seeding.**—To obtain evenness of distribution so that the grass will not appear spotted, requires great care. The work is best done on a quiet day, preferably in the morning, when there is little or no wind. The seed may be sown by hand or with a special seeder. For large areas a seeder of the wheel-barrow type is best adapted, Figure 3. It is advisable to sow one-half of the seed in one direction and the other half at right angles. The seeds should be covered to a depth of ⅛ to ¼ inch and the ground rolled lightly in order to pack the soil firmly. While the seeds may be raked in gently with an iron rake, the use of this tool is liable to give to the grass the appearance of having been drilled in rows, Figure 4. A piece of cloth or fertilizer bag tacked to the smoothing board, already described, makes a better tool with which to cover the seeds than is a garden rake.

**Fig. 3.—The wheel-barrow seeder is useful on large lawns**

### SODDING

Aside from steep terraces it is seldom necessary or even advisable to sod lawns. Seeding not only results in a more even surface, but it is less expensive. Wherever sodding seems advisable, however, the seed bed should be given the same preparation as that already recommended for seeding. It should be thoroly pulverized, drained, and liberally fertilized. To cover hard unfertilized subsoil with sod, no matter how good the sod, is almost certain to end eventually in failure and disappointment. Sodding

is often suggested for shady places where the grass has completely failed, but of course, the cause of the failure of the original grass will, sooner or later, result also in the failure of the sod.

### CREEPING BENT

Probably no more attractive lawn can be established than it is possible to make from the use of creeping bent. With proper care and attention it develops a rich green rug-like appearance which is pleasing and satisfying to the extreme. The strains of bent most commonly used do not seed readily and for that reason they are usually started by sowing the cut grass or "stolons", a method now in common use for starting golf greens. By this procedure a green sward can be established in a few weeks, in considerably less time than is required when seed is sown.

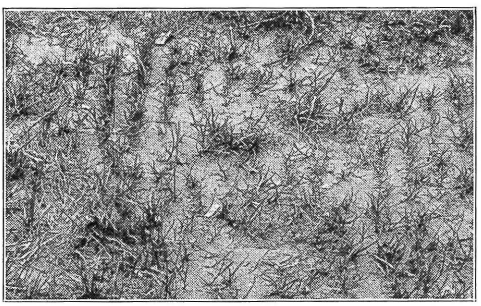

**Fig. 4.—Raking in the seeds with a garden rake may result in an uneven distribution of grass**

Creeping bent, however, is not recommended for general use because success with bent grass lawns requires much more care and attention than can usually be given by the average lawn owner. To keep the sward in good condition, the grass must be clipped closely every day or so. A special "putting green" mower is best adapted. If mowed with an ordinary mower and with the usual frequency—about once or twice a week—the grass, within a year or two, is likely to become stemmy and unsightly as shown in Figure 5. Furthermore, a lawn of this kind should be top-dressed with compost two or more times during the season and it requires liberal fertilizing and watering. Moreover, most of the strains of creeping bent are subject to a disease known as brown patch which gives the lawn an unsightly appearance during the period of its attack. Again, in the fall after the coming of frosts, the grass takes on a brownish color and this unsightly appearance persists late in the spring, long after Kentucky blue grass has taken on a bright green color. For the few, however, who have the necessary time, labor, and facilities with which to develop a beautiful bent grass lawn, there is perhaps no more worthy grass upon which to

bestow effort. Bent grass lawns started from seed of South German mixed, Cocoos, or Rhode Island bents, usually require less special attention.

**Fig. 5.—Creeping bent clipped close and frequent, left: not close and frequent, right. Weekly clipping at moderate height results in a thinning out of plants and in the development of an unsightly appearance.**

## MAINTENANCE OF TURF

**Fertilizers.**—To keep a lawn in good condition requires continued care and attention. To keep the grass growing vigorously it should be regularly and systematically fertilized, using a high grade mixed fertilizer like a 10-6-4 analysis. Ten pounds of such a fertilizer per 1,000 square feet, applied as a top-dressing in the early spring, may be sufficient on a good sod to keep the grass in a thrifty condition, especially if the clippings are not removed. Under less favorable conditions and until the growth of the grass becomes vigorous and a dense sward has been established, it is well to make each year a second application of about 5 or 6 pounds per 1,000 square feet in June and a third in August. The fertilizer should be applied when the grass is dry—free from dew or rain—scattered evenly, and then thoroly watered in, otherwise it may burn the grass. If a commercial 10-6-4 fertilizer is not available, one approximating this analysis can be made by mixing 5 parts of sulfate of ammonia or 6½ parts of nitrate of soda, 3 parts of 20 percent superphosphate, and 1 part of muriate of potash; or by mixing an 0-14-6 and sulfate of ammonia in equal parts. Burning may also be prevented by scattering the fertilizer during a good shower of rain.

**Compost.**—Grass thrives best on soils rich in organic matter. In addition to commercial fertilizers, therefore, the use of some vegetable material is helpful. Stable manure is becoming increasingly difficult to obtain and it is often badly contaminated with weeds. In lieu of manure a good compost pile is useful. Instead of burning leaves in the fall, these may well be saved in a flat pile, allowed to rot during the winter, and mixed in alternate layers

about 6 inches deep with good loam soil in the spring. If available, it is well to mix in stable manure with the leaves and soil. If kept moist and forked over once or twice during the season the compost should be in a suitable condition for use the following year. Compost applied in the spring before rolling not only adds fertility, but it helps to cover the roots of any plants that may have been heaved out. It is also useful in covering seed added to thicken the stand. Lawn clippings, if removed, may well be added to the compost pile. In many neighborhoods a compost pile may be developed as a community affair.

**Lime.**—The use of lime on a lawn should be made with strict regard to its needs. Some lawns require lime; most do not. On the limestone soils of western Ohio, it is seldom if ever that lawns need the addition of lime. In eastern Ohio, however, where the soils are naturally acid in reaction, it is to be expected that occasional light applications of lime may be beneficial on lawns that have not been heavily limed, excepting those consisting chiefly of acid tolerant grasses like the bents and fescues. An application of 25 pounds of hydrated lime or double this quantity of finely pulverized limestone per 1,000 square feet once every 5 or 6 years is sufficient. Heavy and repeated applications made in excess of the lime needs of the grass are to be avoided because they are not only wasteful of material but the accumulation of lime tends to create soil conditions favorable to the growth of troublesome weeds, Figure 6. The presence of moss in a lawn does not indicate a need for lime. Rather, it indicates a need for fertilizers.

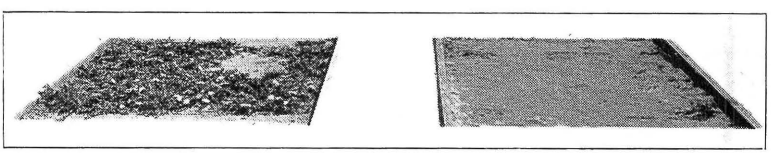

**Fig. 6.—Acidity militates against the growth of dandelions—moderate acidity, left; higher acidity, right**

That continued heavy applications of lime may be much less effective than the use of a good high grade fertilizer in the maintenance of a lawn is indicated by the growth made on two plots during the summer of 1928. A plot which receives hydrated lime at the rate of 100 pounds per 1,000 square feet annually yielded 8.5 percent more than an untreated plot, while one which receives annually 23 pounds of a 10-6-4 fertilizer split in three separate applications yielded 91 percent more than the untreated plot.

**Rolling.**—During the winter and early spring there is always alternate freezing and thawing, which results in more or less heaving of grass. To press the roots down, to pack the soil, and to make a smooth surface over which to mow, it is advisable to roll the lawn in the spring. This should be done as soon as the ground is firm enough to walk over without injury, but before it becomes settled, otherwise it will do little or no good. The time during which rolling can be done effectively is often limited to a few days.

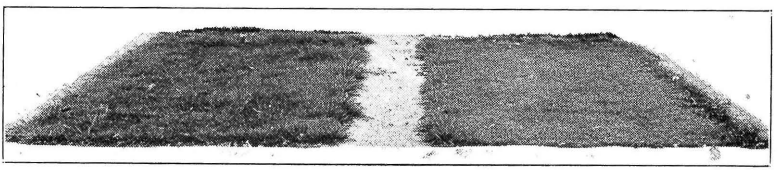

**Fig. 7.—Clippings returned to the lawn tend to keep the grass dark green in color and to promote the growth. Clippings not removed, left; removed, right**

**Mowing.**—Grass should not be cut too closely, especially in dry weather and in the early spring and late fall, when the mower should be set as high as possible. It should be cut with sufficient frequency that the clippings remaining on the lawn do not appear unsightly. The leaving of the clippings not only returns fertility to the soil, but conserves moisture. Both contribute to the growth of the grass. In 1928 a plot to which clippings were returned yielded 55 percent more than one from which they were removed but which was otherwise treated the same. As compared to the plot with clippings removed, the grass on the one to which the clippings were returned was much darker green in color as shown in Figure 7. In shady places, however, especially if damp, it is best to remove the clippings to prevent damage from disease.

**Watering.**—In hot dry weather most of the more common lawn grasses turn somewhat brown and tend to become more or less dormant. This is not necessarily a serious condition for with the return of cool weather and fall rains most of them, and particularly Kentucky blue grass, quickly revive, start vigorous growth, and soon present a refreshed dark green appearance. Liberal watering may ameliorate somewhat the drab appearance of midsummer, but the quantity required is so great that under many circumstances the question may well be raised as to whether the end attained justifies the cost. If, however, watering is to be resorted to, it

should be started before the grass shows injury and it is usually thought best to apply the water in liberal quantities at intervals of several days, rather than in light and frequent applications.

## REJUVENATION OF OLD LAWNS

In most lawns that are unsightly and unsatisfactory not only is the grass thin and unthrifty, but the soil is badly contaminated with weeds. This is usually the end result of a long period of neglect and in most cases indicates an impoverished soil. Thru years of inattention the turf grasses fail eventually to make vigorous growth, become thin, finally leave bare spots in which moss, weeds, and undesirable grasses develop, for it is Nature's way apparently to keep the ground covered with something. In extreme cases the best procedure is probably to rebuild; to plow or spade up, fertilize, and reseed.

Where plowing or spading is impractical, it is possible to renovate an old weedy lawn without resort to these drastic measures, but in attempting to do so it should be kept in mind that the element of time is important. It cannot be accomplished in a few weeks. Two or three years, even, may elapse before a satisfactory turf can be re-established.

The rejuvenation of an old lawn involves three steps; (1) elimination of weeds, (2) liberal fertilization, (3) reseeding. In cases where there is a great preponderance of weeds, where the stand of grass is not thick enough to make it worth while to try to save, it is suggested to spray the lawn in the late summer or fall with sodium chlorate using 2.5 to 3 pounds per gallon of water and putting that quantity of solution on 400 square feet of lawn.* Before winter, fertilize heavily using some high grade mixture like a 4-12-4 at the rate of 25 to 40 pounds per 1,000 square feet and in the spring, preferably some time in March when the ground is honey-combed with frost, reseed depending on subsequent freezing and thawing to cover. In the absence of sufficient freezing and thawing weather to honey-comb the ground, the seed should be covered with compost or garden loam.

On lawns where there is a fair stand of grass, but in which weeds are too numerous to remove by hand, special methods may be employed which are fairly effective on many common weeds.

*Caution.—Sodium chlorate of itself is not inflammable or explosive, but it may readily acquire these properties if allowed to come in contact with organic dust as would be the case when stored in open containers placed in a barn or other buildings. It should be stored in a closed metal container. Ignited material of any kind should not be allowed to come in contact with a treated area until after a rain.

Dandelions yield to repeated treatments of iron sulfate (copperas). From three to five applications during a season are required. The first may well be made before the plants come into bloom and the applications should be repeated as soon as the leaves become 3 or 4 inches in length. From 1½ to 2 pounds of iron sulfate is used per gallon of water and this is enough to cover 400 square feet. This spray injures or kills many other weeds such as broad-leaved plantain, narrow-leaved plantain, and ground ivy.

Some disadvantages accompany the use of iron sulfate. It will kill white clover. Moreover, if it is allowed to come in contact with sidewalks, stone, metal, clothing, or other objects, it produces a rusty stain which is not easily removed.

Dandelions and broad-leaved plantain can be eradicated also by the use of sulfate of ammonia. If applied in liberal quantities—10 to 15 pounds per 1,000 square feet—when the plants are wet so that the sulfate will cling to the leaves, practically all the dandelions or plantain can be killed in one season providing four or five applications are made about a month apart beginning when the plants first come into bloom. The grass may suffer some, but the permanent injury will not be great if the material is evenly distributed. Any bare spots that develop can be reseeded in the fall or in the following spring. The continued use of smaller quantities of sulfate of ammonia will eventually eradicate dandelions, but more time will be required—perhaps 3 or 4 years.

Where the number is not great, perennials like dandelions, broad-leaved plantain, and narrow-leaved plantain can be eradicated by the injection of gasoline into the crown of the plant by means of a sharp-pointed oiling can or by touching it with a stick or iron rod previously dipped in concentrated sulfuric acid.

After practically all the weeds have been removed, the lawn should be liberally fertilized using 15 to 25 pounds per 1,000 square feet of a high grade mixture like a 10-6-4. The removal of weeds will undoubtedly leave some bare spots. These should be reseeded early in the spring, preferably some time in March, depending on subsequent freezing and thawing to cover the seeds.

After grass has been re-established in the bare spaces, the lawn should be fertilized regularly as suggested under maintenance.

In the case of annuals, like crab-grass, which do not appear until midsummer, much can be done by fertilizing the lawn liberally in early spring and monthly thereafter, thus stimulating the growth of grass so that as much as possible of the ground will be covered when the seedlings of these weeds appear. An application

of a 10-6-4 at the rate of 10 pounds per 1,000 square feet in the early spring with the first signs of growth followed monthly with applications of sulfate of ammonia at the rate of 3 pounds per 1,000 square feet will tend to crowd them out. Raking over the lawn with an iron rake before mowing will facilitate the cutting off of the heads so that they can be gathered in a grass catcher and thus prevented from depositing their seeds.

## PESTS

**Ants.**—Carbon bisulfide is an effective remedy for ants. If the ant holes are difficult to find, new holes should be made to a depth of 8 or 9 inches. Into these squirt carbon bisulfide from a small oiling can. Immediately seal the holes with moist earth or cover the ant hill with a blanket and leave it overnight. Repeat the treatment in four or five days or until such time as the ants disappear.

**Grubs.**—One of the most effective materials with which to control grubs is arsenate of lead. It should be applied at the rate of 3 to 5 pounds per 1,000 square feet. To insure evenness of distribution, it is best mixed with dry sifted sand, soil, or some organic fertilizer, using about five pounds of these materials to each 1 pound of lead arsenate. Where facilities are available, it is best watered in, altho it will be worked down into the ground gradually by rains and dews.

**Moles.**—No very satisfactory methods are available by which to control moles. Perhaps one of the best is to make holes into the mole burrows every 10 feet and put in 1 teaspoonful of calcium cyanide **(poison)** and plug with a bit of soil. Carbon bisulfide is also effective and may be used in the same way. The moles may be trapped as directed in Farmers' bulletin No. 1247, U. S. Department of Agriculture, Washington, D. C.

**Earthworms.**—Bichloride of mercury **(poison)** is one of the best remedies for earthworms. Two ounces dissolved in 50 gallons of water is sufficient to sprinkle an area of 1,000 square feet. It should be well watered in immediately after application. Bichloride of mercury may also be applied by mixing 2 ounces of it with 2 cu. ft. of sand and distributing the mixture evenly over 1,000 square feet, after which the treated area should be liberally watered. Many of the earthworms will come to the surface and should be collected in order to prevent poisoning of birds or fowls.

Arsenate of lead applied as for grubs also kills earthworms.

# OHIO AGRICULTURAL EXPERIMENT STATION

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*In cooperation with the College of Agriculture of the Ohio State University.
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