

## CHAPTER VI

### THE IMPORTANT TURF PLANTS

IN growing turf one is in reality cultivating a particular grass or a mixture of grasses. It is manifest that to secure the best results detailed knowledge of each grass is necessary. Too often the sowing of a mixture is a frank acknowledgment of lack of knowledge, and this method is adopted in the hope that one of the grasses may succeed even if the others fail. To that extent it is justifiable, but as a rule one cannot hope to secure the best results if the grasses in the mixture make unlike qualities of turf or require different methods of treatment. In a few cases mixtures seem not only warranted but desirable. But in such cases there are definite reasons for using mixtures and not merely the hope that one may succeed if the other fails. While there is yet much to be learned about every turf grass, there already exists a large body of knowledge upon which a rational mixture can be based. Too often the mixtures used depend primarily upon what a

seedsman or a fertilizer dealer may advise, albeit in each case the advice comes from a man who has something to sell and naturally advises what he has to offer. There is no mystery about the sources of grass seeds nor of methods of recleaning them, even if it is undeniable that some seedsmen are more careful in recleaning their seeds and more reliable in their statements than are others. There is still much of mystery regarding the relative efficiency of fertilizers under different conditions, but the problems of fertilizers are so complex that one should always test a new fertilizer in a small way first before accepting it in place of another that has given satisfactory results.

The important turf grasses are discussed in detail. The finest species for putting-greens are Creeping Bent, Velvet Bent, Rhode Island Bent, and Red Fescue. Somewhat coarser grasses often used for putting-greens but more suitable for fairways are Kentucky Blue-grass, Redtop, Bermuda-grass, and Carpet-grass. Other turf plants that are discussed briefly are Japan Clover, Yarrow, Yellow Oat-grass, Crested Dogtail, Italian Rye-grass, Perennial Rye-grass, Annual Blue-grass, Korean Lawn-grass, Manila-grass, Mascarene-grass, White Clover, Canada

Blue-grass, Sheep's Fescue, Various-leaved Fescue, and Fine-leaved Fescue.

KENTUCKY BLUE-GRASS (*Poa pratensis*)

Kentucky Blue-grass (Fig. 2) is the most common turf and pasture grass in the northern half of the United States, over most of which area it comes in spontaneously. The botanical and traditional evidence both leave scarcely room to doubt that it is not native to the United States, but was introduced from Europe. Other names by which it is known or has been known



FIG. 2. — Kentucky Blue-grass (*Poa pratensis*): a, spikelet; b, floret, showing tuft of hairs at base.

are June-grass, Meadow-grass, Spear-grass, Spire-grass, and, in Virginia, Greensward. In this country most of these names are obsolete, or nearly so, the grass being known almost wholly as Kentucky Blue-grass or simply as Blue-grass.

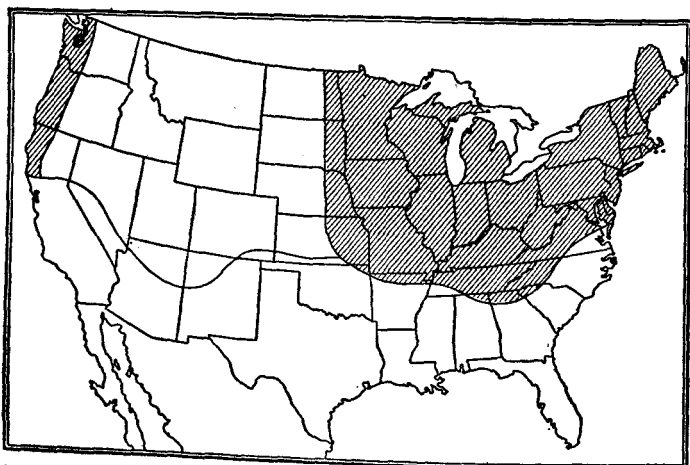


FIG. 3. — Map showing the areas in which Kentucky Blue-grass thrives best.

The name Blue-grass as applied to this grass is an unfortunate misnomer so far as the turf is concerned, which is a deep, vivid green. When in bloom the flowers do have a bluish or rather purplish cast, which perhaps gave rise to the name.

The accompanying map (Fig. 3) shows the area in which Blue-grass occurs abundantly. This area corresponds closely to that of the soils formed in the

southern movement of the great ice sheets in the glacial epochs. South of the glacial soils, Blue-grass is abundant only in limestone areas, but it thrives in California under irrigation, and in the cotton regions occurs in the hilly sections more or less commonly.

Kentucky Blue-grass is unique among our turf grasses in that it shows a strong predilection for limestone soils. It is due to this fact, combined with its nutritiousness, that the grass is so famous in the limestone districts of Kentucky, Tennessee, and Virginia. On the same reason is based the general practice of treating lawns with lime, as Blue-grass is the commonest grass used for this purpose. Unfortunately this has led to the general belief that all turf grasses are favored by lime, which is scarcely the truth. Occasionally excellent Blue-grass is found on land very poor in lime, but in such cases there is always good drainage.

Even when not in bloom Blue-grass may readily be recognized by its leaves. The leaf is about one-eighth inch wide, folded so as to be V-shaped in cross section, and the tip is boat-shaped, so that if it be pulled between the thumb and finger, a very noticeable split will be formed at the point. The only other

turf grass likely to be confused with Kentucky Blue-grass is Annual Blue-grass, but this has only fibrous roots and lacks the rootstocks of the former grass.

Kentucky Blue-grass is very variable, and many strains differing to a slight degree may easily be selected. Occasional tufts are very dense and fine-leaved.

Kentucky Blue-grass is an ideal grass in the North for fairways, and not rarely putting-greens are made up largely or almost wholly of this grass, especially where lime is used as a fertilizer. For putting-greens, however, it is not as fine as Creeping Bent or Red Fescue, but a good green of Blue-grass gives a fairly satisfactory putting surface.

Excepting in the northern tier of states, Blue-grass languishes during midsummer, as it is not adapted to withstand high temperatures. With the advent of cool weather in autumn, however, it generally recovers, even where a dense growth of Crab-grass has covered it during summer and early fall.

Commercial seed of Kentucky Blue-grass is produced in a few counties of Kentucky, Missouri, and Iowa, the greatest part of it from the first mentioned state, especially about the cities of Lexington, Winchester, and Paris. The seed is gathered by special

stripping machines, as the tuft of hair at the base of the seed makes other methods unsatisfactory. The stripping is done before the heads are quite mature, on which account the seeds must be dried very carefully, as otherwise they become injured by the spontaneous heating which occurs in the piles of the scarcely ripe seeds.

Blue-grass seed germinates better a year after it has been harvested than when fresh. Good seed should have a dark golden brown color, and be free from dust or musty odor. Light color indicates adulterated or mixed seed, while the presence of dust or musty odor implies improper curing and consequent low vitality. The best seed weighs twenty-eight pounds to the bushel. Formerly it was much adulterated with Canada Blue-grass, but such practice has now largely ceased.

#### ANNUAL BLUE-GRASS (*Poa annua*)

Annual Blue-grass (Fig. 4) is a weedy little grass that often occurs abundantly in putting-greens, springing up in the fall and disappearing in early summer. Where it is once established, it volunteers year after year, and in shady places often forms an excellent lawn in the spring. It is rather easily recognized by its light,

bright green color, its soft texture, the tendency of the leaves to curl toward the center, and the



FIG. 4. — Annual Blue-grass (*Poa annua*): *a*, base of leaf showing ligule; *b*, tip of leaf.

fact that they are often crumpled near the base. No matter how closely it is clipped, it will produce blossoms, often next to the ground. These sometimes appear in fall and are always abundant in earliest spring. Most of the plants die by early summer, but in cool seasons a few will live over a year.

Annual Blue-grass is not always looked on with favor, but when abundant it makes excellent putting-greens especially in early spring, and southward in late fall and winter as well. On some

Creeping Bent greens, Annual Blue-grass seems to make up all the grass on the green in early spring,



but as it gradually disappears in summer the Creeping Bent quickly replaces it as a rule. Occasionally the Annual Blue-grass is so abundant and dense as to injure the other grass seriously, but such cases seem rare.

In the South Annual Blue-grass would be ideal as a winter turf for putting-greens, but unfortunately the seed is high priced and but little of it can be secured commercially. As a consequence, such putting-greens are found only where the Annual Blue-grass has been abundant enough to reseed the ground thoroughly.

#### CANADA BLUE-GRASS (*Poa compressa*)

In spite of its name, Canada Blue-grass (Fig. 5) is a native of Europe, but for many years has been abundantly established in Canada. The distribution of Canada Blue-grass in America is nearly the same as that of Kentucky Blue-grass, but it is most abundant in poor soils, especially when rocky or gravelly.

Canada Blue-grass is easily distinguished by various characters. The leaves are gray-green or bluish-green, rather tough in texture. The stems are compressed so as to be two-edged, and the

same is true of the abundantly produced rootstocks. The panicle is close and narrow, not loose as in Kentucky Blue-grass.



FIG. 5.—Canada Blue-grass (*Poa compressa*):  
a, spikelet; b, a single floret.

The seeds lack the hairy appendage at the base found in Kentucky Blue-grass. In consequence the seed is much more easily harvested, and therefore sells at a much lower price. Most of the commercial seed is produced in southern Ontario. Formerly this was much used to adulterate Kentucky Blue-grass seed, but under stringent legislation this practice has largely ceased.

Canada Blue-grass produces a very tough but not very dense or attractive turf. It is a useful grass on fairways in the

northernmost states, especially where the soil is thin, but on better soils is not as good as Kentucky Bluegrass or Redtop.

REDTOP (*Agrostis alba*)

Redtop (Fig. 6) is botanically closely related to Creeping Bent. It is, however, a decidedly coarser, larger grass with broader leaves and larger inflorescence. Single plants of Redtop grow to a height of two to three feet, with leaf blades one-eighth to one-fourth of an inch wide. It spreads by creeping underground rootstocks. When planted thickly, however, and kept closely



FIG. 6. — Redtop (*Agrostis alba*).

mowed, the leaves are smaller and the turf not particularly coarse. If, however, the plants be given a better chance to grow, as at the edges of a green, the coarser nature of the turf quickly develops. Even when the turf is kept closely cut, Redtop can readily be distinguished from either Creeping Bent or Rhode Island Bent by the longer ligule (Fig. 18).

Redtop is a remarkable grass, owing to the wide range of conditions under which it will thrive. It grows admirably in wet land or even in shallow water. In strange contrast it will resist drought as well or better than most other grasses. For poor soils Redtop has long been recognized as one of the best grasses. Its range of climatic adaptation is scarcely less noteworthy, as it succeeds well from Canada south to the Gulf.

Redtop is a grass of considerable agricultural importance, being utilized mainly on wet lands for hay and on poor uplands for either hay or pasture. Due to its wide agricultural use, commercial seed is grown in large quantity, mainly in southern Illinois. This seed is much cheaper than that of either Creeping Bent or Rhode Island Bent, and as it can be distinguished only by an expert, it has often been used as a substitute or an adulterant for the two bents.

Redtop is a very valuable grass for fair greens in the northern half of the United States, especially on soils poor in lime. Under such circumstances, it is much cheaper and just as satisfactory to grow Redtop as it is to lime the land to induce the growth of Blue-grass.

For putting-greens Redtop is rather too coarse to be desirable.

#### RHODE ISLAND BENT (*Agrostis vulgaris*)

Rhode Island Bent (Plate V) is the most abundant turf grass growing on well-drained lands in New England, and it is common west to Michigan and south to Maryland. Botanically this grass is quite indistinguishable from Creeping Bent except that it produces only short stolons or runners. It is not the same as any of the three forms mentioned under Creeping Bent. The evidence is quite clear that the grass is not native to America, in spite of its abundance in New England, but that it was introduced from Europe, probably from England.

At one time Rhode Island Bent was mistakenly supposed to be the same as Velvet Bent or Brown Bent (*Agrostis canina*), but this last grass is not only very different, but it has never been a commer-

cial grass seed. Furthermore, Velvet Bent is not aggressive under American conditions and nowhere has become a common grass. Rhode Island Bent seems to be a uniform strain and makes a slightly coarser, darker green turf than does Creeping Bent.

Partly due to an error, but mainly to fraud, Rhode Island Bent has long been driven from the market. In former times Rhode Island Bent was much esteemed in New England for both hay and pasture. It was also known as Fine Bent, Furze Top, and Redtop, but is very different from the coarser grass now known commercially as Redtop.

Two causes led to driving Rhode Island Bent seed from the market. First, Illinois Redtop seed was much cheaper, and even in New England produced much higher hay yields, as it is a larger and coarser grass. The seed also is so nearly identical with that of Rhode Island Bent that unscrupulous or not well-informed seedsmen sold one for the other. Agriculturally Redtop is the better grass, but for lawns or fine turf Rhode Island Bent is far superior. Second, the idea became established in the seed trade that Creeping Bent and Rhode Island Bent were identical. This idea, it is true, is not far wrong as to botanical species, but turfs of Rhode Island



PLATE V. — Rhode Island Bent (*Agrostis vulgaris*).

Bent and Creeping Bent are different in appearance even if the seeds are indistinguishable.

Rhode Island Bent thus lost much of its identity and reputation. It is scarcely inferior to German Creeping Bent for fine turf. Large areas of the grass in practically pure growth occur throughout New England and on Long Island. There is no good reason why large quantities of this seed should not be gathered to supply the American demand, as it is a grass of much value for fine turf.

#### CREEPING BENT (*Agrostis stolonifera*)

Unquestionably the finest commercial grass for putting-greens in the North is Creeping Bent. It makes a beautiful, dense, soft, velvety turf, very compact and smooth, the ideal for a perfect putting-green (Plate VI). It thrives best in regions of moist, cool summers. On the outline map (Fig. 1) is shown graphically the areas in which it may be grown.

It succeeds best in the eastern states north of the Potomac and Ohio rivers and especially well in New York and New England; also on the northwest coast. In the South it can be grown satisfactorily only in the cooler half of the year, namely, fall to late spring.



Creeping Bent seed all comes from south Germany, and as handled by seedsmen differs mainly in the degree to which it may have been re-cleaned. Certain weed seeds are commonly present, only a few of which are objectionable, namely, mouse-ear chick weed, veronica, sorrel, and plantain.

Occasional lots of Creeping Bent from Germany represent a trailing form of Redtop, which produces much coarser stems and leaves. This form of Redtop is not found in America, and probably comes from a different part of Germany than does the true Creeping Bent.

The seed is now most commonly sold under the name of Creeping Bent, but sometimes is catalogued as Fiorin-grass (also applied to Redtop), and True German Fiorin-grass.

The seed is gathered from the wild grass, and never gives a perfectly uniform turf from the fact that several strains or varieties are included. If a Creeping Bent putting-green three or more years old be carefully examined, four kinds of turf can usually be distinguished, namely: (1) Very dense circular mats with fine, pale green leaves and long ligules; (2) Similar, somewhat coarser, mats of a darker blue-green color; (3) Much like 2 but of a

brighter green color; and (4) Less compact turf that does not make circular mats but fills the spaces between the others. Number 1 is in reality Velvet or Brown Bent (*Agrostis canina*), the seed of which is very commonly harvested with Creeping Bent. The three other forms are varieties of Creeping Bent, and when grown as separate plants produce runners one to six feet long which root at each joint. The three forms differ only in color and the compactness of the turf they form.

There has been much confusion about the botanical identity of Creeping Bent, albeit there is none about its commercial origin. Creeping Bent belongs to a group of grasses that are extraordinarily difficult to distinguish critically one from another, among them being those commercially known as Redtop and Rhode Island Bent. Creeping Bent, as pointed out, has at least three distinguishable kinds of turf, but the adult plants seem properly referable to the species known as *Agrostis stolonifera*, the name usually adopted in the trade. The three strains are not more different than similar strains that exist in most other grasses.

The existence of these three strains, however, keeps Creeping Bent turf from being entirely uni-

form. Another slight objection is the fact that the older leaves in dying turn brown and persist for some time, so that there is often a brownish background to the green in close-cut turf.

The seed was formerly much adulterated with that of Redtop, the seeds of the two being so nearly identical that only an expert can distinguish them. This fraud is now seldom practiced, but it is well to purchase only from reliable seedsmen who are in position to guarantee the seed. The individual seeds are very small, one pound containing about 6,000,000.

Creeping Bent is but slightly affected by lime, and it is very questionable whether lime should ever be applied where this grass is desired. Lime stimulates Blue-grass and White Clover, as well as various weeds, all of which on limed soils tend to crowd out the Creeping Bent.

Creeping Bent should be sown alone, as other grasses do not blend with it and most of them are coarser. There is perhaps one exception to this statement; namely, that Red Fescue and Creeping Bent together are often very satisfactory, at least for two or three years while the grasses are inter-mixed. In time, however, each grass will make cir-

cular mats which spoil both the appearance of the turf and its putting quality, as the stiff, wiry leaves of Red Fescue make quite a different putting surface from the soft leaves of Creeping Bent.

VELVET BENT OR BROWN BENT (*Agrostis canina*)

Velvet Bent makes the finest and most beautiful turf of any northern grass yet known. The grass is native to Europe, but has never been handled pure in the seed trade. The seed is nearly always found in Creeping Bent, sometimes to the extent of 40 per cent of the whole.

On any putting-green of Creeping Bent three years or more old, the circular mats made by Velvet Bent may readily be identified by the very dense, fine leaves and the rather pale apple-green color. By using a lens it will also be seen that the ligule is long and the surface of the leaves minutely roughened.

For some strange reason the fact that Velvet Bent makes such exquisite turf has been overlooked, but efforts are now being made to establish the seed commercially. Rhode Island Bent has erroneously been advertised by seedsmen as *Agrostis canina*, and the frauds which have surrounded the handling

of Rhode Island Bent seed have probably had much to do with causing the neglect of Velvet Bent. The name Brown Bent is in allusion to the color of the flower and not of the turf. Putting-greens of pure Velvet Bent would be far superior in beauty and fineness to the best greens now in existence, but only actual experience will determine whether they could be maintained as well as those of Creeping Bent.

#### RED FESCUE (*Festuca rubra*)

Red Fescue (Fig. 7) is next to Creeping Bent and Rhode Island Bent the most desirable grass for northern putting-greens. It is particularly adapted to growing on sandy loams but succeeds well on clay loams or even on clays. On the sandy types of soil it is to be preferred to the bents, especially in New England and the northern tier of states. Red Fescue is almost indifferent to lime, and this substance need not be used where this grass is desired. The grass is also remarkably adapted to growing in shade, being in fact the best lawn grass for this purpose under American conditions.

Red Fescue is native to the whole northern hemisphere, and is particularly abundant near the seacoast. In Europe there are numerous varieties, dis-



FIG. 7. — Red Fescue (*Festuca rubra*): *a*, top of sheath and base of blade; *b*, cross-section of leaf; *c*, the same as expanded on the upper leaves.

tinguished in part by the color of the herbage which varies from dark green to a pale glaucous green.

Like all the fescues, Red Fescue has stiff leaves, which give it a characteristic feeling if the palm of the hand is passed over the turf. The lower leaves persist a long time when dead, so that close-cut turf often has a reddish brown background. It is the only one of the fine-leaved fescues that will make a dense continuous turf.

Two varieties of Red Fescue occur in the trade, namely, Genuine or Creeping Red Fescue (*Festuca rubra* var. *genuina*), of which a small amount of seed is gathered in Germany; and New Zealand or Chewings' Fescue (*Festuca rubra* var. *fallax*). Creeping Red Fescue has slender rootstocks by which it spreads, so that a single plant may in time occupy an area six feet in diameter. The small amount of commercial seed that may be obtained is, however, much mixed with Sheep's Fescue and various weeds. Chewings' or New Zealand Red Fescue is a pure variety distinguished by its dark green color and the absence of creeping rootstocks, but the branches are extravaginal so that a single plant will spread to be a foot in diameter, and the grass will make a solid compact turf. This grass was introduced into

New Zealand from Germany about 1880 and for a time was very popular as a pasture plant, the seed having been harvested and sold first by a farmer named Chewings. At the present time it is used in New Zealand mainly on poor or thin soil, as other pasture grasses yield more on good soil. The New Zealand seed averages about twenty-four pounds to the bushel, but the best will weigh about twenty-six pounds. In well-cleaned commercial samples there are but few weed seeds, the only objectionable ones being Velvet Grass and Sheep Sorrel. The seed is often very low in viability, so that heavy seeding is necessary.

The dark green strain of Creeping Red Fescue makes probably the most beautiful lawns of any grass. In the turf experiments conducted by J. B. Olcott at South Manchester, Connecticut, all of the grasses were propagated by division so as to secure absolute uniformity. The most beautiful of the numerous turfs he grew was a dark green strain of Red Fescue. His lawns of this were probably the most beautiful lawns ever grown anywhere. In 1912, Fred W. Taylor, of Philadelphia, purchased this turf and about his home "Boxly" constructed his lawns of this grass. In spring and early summer



and again in late fall these lawns are unquestionably the most beautiful that exist. Unfortunately, how-

ever, in the latitude of Philadelphia this strain of Red Fescue in pure growth suffers from the attacks of a fungus disease, so that in midsummer the attractiveness of the turf is much lessened.

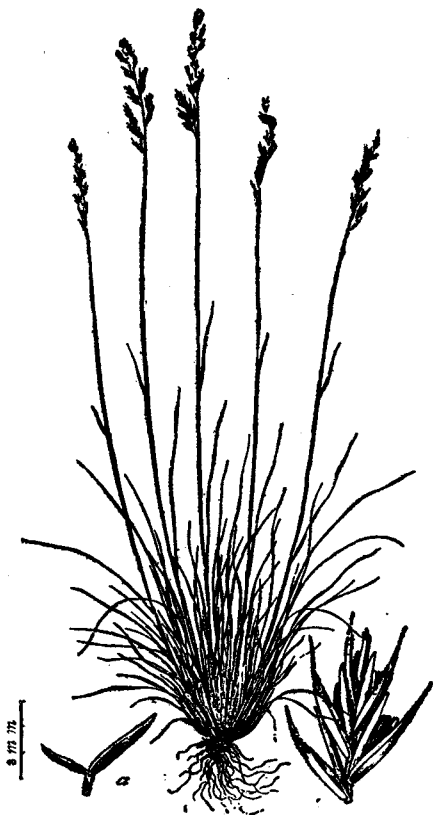


FIG. 8. — Sheep's Fescue (*Festuca ovina*): a, glumes at base of spikelet; b, spikelet.

SHEEP'S FESCUE  
(*Festuca ovina*)

Sheep's Fescue (Fig. 8) is native in the northern parts of the Old World, and apparently to a limited extent in

North America. Commercial seed is produced wholly in Europe, and it is the cheapest of the fescues. The

grass is useful agriculturally for planting on well-drained soils, especially those too poor to produce better pasture grasses. It thrives well both on sandy soils and on thin, rocky hills.

The grass is a bunch-grass, forming small tussocks four to eight inches in diameter, and usually separated by spaces equally wide. Under no circumstances will it alone form a good turf, as there are no creeping stems, but on rich soils the tufts may be made to grow close together. While often used in mixtures for the fairways, this is never advisable, as it is not needed where creeping grasses will thrive, and if planted alone it gives a bunched sward with objectionable cuppy lies for the ball between the tufts.

The only desirable place for Sheep's Fescue on golf courses is in the rough, and especially where the soil is thin or sandy.

#### HARD FESCUE (*Festuca duriuscula*)

Hard Fescue is merely a variety of Sheep's Fescue with stiffer, broader leaves. Everything concerning the use of Sheep's Fescue on golf courses applies also to Hard Fescue. Most of the Hard Fescue seed in the trade is in reality Sheep's Fescue.

FINE-LEAVED FESCUE (*Festuca capillata*; *Festuca tenuifolia*)

Fine-leaved Fescue is also a grass of European origin. The leaves are very fine and dark green, much like those of Red Fescue. When in bloom this fescue is very easily distinguished, because its flowers are devoid of awns.

Fine-leaved Fescue is a bunch-grass, the circular tufts being usually two or three inches in diameter, but sometimes larger. On this account it is not a desirable putting-green grass either alone or in mixtures. Like Red Fescue it will thrive well in the shade, but the Red Fescue with its creeping habit is far more desirable.

VARIOUS-LEAVED FESCUE (*Festuca heterophylla*)

This fescue derives its name from the fact that the stem leaves differ from the basal leaves in being broad and flat. It is native to Europe where all the commercial seed is gathered. The leaves are fine and dark green, and the grass is partly creeping in habit. It does best on a soil rich in humus. It is not a very satisfactory turf plant, however, and it is doubtful whether it has any place on American golf courses.

BERMUDA-GRASS (*Cynodon dactylon*)

Bermuda-grass (Fig. 9) is native to India and probably other parts of the Old World. In most parts of India it is known as doob, but in the southern portions as hariali. It became introduced into the United States before 1807, at which date it was already well established. The outline map (Fig. 1) shows the area where Bermuda will survive the winter, and in most portions of this area it is now abundant. While Bermuda is the most valuable pasture grass in the South, it is often troublesome as a weed on account of the difficulty of eradicating it from cultivated fields. It is often termed Wire-grass, especially in Virginia, and in California also bears the name of Devil-grass.

Bermuda-grass consists of numerous varieties which vary particularly in their degree of coarseness and in the presence or absence of rootstocks. Ordinary Bermuda-grass has abundant creeping underground stems, but in the variety known as St. Lucie-grass these are entirely absent, all the stems being above the ground.

Bermuda-grass will grow in all types of soil when well-drained, but shows a notable preference for

compact soils such as clays and clay loams. Bermuda-grass is also much favored by the presence of lime; a fact particularly noticeable along the edges of shell roads.

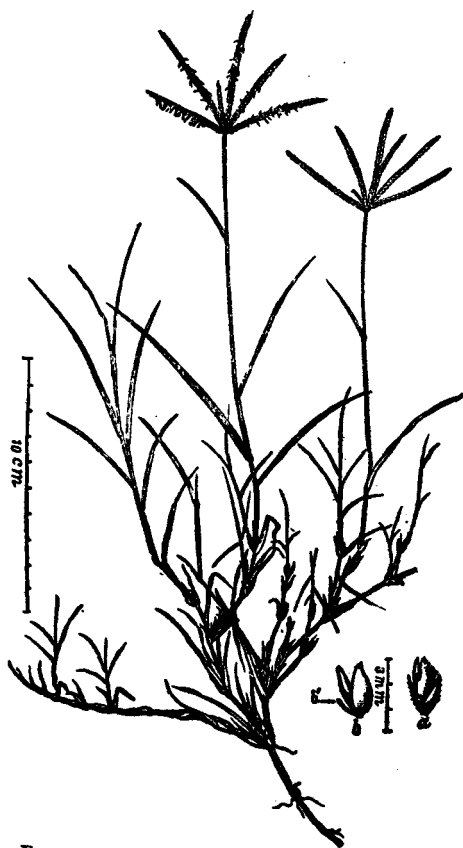


FIG. 9. — Bermuda-grass (*Cynodon dactylon*): a, spikelet; b, floret.

In general, Bermuda is not abundant on the sandy coastal soils of the South, Carpet-grass replacing it in large measure. There is reason to believe, however, that the use of lime would greatly increase its value on such soils.

For ordinary lawns and fairways Bermuda-grass is most excellent during summer, but it turns brown

with the first heavy frost. By sowing Italian Rye-grass on top of the close-clipped Bermuda turf in fall, a good green lawn can be made for the winter. In the early summer after the Bermuda is growing vigorously, the Rye-grass disappears. This same method can be used on fairways to advantage, but few southern golf courses have thus far followed this plan, though commonly used in lawns.

Bermuda putting-greens have in general not been altogether satisfactory, but a very notable exception is found in the greens of the Country Club at Montgomery, Alabama, developed by John M. Inglis. The excellent turf is apparently due primarily to the character of the soil, a heavy clay loam rich in lime. Heavy rolling to insure compact soil may also be important, as the close dense turf which occurs along paths and roadsides would seem to indicate. Inglis believes that the withholding of artificial watering is important.

The results secured at Montgomery make it seem probable that equally good putting-greens may be secured in the sandy soil area by using a top layer of clay soil a few inches thick and by applying lime generously.

On many putting-greens the creeping runners of

Bermuda make an uneven putting surface; but at Montgomery this difficulty does not occur. It is evident that for the best results a method must be used that will not induce the development of runners. In this connection several things are worthy of trial, namely, a clay surface soil, lime, moderate watering, and light fertilizing. It is not yet clear whether the growth of runners is stimulated by favorable conditions or by unfavorable, but the evidence indicates that on a rich well-limed compact clay loam soil a dense turf of Bermuda does not tend to produce runners, while on sandy land the growth is thinner and the runners are produced abundantly.

Another hope lies in finding a variety of Bermuda that is fine in texture and which does not form creeping stolons. If such a form can be found, it may easily be kept pure by vegetative propagation.

Bermuda may be grown either from seed or vegetatively from the turf. Commercial seed is produced both in Australia and in Arizona, the latter being preferable. The seeds are very small so that in sowing it is best to mix with double the quantity of some inert substance like sand, cottonseed-meal, and the like, by which means the seed can be scattered much more evenly.

In propagating Bermuda vegetatively, the sod or rootstocks should be in small pieces, if convenient cut up by putting through a feed-chopper. These pieces can then be scattered over soil with a loose surface and pressed in with a roller. This can be done at any time during the growing season. With a reasonable amount of moisture, nearly every piece of turf or rootstock will root and grow.

Where Bermuda is used for putting-greens, Italian Rye-grass is sometimes sown on the greens as soon as the Bermuda browns in fall. Italian Rye-grass grows very rapidly and soon forms good turf which will remain green all winter. For putting, however, Italian Rye-grass is coarser than is desirable. Redtop for winter greens should be fairly satisfactory, but thus far it seems not to have been utilized. An ideal grass for the purpose is Annual Blue-grass, but unfortunately the seed of this is rarely procurable. Where once well established this grass will usually reseed itself each year. Bermuda turf when thick will kill out all other perennial grasses where it grows, so that if Redtop or Italian Rye-grass is used as a winter green, it must be sown each fall.

On fairways that are not to be used in the summer, the Bermuda sod can be greatly invigorated if desir-



able by plowing or disking once during the period when the course is not being used, preferably in spring or early summer.

In the northern part of the region where Bermuda-grass will survive the winter, and in particular the area north of the southern boundaries of Virginia and Tennessee, it can scarcely be recommended for golf courses. In this area excellent fairways can be maintained with Blue-grass, Redtop, and White Clover, grasses which are green nearly all of the year. Bermuda-grass under such conditions forms unsightly brown spots in the sward in late fall and early spring, and has no compensating advantages. Besides there is danger of the grass finding its way to the putting-greens, where it is wholly undesirable if the greens are of finer grasses.

BLUE COUCH-GRASS (*Syntherisma didactyla*; *Digitaria didactyla*)

Blue Couch-grass is a native of Australia much used for lawns in that country. In habit it is not unlike St. Lucie-grass, a variety of Bermuda-grass, but the leaves are decidedly bluish in color. From preliminary experiments it seems well adapted to the southern states, and it may prove more desir-

able for turf than Bermuda-grass. It is propagated vegetatively as described for Bermuda-grass. It is not to be confused with Quack-grass or Witch-grass, commonly called Couch-grass in some sections.

#### CARPET-GRASS

(*Axonopus compressus*)

Carpet-grass (Fig. 10) occurs spontaneously south of latitude 32° to the Gulf and as far west as Texas. The grass is a perennial with creeping root-stocks and numer-



FIG. 10. — Carpet-grass (*Axonopus compressus*).

ous short, rather broad, flat, blunt-pointed leaves. The stems are compressed so as to be two-edged, and the slender flowering branches are one to two feet high.

Carpet-grass prefers sandy land, especially where moist, and in such situations makes a fine dense sward. It stands trampling and pasturing without injury and seems to thrive best under such conditions.

Carpet-grass can scarcely be considered a cultivated grass, and commercial seed is seldom obtainable. This grass now occurs in nearly all the area to which it is adapted, so that it is rarely necessary to plant it especially. Where this is desirable, however, Carpet-grass may be planted by scattering small pieces of sod, as in the case of Bermuda-grass. Or better, the grass may be permitted to seed, mowed when mature, and the straw with the attached seed scattered over the field where it is desired.

Carpet-grass is rather too coarse for putting-greens, but for fairways is an excellent turf grass. Near the Gulf Coast it is green from April to November.

#### CRESTED DOGSTAIL (*Cynosurus cristatus*)

This is a European grass that is very poorly adapted to American conditions, so that it is a rare plant in the United States. On European golf

courses it is used to some extent, especially on tees, as the tough turf holds the ball up well.

For some unfounded reason it is an element in many of the seedsmen's mixtures advertised for use on putting-greens in America. Even if the grass would thrive in this country, it does not make a turf comparable in fineness with Red Fescue or the bents. Its use in the United States, except perhaps in the western portions of Oregon and Washington, is a mistake.

#### YELLOW OAT-GRASS (*Trisetum flavescens*)

Yellow Oat-grass is a native of Europe used in pasture mixtures. Commercial seed is gathered in France. Plants of it are occasionally found in putting-greens, and are easily recognized by the pale color and hairiness. The turf is fairly good, but soft and slow, so that it is not to be recommended. It is not an aggressive grass under American conditions.

#### ITALIAN RYE-GRASS (*Lolium multiflorum* or *Lolium italicum*)

Italian Rye-grass (Fig. 11) is a native of Europe, much used there for hay production, and to a small extent in a similar way in the United States. The

grass is a short-lived perennial, usually treated agriculturally as a winter annual. It is a common

constituent of lawn mixtures, primarily, because the young seedlings grow so rapidly and make a green cover while the slower growing grasses are becoming established.

For golf purposes, it has no place except to sow on Bermuda turf in the fall as the latter becomes brown. Used this way it will make a good green fairway for the winter.



FIG. 11.—Italian Rye-grass (*Lolium multiflorum*).

It has also been used in this manner for putting-greens, but is rather too coarse, Annual Blue-grass and Redtop being preferable for this purpose.



FIG. 12. — Perennial Rye-grass (*Lolium perenne*): *a*, top of sheath, base of blade and ligule; *b*, cross-section of leaf-bud to show manner of folding.

PERENNIAL RYE-GRASS (*Lolium perenne*)

This grass (Fig. 12), also known as English or Australian Rye-grass, is in general much like Italian Rye-grass, save that it is perennial, living several years. For golf purposes it has no higher value than Italian Rye-grass, and its initial growth is not so rapid. Perennial Rye-grass seed is sometimes put by seedsmen in putting-green mixtures, but the turf it forms is too coarse to be desirable. On fairways it is not objectionable, but there are few conditions under which other grasses are not more desirable, excepting where a turf is desired quickly.

KOREAN LAWN-GRASS (*Zoysia japonica*)

This grass (Fig. 13) was introduced into the United States many years ago from Korea. In a general way it is comparable to Bermuda, but is far less aggressive than that grass. It will survive the winter as far north as Connecticut. For putting-greens it may prove desirable on sandy soils from North Carolina southward, but there is yet need of much experimenting to determine this point. Very beautiful turf of this grass is growing at Miami, Florida. It is also known as Palm Beach-grass.



FIG. 13. — Korean Lawn-grass (*Zoysia japonica*).

#### MANILA-GRASS (*Zoysia matrella*)

Manila-grass is native to the Philippines and other places in the Malayan region. In Manila it makes the very fine and beautiful turf seen on the Luneta. In experimental trials along the Gulf Coast of the United States this grass has formed very beautiful



plots of fine-leaved turf, which remains green all winter. The texture of the turf would make it ideal for putting-greens, and there is hope that this grass may be exactly what is desired for Gulf Coast and Florida golf courses.

#### MASCARENE-GRASS (*Zoysia tenuifolia*)

This grass was originally found in the Mascarene Islands, but was introduced into the United States in 1912 from Guam. It differs from the other *Zoysias* in having very short, stiff leaves and makes a beautiful turf much like Red Fescue. Underground it produces an enormous quantity of short rootstocks which keep elevating the turf in ridges, a defect that probably could be controlled by proper rolling. Both in California and along the Gulf Coast, plots of this turf succeed well, but it has not yet been tested for golf purposes. It remains green all winter on the Gulf Coast.

#### JAPAN CLOVER (*Lespedeza striata*)

Japan Clover or *Lespedeza* (Fig. 14) is an annual clover-like plant introduced into the United States about 1846. It is native to western Asia and undoubtedly became introduced into America by acci-

dent. There still exists a dried specimen of the plant collected by T. C. Porter at Monticello in central Georgia in 1846, which is the first definite record of the plant in America. In the South the opinion exists in many places that the plant was first introduced during the Civil War. Doubtless the plant was greatly spread during that struggle by the movements of cavalry. On the accompanying map (Fig. 15) is shown the outline of the area over which Japan Clover has become established, and also the probable



FIG. 14.—Japan Clover (*Lespedeza striata*). A young seedling and the tip of a mature branch.

area to the northward over which it can profitably be seeded on fair greens.

Within the limits indicated on the map, Japan Clover persists where once established, reseeding itself each year. In the lower Mississippi Valley

on rich land it sometimes grows two feet high and makes heavy crops of valuable hay. On poorer land, and towards its northern limits, it grows only two to six inches high, and is valuable mainly for pasturage. If closely pastured or frequently mowed, it makes a good turf from early summer until killed by frost. A single plant will often make a dense mat six inches in diameter. Throughout the South lawns and pastures usually contain a considerable percentage of Japan Clover, and it blends well in color with the grasses.

Japan Clover is remarkable for its ability to grow on very poor soils. This makes it invaluable on many golf courses where the soil is poor, as during the summer such spots become thickly carpeted with Japan Clover. The young plants usually appear in the latitude of Washington, D.C., about May 1, and by June have made a dense covering. It can be closely clipped without injury, and makes an ideal lie for brassy shots. Where, however, the plant is kept closely clipped, it can form but little seed and so will disappear in a few years unless reseeded.

The season north of the limit shown on the map (Fig. 15) is not long enough to enable Japan Clover to reseed itself naturally, but the plant assists ma-

terially for three or four months. Japan Clover is practically the only plant available for sowing on fair greens in spring with the assurance that it will improve the turf the same season, no matter how poor the soil may be. It can be made almost

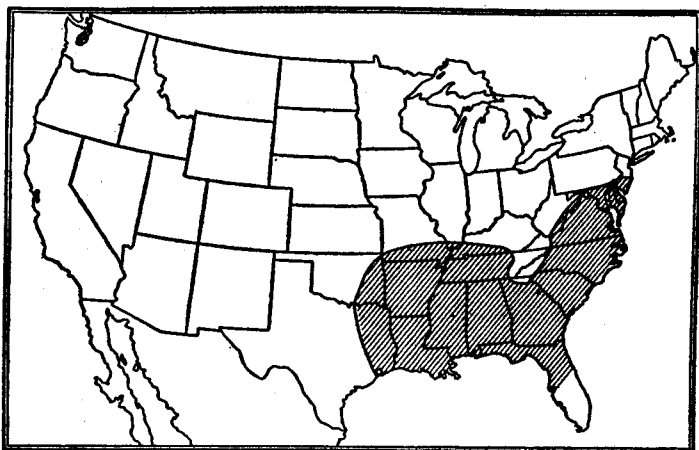


FIG. 15. — Outline map of United States showing area adapted to Japan Clover; north of the cross-hatched area it does not reseed itself.

as valuable on golf courses in the North as in the South — only it must be sown every year in the North.

Japan Clover should never be sown before the ground is well warmed; that is, about corn planting time. Under natural conditions the seed falls on the ground in fall and germinates in late spring,

but stored seed usually sprouts promptly if planted when the weather is warm enough.

Seed of Japan Clover is now commercialized and can be purchased in any quantity at reasonable prices either hulled or unhulled. It is handled by all southern seedsmen.

In the North it should be seeded rather thickly so as to secure a thick stand of turf quickly. Its ability to grow on the poorest and hardest soil is such that no previous treatment of the land is necessary, but if sown on thin slopes it may wash down during heavy rains. On such places, therefore, the soil should be scratched or the seed covered with a little soil. Where the turf is bunchy, Japan Clover is one of the best plants to fill in the cuppy interstices. Heavy seeding is desirable, about one bushel to the acre where turf is thin.

It still remains to be determined just how far northward Japan Clover can be used with satisfaction on golf courses, but with little doubt it will be found valuable at least as far north as indicated by the limit on the map (Fig. 15). Its very high value as far north as the southern line of Pennsylvania, where it persists naturally, leads to the conclusion that it will be valuable much farther north. Until

this is fully determined, however, only experimental trials are advisable on golf courses where it would be likely to be helpful.

#### WHITE CLOVER (*Trifolium repens*)

White Clover is so well known as to need no description. Though native to Europe, it is common over nearly all parts of the United States. It is most abundant in the northern half of the country, but plentiful enough in the South. White Clover is very frequently used in lawn mixtures, but on golf courses is not usually welcomed. The plant spreads naturally to such an extent that it nearly always finds its way into grass turf wherever planted. On fairways there seems no really valid objection to the plant, but for some reason golfers have acquired a prejudice against it. The good points of White Clover as a turf plant are its ability to grow on poor soil, to form a close, dense mat, and to withstand very close clipping well. The common criticism against it is that the leaves become crushed and make a slippery mass, but this objection is more fancied than real.

On putting-greens, White Clover is not desirable, although when closely clipped the turf permits of accurate putting. (Plate VII.) Scattered tufts of

White Clover are not uncommon on very good putting-greens, and are nearly always tolerated. On putting-greens, however, White Clover may be considered a weed, and if considered sufficiently objectionable its turf can be removed bodily and replaced by patches of whatever grass is being used on the greens.

#### YARROW (*Achillea millefolium*)

Yarrow or Milfoil is more often regarded as a weed than as a turf plant, especially when found on putting-greens. Nevertheless, it, like White Clover, is usually suffered to remain on a putting-green, even if its turf (Plate VII) is recognized to be inferior to the fine grasses. Yarrow is a deep-rooted perennial that makes a very tough persistent turf, a single plant sometimes covering an area three feet in diameter. A few golfers have seriously advocated its use for putting-greens, and in a few cases greens have thus been sown. Seed is obtainable from European seedsmen, as yarrow is often sown on thin land in mixtures for sheep pastures. The seed is very fine, containing 3,500,000 to the pound, and it is therefore desirable to mix with sand or other inert material when sowing.