

The time of planting in the dry region will depend primarily on the method of planting employed. If sprigs or sod are used they should be planted in the spring or early summer. Seeding is done either in the spring or fall, depending on

GRASSES AND LEGUMES WHICH CAN BE USED FOR TURF IN THE THREE CLIMATIC REGIONS OF THE UNITED STATES. THE ACCEPTED METHOD OF PLANTING IS GIVEN FOR EACH. WHERE A PLANT MAY BE PROPAGATED EITHER BY SEEDING OR SPRIGGING, THE MOST COMMONLY USED METHOD IS GIVEN FIRST.

Common Name	Scientific Name	Method of Planting	Page No.
<i>Cool Humid Region</i>			
Kentucky bluegrass	<i>Poa pratensis</i> L.	Seed	226
Canada bluegrass	<i>Poa compressa</i> L.	Seed	227
Trivialis bluegrass	<i>Poa trivialis</i> L.	Seed	227
Redtop	<i>Agrostis alba</i> L.	Seed	228
Red fescue	<i>Festuca rubra</i> L.	Seed	228
Meadow fescue	<i>Festuca clatior</i> L.	Seed	228
Perennial ryegrass	<i>Lolium perenne</i> L.	Seed	229
Annual ryegrass	<i>Lolium multiflorum</i> Lam.	Seed	229
Common ryegrass	<i>L. perenne</i> and <i>L. multiflorum</i>	Seed	229
Colonial bent	<i>Agrostis tenuis</i> Sibth.	Seed	230
Creeping bent	<i>Agrostis palustris</i> Huds.	Sprigs and Seed	230
Quackgrass *	<i>Agropyron repens</i> (L.) Beauv.		231
White clover	<i>Trifolium repens</i> L.	Seed	231
<i>Warm Humid Region</i>			
Bermuda grass	<i>Cynodon dactylon</i> (L.) Pers.	Sprigs and Seed	231
Centipede grass	<i>Eremochloa ophiuroides</i> (Munro) Hack.	Sprigs	233
Narrow-leaved carpet grass	<i>Axonopus affinis</i> Chase	Seed	233
Broad-leaved carpet grass	<i>Axonopus compressus</i> (Schwartz) Beauv.	Seed	233
Japanese zoysia	<i>Zoysia japonica</i> Steud.	Sprigs	234
Manila zoysia	<i>Zoysia matrella</i> (L.) Merr.	Sprigs	234
Bahia grass	<i>Paspalum notatum</i> Flüggé	Seed and Sprigs	236
St. Augustine grass	<i>Stenotaphrum secundatum</i> (Walt.) Kuntze	Sprigs	236

Common Name	Scientific Name	Method of Planting	Page No.
Common lespedeza	<i>Lepedeza striata</i> (Thunb.) H. and A.	Seed	237
Korean lespedeza	<i>Lepedeza stipulaceae</i> Maxim.	Seed	237
Perennial ryegrass (temporary)	<i>Lolium perenne</i> L.	Seed	229
Annual ryegrass (temporary)	<i>Lolium multiflorum</i> Lam.	Seed	229
Common ryegrass (temporary)	<i>L. perenne</i> and <i>L.</i> <i>multiflorum</i>	Seed	229
<i>Dry Region</i>			
Buffalo grass	<i>Buchloë dactyloides</i> (Nutt.) Engelm.	Sprigs and Seed	237
Kikuyu grass	<i>Pennisetum clandestinum</i> Chiou.	Sprigs	238
Smooth brome	<i>Bromus inermis</i> Leys.	Seed	239
Downy brome *	<i>Bromus tectorum</i> L.	239
Blue grama *	<i>Bouteloua gracilis</i> (H.B.K.) Lag.	Seed	239
Sideoats grama *	<i>Bouteloua curtipendula</i> (Michx.) Torr.	Seed	239
Bermuda grass	<i>Cynodon dactylon</i> (L.) Pers.	Sprigs and Seed	231
Crested wheatgrass	<i>Agropyron cristatum</i> (L.) Beauv.	Seed	239
Western wheatgrass	<i>Agropyron smithii</i> Rydb.	Seed	239
Kentucky bluegrass	<i>Poa pratensis</i> L.	Seed	226
Curly mesquite *	<i>Hilaria belangeri</i> (Steud.) Nash	239
Russian wildrye	<i>Elymus junceus</i> Fisch.	Seed	239
Sand dropseed *	<i>Sporobolus cryptandrus</i> (Torr.) A. Gray	Seed	239

* May be established by the hay mulch seeding method or natural stands may be utilized when available.

whether or not one is located in the northern or southern dry regions. In the North, spring seeding may bring good results, whereas in the South fall seeding is to be preferred, unless a southern grass, such as Bermuda grass, is used.

It is realized that conditions vary widely even within each climatic region and the fact that a number of grasses are suggested for use in each of the climatic regions should not be taken to mean that all or any of these can be used successfully in all locations in any one area. There are certain situations where, under present conditions, it will be extremely difficult, if not impossible, to grow any grass at all. Attempts to produce turf on such places is merely a waste of time, effort, and planting material.

In establishing turf for defense purposes it may be necessary to depend on temporary covers for short periods of time. There are a number of plants including grasses which may be used for this purpose and information regarding their use may be obtained upon request.

Kentucky Bluegrass

As this species produces a dense durable turf over a wide range of soil conditions in the cool humid region of the United States, it should be the chief component of most plantings in that area. Where it is watered, it also thrives in the northern half of the dry region. Unlike the southern grasses, the growth of the bluegrasses is confined to the cooler seasons of the year. Growth starts early in the spring, is retarded during the hot summer months, and is accelerated in late summer or early fall. This species is slower to produce a strong turf than are some of the southern grasses, but once it has become established it forms, with proper management, a dense, permanent sod. A number of strains of Kentucky bluegrass have been selected which differ widely in texture, height, ability to spread, and disease resistance. Among these some of the coarser, spreading types are better adapted for airfield and general turf use than are the usual commercial strains.

On lawns and similar areas bluegrass is seeded at the rate of approximately 4 pounds to 1,000 square feet. For larger areas, seeding at the rate of 50 to 75 pounds to the acre should be adequate. When possible, seeding should be done in late summer or early fall rather than in the spring, **never in mid-summer**. This is especially important in the southern part of the bluegrass range. In the North, early spring seedings may sometimes be successful.

Canada Bluegrass

This species has approximately the same distribution as Kentucky bluegrass. It is most often found on soils of low fertility and may sometimes be used as a turf grass on such soils. Canada bluegrass is coarse, stemmy, and a very poor substitute for Kentucky bluegrass; however, it may serve as a ground cover on poor soils where a dense turf is not needed. This species should be seeded at the same rate as that suggested for Kentucky bluegrass.

Trivialis Bluegrass (roughstalk bluegrass)

This is definitely a shade grass and has little application for use outside of shaded moist soils or other cool moist locations. It is not a grass to be used in turf that receives any appreciable amount of heavy wear.

The fact that seed of trivialis bluegrass is produced outside of the United States and will not likely be available in quantity until after the emergency should be kept in mind when drawing up seeding specifications. Trivialis bluegrass is often recommended in seed mixtures and if such mixtures are used in seeding specifications, projects may be unnecessarily delayed due to the fact that trivialis bluegrass is not obtainable.

Redtop

In the northern part of the United States redtop is often used in varying proportions in seed mixtures. It forms a quick cover which serves as a temporary turf until the more permanent grasses have become established. It does well under a wide range of soil conditions and will tolerate poor soils much better than most grasses.

In turf, redtop does not usually persist more than 2 or 3 years if it is growing in competition with other species. After the first year's growth it becomes coarse if it is growing on fertile soils, but this would not be objectionable if used on airfields or roadsides. Seed of this species may be obtained at a much lower cost than that of other grasses, and therefore it is apt to be given undue prominence in seed mixtures. When used in mixtures it should rarely constitute more than 20 percent of the mixture by weight, and usually not more than 10 percent.

Fescue

The fescues are well adapted to the well-drained, sandy loam soils of the northern half of the United States and may also be used on some heavy soils provided drainage is adequate. Fescue invariably fails when it is used on poorly drained, heavy clay soils. So far as climatic adaptation is concerned, the range of fescue is approximately the same as Kentucky bluegrass. Fescue, however, is better adapted to shade conditions than Kentucky bluegrass. Some of the most beautiful shaded lawns in the northern part of the United States are composed of fescue. It is not ordinarily used alone but in combination with bluegrass, redtop, and the bents. In regions where it is well adapted it may constitute 50 percent of the mixture in

which it is used. Fescue seed is usually expensive, therefore the matter of cost should be carefully considered when the use of this species in seed mixtures is contemplated. This does not mean that cheap seed is recommended, but there is obviously no justification for increasing the cost of seed mixtures by adding fescue if the mixture is to be used on soils which are not adapted to the growth of fescue. For most turf purposes red fescue seedings is preferred to other species. For roadsides and other rough turf, however, meadow fescue may sometimes be used to advantage.

Ryegrass

Two species of ryegrass, perennial and Italian, may under certain conditions be used to advantage in turf. The ryegrasses are rarely used alone but usually as a temporary cover



Ryegrass seeded in late fall on area where Bermuda grass had been planted too late to produce a satisfactory cover. Left, Bermuda grass; right, Bermuda grass plus ryegrass.

or as a nurse crop for some more permanent species. In the North perennial ryegrass will, under ordinary conditions, persist in turf for a period of 3 or 4 years. However, in the

southern part of the cool, humid region and in the South ryegrass remains only as scattered plants after the first or second year. Italian ryegrass is an annual and persists for one season only. The ryegrasses are tough and will survive considerable rough treatment. The fact that they are tough, however, makes mowing them rather difficult.

In recent years a mixture consisting of perennial and Italian ryegrasses has been used extensively in this country. The mixed seed is sold under the name of "Common" or "Domestic" ryegrass. It may be used for any purpose for which perennial ryegrass is used and some tests tend to indicate that for turf purposes the mixture is superior to either of the two species used separately.

When used as a nurse crop ryegrass should compose not more than 10 percent of the seed mixture by weight. If it is used alone as a temporary or winter cover seed should be sown at the rate of 50 to 100 pounds to the acre.

Creeping and Colonial Bent

Either of these grasses may serve as satisfactory turf species in the northern part of the cool humid region. They are especially useful as roadside grasses in New England and the Northwest. When used alone bent grasses will not withstand heavy traffic. However, Colonial bent may be used in combination with bluegrass and fescue on large-scale plantings subject to hard wear. Creeping bents, with the exception of seaside, are propagated by stolons and Colonial bent by seed.

The bents when used in combination with other species should normally compose not more than 5 or 10 percent of the seed mixture.

Quackgrass

This is a vigorous, persistent, and rapidly spreading perennial which occurs in abundance north of the Ohio and east of the Missouri Rivers. This species is usually considered a weed where it occurs in abundance. It has caused enormous damage to farm lands, nevertheless it is not entirely worthless since it can be utilized in the production of a rough turf. On areas subject to hard wear quackgrass may be used to advantage since it produces a durable turf if properly mowed. Its use, however, should be limited to locations where it occurs voluntarily in abundance.

White Clover

Turf seed mixtures often include varying proportions of white clover. On many soils of the cool humid region clover may be used to advantage in combination with bluegrass, redtop, or fescue. The clover tends to remain greener during the hot, dry periods than do some grasses. Its presence therefore aids the appearance as well as the density of turf during the summer months. It should be seeded in the spring and at a rate of approximately 20 pounds to the acre.

Bermuda Grass

This grass, without a doubt, is at present more widely used in the South than any of the others mentioned. It is also fairly well adapted to the southern part of the dry region. Bermuda grass thrives under high temperatures and its rapid summer growth, together with its low creeping habit, makes it an excellent turf species in many parts of the southern United States. It does well on a wide range of soils and will survive a great deal of wear and tear. Bermuda grass, like many others,



Cereal rye planted on an airfield as a temporary winter cover. Seeding in this instance was made too late in the season to produce a good stand.

is extremely variable and several selected strains are superior to the ordinary commercial types. Most of these, however, must be increased before they are available for extensive plantings. It is also probable that other strains could be developed which would be better adapted to use on airfields than the usual commercial stock.

Bermuda grass may be planted either by seed, sod, or sprigs. Hulled seed should be sown at the rate of 20 to 30 pounds to the acre. When speed is an important factor in the establishment of Bermuda grass turf from seed, one should insist that the seed be hulled since the germination of unhulled seed is usually slow. The amount of sod or sprigs required for planting

any given area will vary with the method used. Generally speaking, 1 square foot of good sod should plant 20 square feet. If thin sod is used as a source of planting material the planting ratio must necessarily be changed. In many cases 1 square foot of sod will plant no more than 10 square feet. Bermuda grass, like most southern grasses, must be planted either in the spring or summer, since the plants are semi-dormant during the winter months.

Centipede Grass

The range of adaptability of this species is not as great as that of Bermuda grass, nevertheless in many parts of the South centipede grass forms an excellent turf. Although this grass may sometimes be killed by hard usage, this objection is partially compensated for by its rapid growth and spreading ability. Centipede grass has not been tested on airfields, but it seems likely that it will not stand up under the wear such turf receives.

A number of selections have been made of centipede grass but these need to be increased before they are available in large quantities. It is also probable that further tougher strains might be selected and developed which would be better adapted to airfield use than those which are now in existence.

Centipede grass is ordinarily planted by sprigging at a ratio of approximately 1 to 25; that is 1 square foot of good sod is used to plant 25 square feet.

Carpet Grass

This grass forms a dense heavy turf on those southern soils to which it is adapted. It requires more moisture than does Bermuda grass and it generally thrives better in soils of rather high clay content. There are many areas in the South in which



Manila zoysia growing along roadside. This grass was not mowed throughout the growing season, yet its height, as indicated by the ruler on the right, is not more than 6 inches. Note the persistence of the grass at the edge of the road where it has been subject to wear and tear of traffic.

carpet grass appears voluntarily as soon as the soil is disturbed. This fact should be taken advantage of when turf is to be established on those areas where carpet grass occurs naturally. On the other hand, an attempt to grow carpet grass on the drier, sandy soils is not likely to meet with success.

Except in special cases, carpet grass is planted by seed. Under favorable conditions seeding at the rate of 25 to 35 pounds to the acre will produce a good cover. Like redtop, carpet grass is best used in a mixture rather than alone.

Zoysia

Two species of *Zoysia*, namely *Z. matrella* and *Z. japonica*, offer possibilities as turf grasses in the South and in the intermediate zone composing the southern part of the cool humid



Load-bearing capacity of Manila zoysia. This area was driven over by a truck at a time when the soil was wet. Note how the depth of track decreased as the truck proceeded from thin to well-established sod. The load-bearing capacity of well established Manila zoysia sod is unparalleled by most grasses.

and northern part of the warm humid regions. Japanese zoysia, commonly referred to as Japanese or Korean lawngrass, is the coarser of the two species. Some strains are winter-hardy and one planting in Boston, Massachusetts, has survived several severe winters.

Manila zoysia (Manila grass) has a narrow leaf and produces a finer textured turf than does Japanese zoysia. It apparently is not as winter-hardy as is Japanese zoysia, but it has been able to survive southern New England winters.

Japanese zoysia and Manila zoysia are still in the experimental stage but have demonstrated some interesting possibilities

for turf purposes. For example, the entire season's growth is only a few inches and therefore for many situations, such as airfields and roadsides, zoysias need no mowing. They are slow in becoming established, but when once they form a thick turf they compete successfully with weeds. The turf of these species will withstand much heavy wear, as well as rather prolonged periods of drought.

Seed of zoysia is not available commercially at the present time. Therefore it must be planted by sprigging. One square foot of good sod will plant approximately 25 square feet.

These two species of *Zoysia* are very different from *Zoysia tenuifolia* and should not be confused with that species.

Bahia Grass

Temperature is the chief limiting factor in the use of Bahia grass as a turf species. Since it is able to withstand but little cold it should be planted only in the southern portion of the warm humid region. Under favorable conditions Bahia grass spreads rapidly and forms a dense durable turf. It is adapted to a wide range of soil types. Bahia grass may be propagated either by sprigging or by seed. Seeding is to be preferred even though seed germination is often low. Seed should be sown at the rate of 30 to 35 pounds to the acre.

St. Augustine Grass

Although this species forms an excellent lawn turf in the extreme South it is not well adapted to airfield and general roadside use since it requires considerable moisture for best growth. It is tolerant of both shade and sun as well as a wide range of soil conditions—provided adequate moisture is available. St. Augustine grass is planted by sprigging at the rate of approximately 1 to 20.

Lespedeza

This plant is used primarily as a forage or hay crop in the warm humid region. Nevertheless it may supplement grasses as an airfield or roadside turf component in this region. Lespedeza is tolerant of high temperatures and is extremely drought resistant. None of the annual lespedezas will withstand severe frosts. Therefore their use is limited to the southern states. Of the two available annual lespedezas, "Common" is to be preferred for turf use since it does not cease growth after flowering, as does "Korean." Lespedeza produces a satisfactory cover on many acid soils of low productivity.

Seeding is done in early spring (March or April) at a rate of approximately 25 pounds to the acre.

Buffalo Grass

This is a rapidly spreading, low growing, drought resistant species which forms a tough sod and is used extensively in the dry region. Its low growth makes frequent mowing unnecessary. The buffalo grass seed available commercially is expensive but fortunately only a small amount of seed to the acre is necessary to produce a good stand. Untreated buffalo grass seed usually germinates poorly. Certain simple seed treatments have been devised, however, which will often increase germination by as much as 50 percent or 75 percent. Information concerning these methods may be obtained from the U. S. Department of Agriculture or State Agricultural Experiment Stations.

Much buffalo grass seed on the market is non-viable. There-

fore, before large plantings are made the viability of the seed to be used should be determined by germination tests.

The species also lends itself readily to propagation by check sodding, which is the usual method employed in the establishment of buffalo grass turf. Intervals between the blocks of sod, which are usually 3 or 4 inches square, vary a great deal, depending on the speed of coverage desired and the expense justified in the particular planting job at hand. On lawns or other small areas where a rapid cover is desired, these blocks of sod may be placed at intervals as close as 12 inches. On the other hand, large areas such as airfields would require such great amounts of sod that the expense would be prohibitive if the blocks of sod were placed at very close intervals. On such areas the intervals may be extended to as much as 4 feet. Other species, particularly blue grama, which may be desirable in combination with buffalo grass, may be seeded at the same time the sod is placed. Seedlings resulting from this planting serve as a ground cover until the buffalo grass has time to establish a solid cover.

Locally adapted rather than introduced strains of buffalo and grama grass should be used whenever possible.

Kikuyu Grass

This is a perennial with heavy rhizomes which has comparatively recently been tested as a pasture and turf grass in several localized areas. It has been grown with considerable success in parts of Australia and plantings along coastal areas of California have indicated that it may be successfully grown there. It is also probable that it may be well adapted to some parts of the south Atlantic coastal plain.

Experiments in Australia indicate that kikuyu is highly drought resistant. These results have not as yet been dupli-

cated except in limited tests in this country. Kikuyu produces very little seed. It must, therefore, be propagated by sprigging. The planting rate suggested for Bermuda grass will apply also to kikuyu.

Brome Grass

Two species of brome grass, *Bromus inermis* and *B. tectorum*, are worthy of consideration for rough turf purposes. *B. inermis* is the larger and coarser of the two species and requires considerable mowing if used as turf. It does, however, produce a fairly good cover when mowed. *B. tectorum*, an annual, and a weed under many conditions, occurs voluntarily in many parts of the Mid-west and might be used to advantage on those places where it occurs in abundance. For turf purposes *B. inermis* should be seeded at the rate of approximately 200 to 300 pounds to the acre.

Grama Grass

In the southern and central plains regions, grama grass (blue and sideoats grama), produced from local seed, has possibilities for airfield and roadside use. A combination of buffalo grass sod and grama grass seed produces a sod more rapidly than either of the species used separately. The use of such a combination reduces the amount of buffalo grass sod required for planting any given area.

Russian wildrye, crested wheatgrass (preferably Fairway strain), western wheatgrass, curly mesquite, and sand dropseed grass may also be used for the production of turf in certain parts of the plains region, where they are adapted. With the exception of crested wheat (Fairway strain) these grasses are not really turf species. Nevertheless, under favorable conditions they may be used in the establishment of a rough cover on roadsides, airfields, etc.