

THE BULLETIN

of the

UNITED STATES GOLF ASSOCIATION GREEN SECTION

Vol. 10

Washington, D. C., December, 1930

No. 12

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THE BULLETIN is published monthly by the United States Golf Association Green Section. At Room 7207, Building F, 7th and B Streets, N. W., Washington, D. C.

Address all MAIL to P. O. Box 313, Pennsylvania Avenue Station, Washington, D. C.

Send TELEGRAMS to Room 7207, Building F, 7th and B Streets, N. W., Washington, D. C.

Subscription Price: In United States of America, Mexico, and West Indies, \$4.00 per year; in all other countries, \$5.00 per year.

Entered as second-class matter, April 21, 1926, at the post office at Washington, D. C., under the Act of March 3, 1879. Copyrighted, 1931, by the United States Golf Association Green Section.

Sources of Golf Course Grass Seed

The harvesting and cleaning of bent seed were described in the November number of the Bulletin. The current number is devoted to a consideration of the harvesting of the other grass seeds that are commonly used on golf courses. Golf club officials are probably more interested in the different sources of bent seed in spite of the fact that the total consumption of bent seed on golf courses is far less than the consumption of all the other seeds considered in the current number of the Bulletin.

The entire supply of seed of some golf course grasses is produced in this country while the seed of other golf course grasses is practically all imported. Seed of Kentucky bluegrass, Bermuda grass, and redtop is imported only occasionally, and then only in small quantities and with the probability that these importations represent American grown seed which has been exported and shipped back to the United States. The supply of seed of such grasses as the fescues, Canada bluegrass, and crested dog's-tail is practically all imported. The seed of other grasses, notably the bents and rye grass, is grown in the United States and is also imported in large quantities. On pages 220 and 221 of this Bulletin is shown the number of pounds imported yearly during the past four years of seed commonly used on golf courses and in mixtures for lawns or other turf purposes. The figures are furnished by the seed laboratory of the United States Department of Agriculture. The list contains many interesting figures as well as information as to the principal sources of our grass seeds shipped from abroad. Unfortunately there are no records kept of the total production of most of these seeds in the United States. The Bureau of Agricultural Economics of the United States Department of Agriculture keeps a record of production estimates of most of our principal agricultural crops. Kentucky bluegrass and redtop are the only two golf course grasses that are regarded as major agricultural crops of which records are kept. The records of the Bureau of Agricultural Economics on the production of seed of these two grasses are given on page 222 of this number of the Bulletin. Estimates on the production of seed of a few of the other grasses are made by state agricultural workers in the states chiefly interested in such production.

From the list of importations it will be seen that some grass seeds are received from a number of foreign countries while others come from only a single country. Bent seed has been received during the past four years from seven different countries although it is indeed probable that much of it has been shipped from the country in which it was harvested to dealers in some other country, and from the latter country reshipped to the United States. Italian rye grass has been received from more than ten foreign countries although, as is indicated in the list, reshipment was undoubtedly made in some cases. The actual country of origin of seed can be determined by an expert seed analyst by means of either certain distinctive weed seeds contained in the sample or certain definite characteristics of the seed itself. In the case of carpet grass, for instance, the only importations have come from Australia. As is pointed out by one of the contributors to this number of the Bulletin, the carpet grass seed harvested in the United States comes from a limited area. Practically all the available carpet grass seed used in the United States

therefore comes from two distinct regions, one in the United States and the other in Australia. Canada bluegrass is a species of grass the seed of which comes from only one source. When the seed of any grass comes from only one or a few sources the available supply on the market is likely to be much more uniform than in the case of seed coming from many different regions. Italian rye grass is an example of grass the seed of which comes from many countries, with the consequent increase in the likelihood of variations. In recent years there has been a rapid growth in the domestic rye grass industry. Practically all the domestic seed is grown in Oregon and is of a mixed nature. There are small amounts of pure Italian and pure perennial rye grass seed harvested, but most of the seed is a mixture of these two and is sold as western rye grass. In 1924 the production was from 50 to 60 tons. In 1930 the production was over 3,500 tons. This seed sells comparatively cheaply, bringing from $3\frac{1}{2}$ to 5 cents a pound to the grower, and on account of its low cost is being used extensively in lawn grass mixtures and to some extent in replacing Italian rye grass for seeding winter turf in the South.

The importations of bent grass seed in 1930 amounted to 120 tons more than in any of the four preceding years. There was a decrease in importations from Germany, but it was insignificant as compared with the importation of 254 tons of colonial bent seed from New Zealand, which is more than three times the amount imported in any of the four preceding years. There is probably an increase in the use of bent, colonial bent in particular, for fairway and lawn mixtures, but some of this increase was probably due to dealers' increasing their reserve stocks before the new tariff became effective. Our American bent growers will no doubt make every effort to supply the bent seed needed in the future, and there seems to be required only a guarantee of sufficiently high prices to induce the growers to plant thousands of acres more for bent seed production. Even without a protective tariff, production in the United States has more than doubled since 1925. The new bent-growing region in the Pacific Northwest is responsible for this increase in home-grown bent seed. Bent seed production in New England dropped from 62 tons in 1924 to 20 tons in 1927 but increased to $32\frac{1}{2}$ tons in 1930. The production in the Pacific Northwest, on the other hand, has increased from only a few hundred pounds in 1924 to 5 tons in 1925 and 125 tons in 1930.

The price of grass seed is affected primarily by the same laws of supply and demand that affect the prices of other commodities. The golf club market, in the case of bent seed for example, represents a big proportion of the total demand. The demand from golf clubs for other grass seeds such as those discussed in this number of the Bulletin represents a relatively small part of the total market, for these grasses are widely used for pastures and lawns. Many different conditions affect, in varying degrees, both the supply and the demand, and these in turn naturally influence the market prices. It is beyond the scope of this Bulletin to enter into a detailed discussion of the many influences, but it is interesting to note a few of the many factors that may have some bearing on the price of seeds that are purchased by golf clubs.

The method used in producing the crop of seed determines the cost of production, which in turn influences the supply and the price.

Receipts of Turf Seeds from the Various Exporting Countries, 1926 to 1930

In some instances other than those cited below, the seed has apparently originated in a country other than the exporting country

	1927 Pounds	1928 Pounds	1929 Pounds	1930 Pounds
Bent Grass				
Australia	100	.....	.....	.....
Canada	20,600	61,300	13,700	.....
England	17,100	11,200	5,400	1,200
Germany	388,500	349,200	336,900	294,000
Holland	74,900	85,700	130,000	86,000
New Zealand	35,800	44,800	162,600	508,900
Scotland	1,700	.....	.....	.....
Total	538,700	552,200	648,600	890,100
Redtop				
Holland	2,200	.....	.....	.....
Denmark .....	.....	.....	.....	4,400
Germany .....	.....	.....	.....	500
American seed returned.....	1,100	.....	.....	.....
Total	3,300	.....	.....	4,900
Rough-Stalked Bluegrass				
Australia	300	.....	.....	.....
Canada .....	.....	.....	200	.....
Denmark	145,200	235,800	127,600	272,000
England	1,000	2,600	2,000	3,200
Germany	5,200	8,500	120,500	33,600
Holland	16,200	36,500	33,400	33,000
Scotland	2,400	2,200	22,100	5,500
Total	170,300	286,000	305,800	347,300
Wood Meadow Grass				
Australia	200	.....	.....	.....
Denmark .....	.....	.....	.....	4,400
England	200	500	.....	.....
France .....	.....	.....	.....	400
Germany	14,000	27,600	21,300	7,600
Holland	9,300	10,900	7,100	8,300
Total	23,700	38,800	28,400	20,700
Canada Bluegrass				
Canada	881,700	1,101,900	1,227,800	608,000
Chewings' Fescue				
Australia .....	.....	.....	100	.....
Belgium .....	.....	.....	600	.....
Canada	200	300	.....	.....
England	12,300	22,400	.....	.....
New Zealand	941,100	1,083,500	1,446,400	987,900
Scotland .....	.....	500	5,600	.....
Total	953,600	1,106,700	1,452,700	987,900
Other Fescues				
Canada .....	.....	400	1,900	.....
Denmark	24,400	6,900	.....	.....
England	14,800	3,700	10,500	.....
Germany	243,200	305,400	445,400	505,400
Holland	97,800	110,600	201,400	118,400
Scotland	3,400	.....	12,200	.....
Total	383,600	427,000	671,400	623,800

Receipts of Turf Seeds from the Various Exporting Countries, 1926 to 1930

In some instances other than those cited below, the seed has apparently originated in a country other than the exporting country

	1927 Pounds	1928 Pounds	1929 Pounds	1930 Pounds
Carpet Grass				
Australia	3,000	13,600	7,000	7,300
Perennial (English) Rye Grass				
Canada				100
Denmark		20,000	21,500	6,000
England	57,800	8,800	10,600	13,100
France			400	
Germany (1930 importation was of Irish origin).....			2,100	17,400
Holland		1,000	3,700	2,500
Ireland	578,500	624,000	886,900	696,200
New Zealand	378,600	340,200	138,000	11,600
Scotland	187,900	88,800	116,700	189,700
Of Australian origin.....				500
Total	1,202,800	1,082,800	1,179,900	937,100
Italian Rye Grass				
Argentina				44,800
Canada (of Dutch origin)...			1,200	
Denmark	230,900	72,000	42,500	73,100
England	1,300			
France	76,100	21,800		
Germany (of Irish origin)...				4,500
Holland	500	1,900	600	3,900
Ireland	372,400	167,400	102,800	94,600
New Zealand	34,400	187,200	115,300	13,600
Scotland	117,600	5,400	37,400	9,000
Other countries		200	200	
Of Australian origin.....				400
Total	833,200	455,900	300,000	243,900
Crested Dog's-Tail				
Australia	300			
England	100	4,500	4,100	
Germany			400	
Holland	2,600	3,800	17,300	1,800
Ireland	9,400	8,400	10,000	7,700
New Zealand	5,700	38,600	46,800	12,100
Total	18,100	55,300	78,600	21,600
Perennial Sweet Vernal Grass				
Germany	300		100	
Holland	200	600	200	300
Total	500	600	300	300
Annual Sweet Vernal Grass				
Germany		2,200	2,200	
Yarrow				
Germany	100			
Holland	200	400		200
New Zealand		800	1,000	400
Scotland			500	
Total	300	1,200	1,500	600

The method of obtaining Bermuda grass seed largely as a by-product of the alfalfa seed harvest presents an interesting contrast with the method of obtaining bent seed in some sections where ground is prepared for sowing a grass crop and the land is devoted primarily to the production of seed of that crop. In the case of Kentucky bluegrass the seed crop is in a sense a by-product of pastures, while on the other hand redtop seed represents the principal income from the land on which it is produced.

The annual production and the wholesale price during the spring season of seed of Kentucky bluegrass and redtop for the years 1926 to 1930, inclusive, are shown in the accompanying table. Practically no seed of these two grasses is imported; the factors influencing yields and prices are therefore primarily domestic. These grasses are used extensively on farms and lawns and for other turf as well as for golf course purposes. The figures are furnished by the Bureau of Agricultural Economics, United States Department of Agriculture.

Annual Production and Wholesale Spring Prices of Seed of Kentucky Bluegrass and Redtop from 1926 to 1930

Year	Kentucky Bluegrass		Redtop	
	Production in bushels	Wholesale pound price	Production in pounds	Wholesale pound price
1926	2,000,000	38 cents	8,300,000	31.25 cents
1927	1,800,000	20.5 cents	18,000,000	25.30 cents
1928	300,000	19.7 cents	14,250,000	13.10 cents
1929	1,350,000	31.3 cents	7,500,000	14.60 cents
1930	700,000	20 cents	6,000,000	16.45 cents

An important element influencing the price of any crop is the cost of the land on which it is produced. Kentucky bluegrass and redtop are grasses widespread on farms and in the case of each the seed production is an old industry centered in certain well-defined areas. Kentucky bluegrass seed is produced on rich grazing land and the seed crop is secondary to the importance of the pasture. The seed is stripped green from the pastures and must be cured by a process lasting from two to four weeks and requiring the piles of seed heads to be turned frequently by hand in the early stages of the process. Redtop, on the other hand, is produced on poor land. The industry is located in one large area with 2,500,000 acres under production. The 1,700 farmers engaged in the industry harvest and thresh their own crops and the seed is cleaned largely by local dealers. No particular care is given the fields, the sod being plowed under when the fields become too weedy and later they are reseeded. The fields are pastured in the spring and fall before and after the hay is cut. The crop is handled as for hay until it is threshed. The seed yield is lower than with Kentucky bluegrass but the cost of harvesting is less. Redtop land is cheaper than Kentucky bluegrass land and it is doubtful if it could be used for more profitable crops.

The total production of any grass seed, like the production of any crop, is largely dependent on climatic conditions. The drought and cold weather of the spring of 1930 accompanied by a late season were largely responsible for the marked decrease in the production of Kentucky bluegrass seed in 1930. The reduction in yield, however, does not always make immediate corresponding advances in the price of the seed. The previous year's crop and the amount of seed carried over have much to do with price fixing.

It is of interest to note that the retail prices of bluegrass and redtop seed have varied proportionately with the wholesale prices during the last three years. One large retailer's seed prices for the same quality of Kentucky bluegrass seed varied \$10 a hundred pounds in the past three years, redtop \$1, and colonial bent \$35. The price of colonial bent seed averaged about 3 times that of Kentucky bluegrass and $4\frac{1}{2}$ times that of redtop. The steadiness of redtop prices and the wide range of colonial bent prices illustrate the staple nature of the redtop seed industry as compared with the bent seed industry. The similarity of the seed of redtop and bent makes it easy for unscrupulous dealers to adulterate the bent with redtop, to their profit.

The bent seed industry is more specialized than are the other grass seed industries. The seed is the main crop, as is the case also with redtop seed; the seed is harvested for the most part in the same manner as redtop seed and is threshed in a similar manner, but usually more difficulty and expense are involved in cleaning the seed. The seed however is much more costly than any additional labor or machinery connected with the cleaning would account for. The bents, except in a few areas, are apt to become mixed in the fields. This is especially true of velvet bent seed, which to date has not been produced pure in appreciable quantities, due to the fact that it is grown in areas in which the predominating grasses are colonial bent and redtop. These grasses invade the velvet bent fields in spite of all precautions. Due to the similarity of the seeds of these three grasses it is impractical to separate them with available cleaning machinery. Velvet bent seed is somewhat lighter than the seed of redtop or colonial bent and more of it is therefore blown out with the chaff than is the case in cleaning the seed of other species of *Agrostis*. To a somewhat less extent the colonial bent seed industry is faced with the same problem of keeping the seed pure, only in this case it is the redtop that is the chief invader. Great care is often exercised to keep the fields free from redtop, for there is at present no machine for removing redtop seed from bent seed. Because the seeds of redtop and all the bent grasses appear identical to the layman, the whole bent seed industry has to go to considerable pains even after the seed is cleaned to prevent adulteration of the seed in the hands of the unscrupulous by mixing redtop with it. Some growers, particularly in the Pacific Northwest and Prince Edward Island, are having their seed certified as to purity before placing it on the market.

Another factor tending to put the price of bent seed above the price of seed of redtop and Kentucky bluegrass is that the bents are of little agricultural importance whereas there is a large and constant demand for redtop and bluegrass seed for pasture and hay crops. Bent seed does not reach its specialized trade without costly advertising, which is not necessary with seed of outstanding agricultural importance.

In Germany most of the bent seed is harvested by men, women, and children living in the region where it grows. The seed heads are stripped from the plant by hand, the plants being mostly scattered through thinly wooded country. The seed heads are usually hand-flailed, and later the seed may receive further cleaning. The more cleaning the seed receives the greater the percentage of chaff that is lost, and hence the total weight of the crop is reduced. Seed of German bent usually contains much chaff and is about 80 per cent pure

seed. The demand for this seed in the United States has depended mostly on the small percentage of creeping bent seed it contains and the somewhat larger percentage of velvet bent seed. The remainder of the mixture is mostly colonial bent with a small percentage of redtop. Usually the closer German mixed bent approaches 90 per cent or over in purity the more redtop it contains, which in many cases may be due to blowing the chaff from the pure mixed seed as harvested and adding the cheaper seed of redtop. The chaffy mixed seed from Germany is harvested at a comparatively much lower cost than similar seed can be produced in the United States. The colonial bent seed from New Zealand is apparently produced more economically than it has been possible to produce pure colonial bent seed in this country. There is now a protective tariff which will undoubtedly largely reduce seed importations from Germany, New Zealand, and Canada.

It has been evident, especially in the past few years, that the work of the seed analyst is playing an important part in keeping fine turf seeds pure. However, judging from some samples of seed received in 1930 from golf clubs, it is evident also that vigilance is still necessary. Golf clubs should purchase seed on a purity and germination basis, dealing only with reliable seed houses. Wherever there is doubt about seed it should be sent for analysis to one of the state seed laboratories, to a commercial seed laboratory, or to the United States Golf Association Green Section.

How Bermuda Grass Seed Is Secured

By S. P. Clark
University of Arizona

Bermuda grass is named after the Atlantic islands of the same name. It is now widely disseminated throughout the semiarid and subtropical regions where winter frosts are not sufficiently severe to kill its roots. The plant is perennial (living from year to year). It is propagated by means of seeds, jointed rootstocks, and aerial runners which take root at each joint. Seed produced in humid climates is not fertile. All commercial seed comes from the arid regions, such as southwestern United States or Australia. It is very hardy after once becoming established, living for months without moisture, and it is on record that it lived for over two years when submerged by the Saltan Sea (Imperial Valley, Calif.) making renewed growth when the water evaporated. Bermuda makes good pasture for cattle, horses, or sheep. It is a pernicious weed in the arid Southwest and very hard to eradicate when once established in cultivated fields. The principal source of seed comes as a by-product from threshing alfalfa seed—that is, alfalfa fields badly infested with Bermuda are allowed to produce seed, and when the alfalfa is cut the Bermuda is harvested and threshed at the same time. By the proper adjustment of screens in the separator the two kinds of seeds are segregated. Occasionally pasture fields growing on alkaline soil are allowed to produce a seed crop. When this occurs the crop is harvested with hay-making machinery and threshed with ordinary threshing machinery.

Redtop Seed Production in Illinois

By J. J. Pieper and W. L. Burlison

Illinois Agricultural Experiment Station

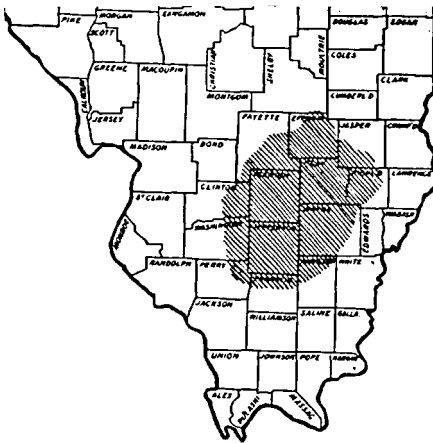
Redtop is an old grass in the United States. It was introduced into the agriculture of the early colonies. It spread west with the advance of civilization and has at last become well established in southern Illinois as an integral part of its agriculture. Suffice it to say, redtop is widely grown throughout the United States regardless of the fact that its seed production is concentrated in a small area of 4,000 square miles in one state.

Redtop (*Agrostis alba* L.) is the most important of grasses belonging to the genus *Agrostis* and the second most important pasture grass in America. It ranks second to Kentucky blue grass in general use as a turf plant. Because of its vigorous growth it will form a turf more readily than most plants. Its seed is the smallest seed among the agricultural grasses, there being from 4,000,000 to 6,000,000 seeds in a pound. The seed is similar to the seeds of other bent grasses and is not easily distinguished from them.

Redtop has many common names, such as whitetop, white bent, marsh bent, southern bent, English bent, fiorin, and Herd's grass. These names are confusing and should not be used in connection with this grass. It is a perennial with a creeping habit of growth and propagates by stolons as well as by seed. It is one of the coarsest of

the turf plants. Because of its size it is used for hay and pasture. It also offers possibilities as a soil binder where erosion is prevalent. The seed of redtop is a component part of most grass seed mixtures. While it is the best wet-land grass that we have, yet it is relatively drought-resistant. All things considered, redtop is the most widely adapted of the cultivated grasses.

Eighty-five per cent of the world's supply of redtop grass seed is produced in a dozen counties in southern Illinois. This area furnishes about 95 per cent of the total production in the United States. Some



Outline map of southern half of Illinois. Eighty-five per cent of the world's supply of redtop seed is produced in the dozen counties covered by the shaded area

seed is also harvested in Indiana, Iowa, Kentucky, and Missouri. The redtop region comprises about 2,500,000 acres. There are 19,700 farms in this area, 7,000 of which grow practically all the redtop seed. The average annual production of seed from 1922 to 1930 was over 10,000,000 pounds. At the average price of 15 cents a pound, the crop has a gross value of \$1,400,000. A record year for seed production was established in 1927, when 18,000,000 pounds were harvested. In 1930 only 6,000,000 pounds of seed were secured. During the past six years, the highest yield of seed was 70 pounds an acre, in 1927, and the lowest 31 pounds an acre, in 1925. The pound price

from 1922 to the present ranged from 10½ cents in 1927 and 1928, to 22 cents in 1925 and 1926. The average annual production of redtop seed for a single farm is 1,500 pounds, having a value of \$225.

There seems to be no single reason why redtop seed production is concentrated in a small area in southern Illinois. It is probably a combination of environmental factors, such as soil, climate, and economic conditions. The producing area and the location of a certain type of soil are almost duplicate patterns. When one speaks of the redtop area he not only thinks of the region producing redtop seed but of definite soil conditions and of a certain type of agriculture.

While redtop is adapted to the soil and climatic conditions of this region, yet this does not mean that the environment is ideal. One should feel that redtop is one of the best crops for this region rather than assume that the region is the best for redtop. Because the land is flat, level, and poorly drained, besides being acid and low in fertility, it is not well adapted for most crops. If the soil in general were more fertile it would be better suited for the production of redtop seed. The few fertilizer experiments which have been conducted indicate that the redtop plant responds very markedly to soil treatment as measured by hay and seed yields. This is especially true where limestone and nitrate fertilizers are added. The soil in this region is largely a light gray silt loam underlaid with a tight or impervious subsoil which will not permit of even fair drainage. Since redtop is the best wet-land grass yet to be brought into cultivation, it appears to be one of the most profitable crops for these conditions.

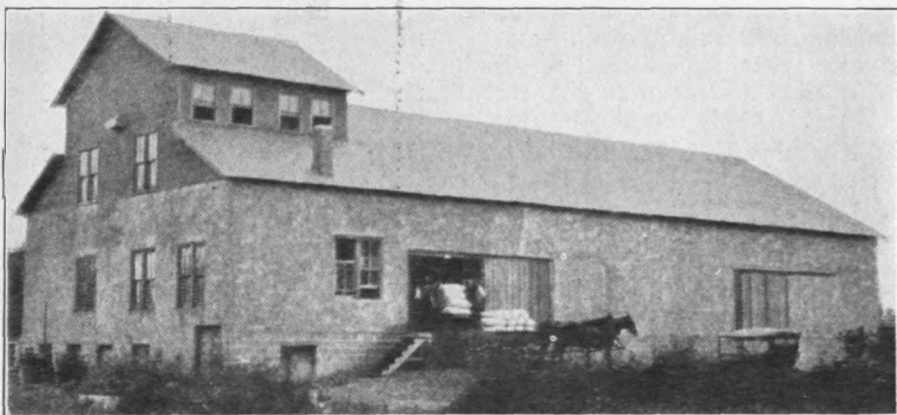
The producers of redtop seed, instead of receiving encouragement and help, have been condemned from many sources for not practicing a better type of agriculture, and as a result little has been done to improve the crop or the environmental conditions under which it is grown. More recently it is believed that a wise choice of a crop for this region has been made and that an effort should be put forth to make redtop seed production more profitable.

Because redtop seeds are small, a fine, compact seed bed is required. The seeds are usually sown broadcast and little or no covering is necessary. The rate of seeding is from 8 to 15 pounds of seed an acre. The time of seeding varies with the cropping system in practice. Redtop is seeded in the fall, early in September, on a well-prepared seed bed or in a field which had previously grown a cultivated crop like corn or soybeans. In the latter case the seed bed is usually prepared without plowing. The crop may be seeded in the month of February on a winter grain, such as wheat. It may also be sown with a spring grain, such as oats. Occasionally it is seeded alone in the early spring on clean land. There is a growing tendency on soils that have been limed to seed some legume such as Grundy County sweetclover, white clover, or alsike clover with the redtop. The associated influence of the legume appears to increase the yield of seed. All redtop except that sown in spring grain should give some seed the first year. Fall seeding seems to give the best results, at least for the first year. It is a general practice among growers to pasture the redtop in the spring and then again in the fall after the seed crop is harvested. This is believed to be beneficial to the crop. Fields are usually maintained until they become so weedy as to necessitate plowing them up and reseeding.

Mowing is the usual method of harvesting redtop seed. The time of cutting is important. If cut too soon many light, green seeds

result, while if it is harvested too late much seed is lost by shattering. The time at which redtop may be harvested to advantage is short. Blooming usually begins at the top of the panicle about the 1st of July and is complete at the base of the panicle by the middle of the month. The crop should be mowed within a few days after blooming is completed, as shattering of seed begins a week later. As the time of harvesting is delayed, the loss from shattering increases rapidly. Earlier cutting also makes the straw more valuable as feed.

After the crop is mowed it is cured and stacked, much in the same manner as hay is made. Redtop may be threshed any time after it is cured. Any common grain separator may be used after making proper adjustments. The grain riddle is replaced by a screen with from 18 to 24 meshes to the inch, depending upon the quality of seed desired. Air adjustments must be made, as the seeds are very light and are easily blown into the straw stack.



Courtesy of Illinois Agricultural Association Record.

Redtop seed warehouse at Flora, Ill. Here the pooled seed is cleaned and stored awaiting sale and shipment

After threshing, the seed is sold to local dealers or to cleaners who clean the seed to the desired purity. A purity of 90 per cent is the standard or common grade. Fancy recleaned seed will have an average purity of 93 per cent or above, and an average germination of 90 per cent or better. This seed may test 30 to 40 pounds to a bushel.

Before the seed is cleaned, it is referred to as chaffy. It is darker in color because of the adherence of the outer glumes and short stems, and lighter in weight because of chaff and stems. This seed usually tests not more than 14 pounds to a bushel, which is the legal weight of redtop for most states. The material separated from the fancy recleaned seed consists of chaff and light seeds. This poor grade of seed is sometimes referred to as "extra." The cleaning process is accomplished by the use of a good fanning mill.

Redtop seed was originally marketed entirely through local dealers. In recent years a part of the crop has been cleaned, graded, and marketed through the Egyptian Seed Growers' Exchange, and the Redtop Growers' Warehouse Association, a subsidiary of the Exchange. These two associations are organized under the Illinois Agricultural Cooperative Act of 1923, and are the first cooperatives in the state to be recognized with a loan by the Federal Farm Board. The

Warehouse Association issues warehouse receipts to the exchange, which in turn uses them as collateral for loans from the local banks, the intermediate credit banks, and the Federal Farm Board. Usually by the middle of October, 85 to 90 per cent of the seed has left the farm and is in the hands of the dealers.

The production of redtop seed is in response to the demand for seed for sowing. Because of the merits of redtop, when used for hay, pasture, or a turf, the demand for seed will continue and southern Illinois will remain a great seed-producing center.

Many weed seeds retain vitality for years.—An article entitled "The Weed Seed Population of Arable Soil," prepared by Winifred E. Brenchley and Katherine Warington, recently appeared in *The Journal of Ecology*. This article is a report of some work done in England to determine the number of viable weed seeds in soil samples of a known area taken from permanent wheat and barley fields at the Rothamsted and Woburn experiment stations. The report deals chiefly with agricultural weeds but some of the results will prove of interest and value to golf clubs in the United States which are trying to rid their top soil of weeds.

Samples of soil were collected at intervals over a period of several years and placed in conditions favorable for the germination of weed seeds. The number of weeds which germinated from the various samples was recorded and the total number occurring in an acre of soil was calculated from these samples. It was found that the number of living seeds of some species of weeds was very large, poppies, for instance, averaging 113,000,000 viable seeds to the acre, with some samples indicating a much greater number. It was also found that comparatively few species of weeds germinated freely throughout the year and that most seeds showed a definite periodicity, the majority of the seedlings appearing during the autumn or winter or both and relatively few in late spring and summer. The report states that "Intensive methods of cultivation indicate that many weed seeds in the soil have a period of *natural* dormancy, during which they will not start into growth even if they are placed under conditions favorable for germination. The length of this period varies with the species, which are considered individually. Seeds buried in the soil under conditions unsuitable for germination may retain their vitality for many years, this prolonged dormancy being termed *induced* in contrast to the *natural* dormancy."

Annual bluegrass, one of our common golf course weeds, was studied during the course of this investigation. It was observed that most of the seeds of this plant germinated at once but that a small number continued to germinate fairly regularly during the two succeeding years.

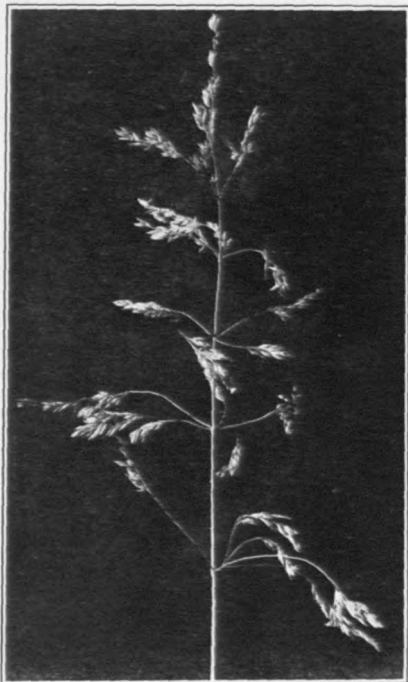
Digger wasps hunt down cutworms, paralyze them by several stings, drag them to their nests, and deposit eggs on them. When the eggs hatch the larvae feed on the cutworm. The wasp eggs, however, do not always hatch, as during the operation of the digger wasp a small grayish fly hovers around and at an opportune time deposits its own eggs on the captured cutworm. Upon hatching, the fly larvae usually eat the wasp eggs immediately and then devour the cutworm.

Harvesting Kentucky Bluegrass Seed

By E. N. Fergus

College of Agriculture, University of Kentucky

Kentucky bluegrass (*Poa pratensis*) is easily the favorite grass for fairways, lawns, and pastures in the United States north of the Gulf states and east of Kansas. There are some soils in this region on which it will not grow well, but there are very few which can not be made suitable for it at moderate expense. The grass is unquestionably a native of the Old World, and was brought to America by the colonists. English and French traders and explorers of the 17th century are thought to have introduced it into Kentucky, but most of the credit for its introduction and distribution probably belongs to the settlers of the 18th century. Kentucky bluegrass thrives so well and is so widely grown in central Kentucky that the fame of the state is inseparably associated with it. On the extensive pastures of the bluegrass region are to be found not only the horses for which it is famous, but also well-bred cattle and sheep.



The compact clusters of seed and the slender stalks of Kentucky bluegrass lend themselves readily to the harvesting of the seed by means of the comb stripper

While most of the bluegrass in Kentucky is grown primarily for pasture, the bluegrass seed crop is a considerable item in the profit which the grass yields. In Kentucky the bluegrass seed crop is produced in a few counties near Lexington. The so-called "Missouri area" comprises the northwest corner of Mis-

souri with adjacent parts of Iowa, Kansas, and Nebraska. In Kentucky the fields from which seed is to be saved are pastured little or none in the spring. The seed ripens about the first of June and is harvested within a week or ten days. A good many years ago much seed was obtained by hand stripping, but at the present time only very small areas are so harvested, and the amount of such seed is insignificant, though its quality is usually of the highest.

Until very recent years, practically all the seed has been harvested in Kentucky by means of a



The hand stripper is still used to a slight extent in harvesting Kentucky bluegrass seed

stripper, which consists of a box swung low between two high wheels. The front side of the box is open and carries a steel comb along its edge. As the box is moved forward, the heads of the grass are combed off. Two men are necessary for the operation of such a stripper—one to drive the mule or horse and the other to draw the heads of grass from the comb back into the box. Much of Kentucky's seed crop is now harvested with an automatic stripper equipped with a reel which combs off the seed and, with the aid of canvas belts, places it in a box or bag. Not only does this machine harvest the seed more rapidly than the older comb stripper, but also dispenses with the labor of one man. In the Missouri-Iowa area all the seed is harvested by machines with reels which beat off the seed.



Stripping Kentucky bluegrass seed with the old-type comb stripper

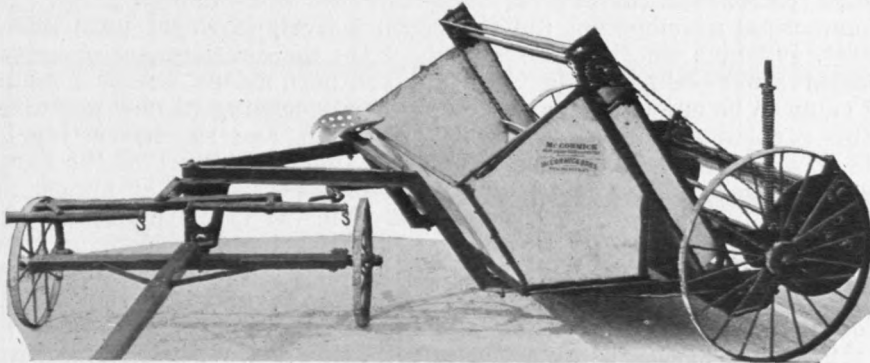
As soon as the seed is harvested, it is placed in large burlap bags and taken at once to the curing field or floor. There it is piled in long, narrow windrows about 2½ feet high. Since the green material would quickly become hot enough to kill the seeds and thus result in a low germination, the windrows must be turned frequently. At first this must be done three or four times daily, then as curing progresses fewer turnings are necessary. Formerly all curing was done in the open on closely clipped patches of bluegrass sod, but now much is cured on the large floors of loose-leaf tobacco warehouses of the regions. Curing requires from two to four weeks.



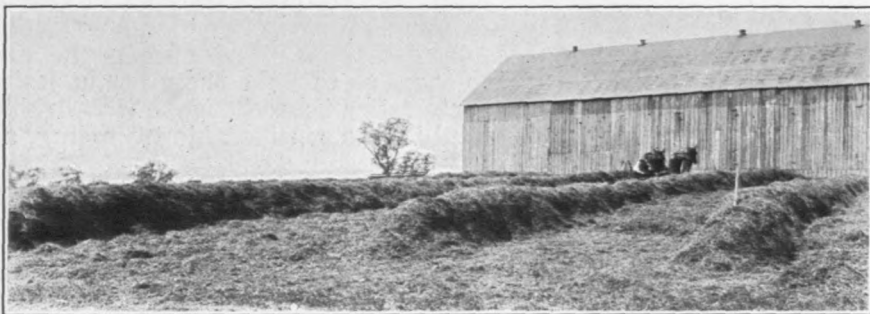
The seed of Kentucky bluegrass is gathered at once in large burlap bags, after being stripped, for transporting to the curing field or shed

Seed cleaning, the next step in preparing the market product, is in reality a combination of threshing and cleaning and requires elaborate and costly machinery. It will be recalled that the harvested material consists of seed in the chaff and associated portions of the stems. The cleaning process removes the seed from the other portions of the head in addition to cleaning the seed. The loss in weight from cleaning varies from 25 to 50 per cent, depending upon the maturity of the crop and the amount of chaff, straw, and weed seeds contained.

The cleaned seed goes on the wholesale market in 8-bushel burlap bags, which quantity, incidentally, is about an average yield to the acre in Kentucky. Retail dealers break these bags to meet the demand for small lots.



An automatic Kentucky bluegrass seed stripper



Stripped Kentucky bluegrass seed is piled in the open for curing. The windrows are turned by a man and team, alternate windrows being turned at a time

The legal weight of bluegrass seed is 14 pounds to the bushel, but the weight contained in a measured bushel varies from even less than 14 pounds to 21 pounds or even more, depending upon the maturity of the seed when harvested, the amount of weeds present, and other factors. Generally speaking, the heavier lots contain the best seed.

Scientific methods applied to the care of the soil, it is stated, have increased the productivity of the crop land in Pennsylvania 22 per cent over the 50-year period 1879 to 1929. On the other hand, in some sections of the country the replacing of plant foods in the soil, by fertilization, has been neglected to such an extent that the productivity of the soil has been decidedly reduced. Apparently Pennsylvania is keeping step with science by the use of high-grade fertilizers, improved cultural methods, rotation of crops, and better control of insects. Some of these modern improvements in agricultural practices are reflected on golf courses in a more intelligent use of fertilizers, seed, weed-control agencies, and cultural practices.

Carpet Grass Seed Production

By W. R. Dodson

Bureau of Animal Industry, United States Department of Agriculture

In some of the older literature, say that of 30 years ago, carpet grass (*Axonopus compressus*) is designated as Louisiana grass. Its commercial development did not begin actively however until about 1921, at which time special campaigns for the development of better pastures were being conducted in the southern states, and as a result it came to be one of the favorite grasses for sowing in new pastures. This created an active demand for its seed, and the harvesting of its seed has accordingly come to be an important part of the farm work in many places of the South. The grass thrives on almost all types of soil and withstands drought well. It is more resistant to cold than is Bermuda grass and comes out earlier in the spring than does Bermuda. It is now generally distributed in the Gulf Coast states, the northern portion of South America, and the islands that lie between the United States and South America.

Carpet grass forms a very compact, dense sod, withstanding grazing well, and on many types of soil crowding out most other grasses. The leaf blades are short and broad. The main stems spread on the ground and take root at each joint. At seeding time slender shoots grow to a height of 6 to 8 inches, terminating in two or three slender spikes on which the small seeds are developed. These seed stalks are so slender and the leaf blades so short as to make the grass undesirable as a hay plant. Such characteristics however make it desirable as a sod grass where the soil is subject to considerable trampling, as on the fairways of golf courses.

The harvesting of carpet grass seed for commercial use is a very simple process but requires special equipment. The sods are grazed by cattle in spring and until near midsummer. The cattle are then removed, the fields clipped as short as possible with a mowing machine, and the clippings carefully raked off. A crop of seed soon develops. When the seeds have reached maturity in sufficient quantity and the weather is favorable, the crop is cut with an ordinary mowing machine fitted with a special attachment for gathering the cut material into small bunches. Ordinarily the attachment consists of a series of small iron rods projecting about 18 inches to the rear of the mower bar, free at the back end, comparable to the tines of a many-tined pitchfork or to a set of grate bars. A baffle board at the back is so arranged that it can be lifted with a foot lever. The man driving the mowing machine lets the cut grass accumulate on these grate bars until there is enough to make a small pile, and then raises the baffle board with his foot lever, and the resistance of the stubble against the cut grass holds it while the mowing machine moves out leaving the cut material lying on the sod. The baffle board is then allowed to fall back to place so as to gather the next bunch. The driver never stops for dumping. When the seed has dried sufficiently, the hay is either stacked for a convenient threshing time, or else threshed directly and the drying of the seed subsequently completed with care. The ordinary grain thresher is used, with special sieves and proper adjustment of the air draft for cleaning the seed. A second crop of seed is harvested in the late fall. Sometimes three crops may be harvested in a year. As new shoots are coming out continuously, the seed harvest always includes some immature seed; but most

of this immature seed can be eliminated in the recleaning. Most of the seed is recleaned after it comes from the thresher.

According to the best information I have been able to obtain without exhaustive inquiry, the best seed-producing sections are eastern Louisiana, western Mississippi, and such portions of the Gulf Coast states as have a loam soil of moderate fertility.

QUESTIONS AND ANSWERS

All questions sent to the Green Section will be answered in a letter to the writer as promptly as possible. The more interesting of these questions, with concise answers, will appear in this column. If your experience leads you to disagree with any answer given in this column, it is your privilege and duty to write to the Green Section.

While most of the answers are of general application, please bear in mind that each recommendation is intended specifically for the locality designated at the end of the question.

Effect of close cutting on bluegrass; controlling clover in fairways. Our fairways and tees were planted in late fall four years ago. The fairways were seeded with a mixture of 4 parts of Kentucky bluegrass and 1 part of recleaned redtop, at the rate of 150 pounds to the acre. The tees were seeded with the same mixture at the rate of 200 pounds to the acre. The soil of neither the fairways nor the tees was fertilized sufficiently to insure vigorous growth. The soil is naturally an alkaline clay which packs and bakes readily during summer. The grass on our tees burns out after the first spell of intensely hot weather in spite of the fact that they have been continuously top-dressed since being constructed. The tees have been cut usually not more often than twice a week and never shorter than $\frac{1}{2}$ inch. It is argued that more frequent and shorter cutting of the tees would make the grass stool out and become stronger and thus better able to withstand drought and heat, while on the other hand it is argued also that more frequent and closer cutting of fairways and tees is liable to make the grass turn yellow and burn out during dry, hot spells, on account of both the shortness of the blades and the tendency of the soil to pack more readily with short turf. What is your opinion on this point? Also give us your opinion on the effect of close cutting on the clover with which our fairways are infested. The clover seems to be more prevalent than previously in spite of the fact that everything possible has been done to encourage the growth of the bluegrass. The fairways are cut twice and sometimes three times a week, never much shorter than $\frac{3}{4}$ inch. It is argued that it would benefit the bluegrass if the fairways were cut shorter and more often, since the clover blossoms and leaves would thereby be removed to greater extent, thus permitting the bluegrass to have more sunshine and air. (Pennsylvania)

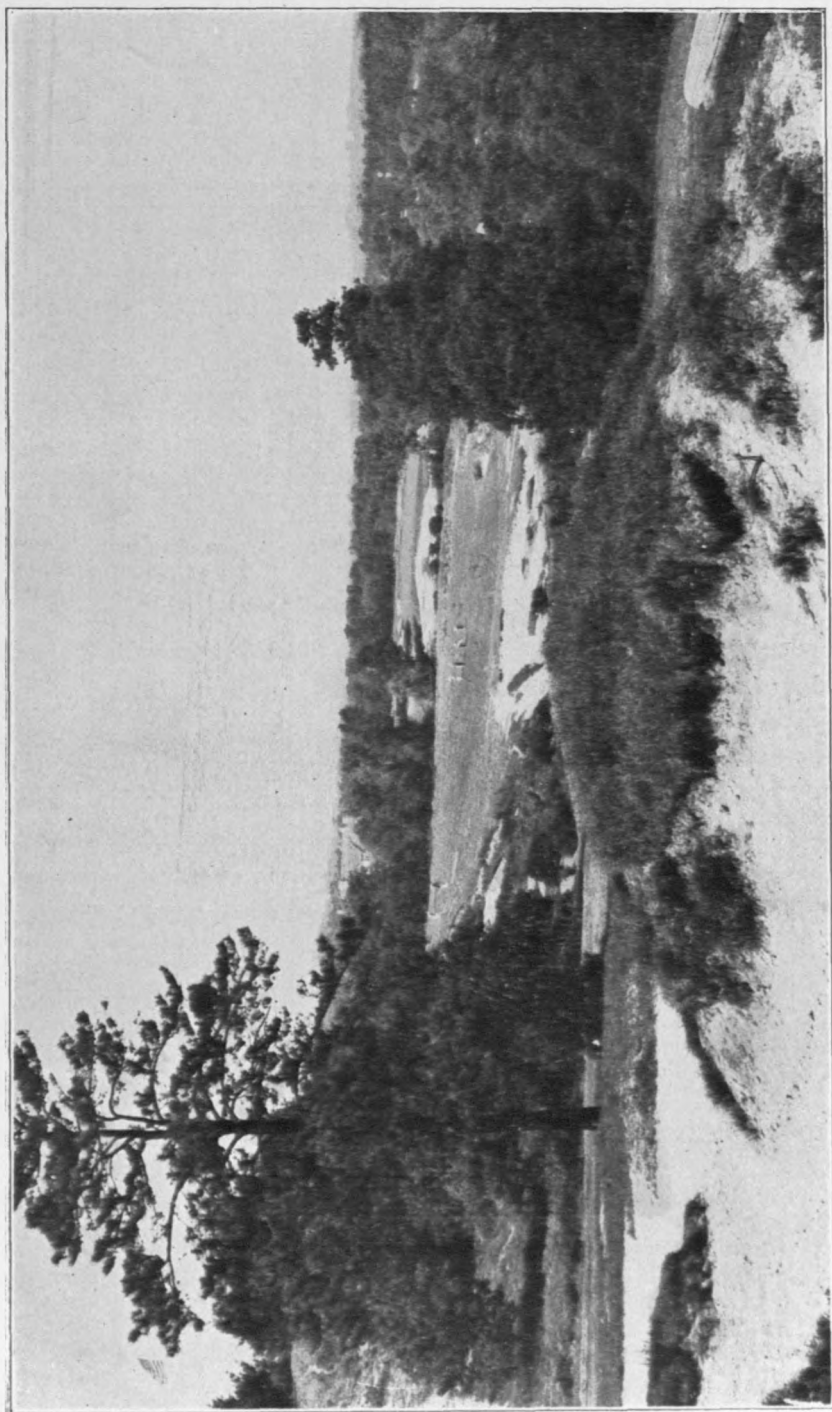
ANSWER.—The argument that grass stools and becomes stronger and healthier under close cutting so that it can better withstand drought and heat is correct if one is comparing a hay field or deep rough with a pasture or fairway but it does not hold if one is com-

paring a low cut with a high cut when there is a difference of only an inch or two between the cuts. To a certain extent grass will stool and form a turf more quickly when cut. This can be noticed after the first cutting of new fairways. The tendency to form turf under such conditions is due to the fact that the plants are prevented from making large leaf growth and even from going to seed, and hence, instead of supporting so much leaf growth the plants tend to produce stolons or make lateral growth. However, when once there have been many new plants established, even though the turf may be thick it is not as strong under close cutting as a turf that is not severely pruned. The leaf of a plant, when having free access to light and air, performs a function in some respects similar to digestion in an animal. Pruning of the leaf impairs the digestion and weakens the plant. Therefore we would recommend that you cut both your fairways and tees frequently but that the length of the grass be kept as great as the players will permit. It is better to cut frequently than to allow grass to grow too high and then to cut it comparatively short. Frequent cuttings of grass kept reasonably long simply snip off the ends of the leaf blades and do little injury to the plants.

Clover can better withstand short cutting during warm weather than can bluegrass, and we would recommend that you do not try to eliminate clover in that way. On the other hand, if you could let the bluegrass grow long enough it would smother out the clover. This can be observed on many golf courses, where one has only to step on the rough from the fairway to notice that the clover stops at the edge of the rough and that the bluegrass becomes solid and dense in the rough where it is allowed to grow much longer. Continued early fall fertilizing with fertilizers comparatively high in nitrogen, and an early spring fertilizing with soluble nitrogen, such as in sulphate of ammonia, will do much to enable bluegrass to crowd out clover. When clover is becoming established it also may be practical to burn large areas of it by a heavy sprinkling with sulphate of ammonia applied directly to the clover, followed immediately by top-dressing the area. In this way the clover is temporarily set back while the nitrogen applied in the sulphate of ammonia helps to encourage the grass to fill in the thin areas where the clover has been checked.

Rate of seeding bent grass.—You have recommended a rate of 5 pounds to 1,000 square feet for seeding putting greens with German mixed bent seed. Why is it that frequently seeding rates as high as 15 pounds to 1,000 square feet are recommended by those who have had experience? (New Jersey)

ANSWER.—Three pounds of bent seed of good quality sown on 1,000 square feet will give a good stand of grass. We consider therefore that 5 pounds of bent seed of standard quality is ample for 1,000 square feet and that any heavier rates of seeding represent merely a waste of money. If the seedsman provides a good grade of bent it should be possible to get a good stand with this rate but if he furnishes a very poor grade largely composed of chaff it is possible that it would take 15 pounds to give a good stand. However, the big majority of seedsmen are handling well cleaned seed and we think you are perfectly safe in using the 5-pound rate.



Eighteenth hole (425 yards), Pine Valley Golf Club, Clementon, N. J.



**We may only work in conjunction with Nature;
none may war against her successfully; and the
wise man is he who judges if Nature's opposition to
his desire is real or only apparent; if it is real he
abandons the battle.**

George Moore

