

Demonstration Turf Garden Results: A Three-Year Summary

By John Monteith, Jr., and Kenneth Welton

During the past three years the Green Section has established a number of demonstration turf gardens in different sections of the country in cooperation with local golf organizations. These gardens are to provide stations for testing various grasses, fertilizers, and cultural methods used on golf courses under a large number of soil and climatic conditions. They also serve as outposts for Green Section work for presenting actual exhibits of the elementary principles of scientific turf culture at which those who are interested in golf course maintenance may observe them in their immediate localities. The first gardens were planted in 1928. Additional gardens were planted in 1929 and 1930. Unfortunately some of the gardens had to be abandoned due to lack of adequate care, for financial or other reasons. The purpose and locations of the original demonstration gardens were set forth in the Bulletin for December, 1928. Summaries of the first two seasons' observations were presented in the Bulletin for December, 1929, and June, 1931. The reader is referred to these two numbers of the Bulletin for the details of the summaries. Some of the explanatory matter, more necessary for an understanding of the present summary, will, however, be found presented again in the following pages.

The demonstration gardens are divided into series of plots 10 feet square, as shown in the accompanying plan of the gardens. The plots are divided into groups for making certain tests, thus the group in rows 2 and 3 is for a test of different grasses maintained as putting green turf, whereas the group in rows 4, 5, and 6 is for tests of fertilizers for turf used on putting greens. Seed, stolons, and fertilizers for the gardens are furnished by the Green Section. Certain standard directions for the general care of the gardens are given to those who are charged with their maintenance, but details of maintenance are left to the individual greenkeepers. In general the instructions are to maintain the turf in rows 2, 3, 7, 8, and 9 as turf for a similar purpose would be maintained on the golf courses where the gardens are located. The plots in the fertilizer series do not receive the dressings of compost that are commonly used on golf courses. This is because compost contains elements of plant food to supply which fertilizers are ordinarily applied to turf, and applications of compost would accordingly complicate the results to be obtained from the fertilizer tests. Fertilizers are applied at regular intervals according to directions. In addition to the differences due to soil and climate there are differences in the care of the several gardens due to variations in the individual maintenance methods practiced on the courses where they are located. As a result of this variation the plots that have the highest ratings in the accompanying tables indicate the ability of the particular grass or treatment to produce good turf under a great variety of soil, climatic, and cultural conditions.

The gardens continued to prove a source of interest to greenkeepers and members of green committees in their neighborhoods. Several meetings were held at a number of these gardens during the season at which the various tests were explained in detail to the visitors. In addition to the visitors at the time of these regular meetings, a large number of persons, singly or in small groups, have gone

PLAN OF DEMONSTRATION TURF GARDENS

	A	B	C	D	E	
1						Optional.
2	Red fescue Chewings fescue	Washington Metropolitan	Colonial, western Colonial, N. Zealand	Colonial bent, R. I.	Velvet bent seed	
3	Annual bluegrass	Virginia Columbia	Seaside bent	German mixed bent	Highland velvet No. 14276 velvet	
4	Activated sludge	Poultry manure tankage	Check	Sulphate of ammonia	Compost and sulphate of ammonia	Fertilizer experiments on putting green grass (seeded German mixed bent).
5	Check	Nitrate of soda	Urea	Ammonium phosphate	Check	
6	Complete fertilizer 6-12-4	Complete fertilizer 12-6-4	Check	Lime and sulphate of ammonia	Bone meal	
7	* German mixed bent	German mixed bent	German mixed bent	Metro. bent stolons	Chewings fescue	Putting green length.
8	* Ky. blue and redtop	Ky. blue and redtop	Ky. blue, redtop and Ger. mixed bent	Ky. blue and redtop	Chewings fescue and Ger. mixed bent	
9	Ky. blue redtop and Chewings fescue	Ky. blue and redtop	Ky. blue, redtop and Ger. mixed bent	Colonial bent	Chewings fescue and Ger. mixed bent	Trial plots of fairway grasses.
10	Bone meal	Lime	Check	Sulphate of ammonia	Activated sludge	
11	Check	Manure	Complete fertilizer 6-12-4	Complete fertilizer 12-6-4	Check	
12	Lime and mixed fertilizer 6-0-4	Lime and mixed fertilizer 6-12-0	Check	Mixed fertilizer 6-0-4	Mixed fertilizer 6-12-0	

* Soil in plots 7A and 8A poisoned with arsenate of lead before seeding.

over the gardens with the greenkeepers or others familiar with the plans. The clubs on whose grounds the gardens are located have willingly made the gardens accessible to visitors at all times.

**DEMONSTRATION TURF GARDENS COOPERATING WITH THE
GREEN SECTION**

Allegheny Country Club.....	Pittsburgh
John Pressler and Lois Miller	
Century Country Club.....	Metropolitan District
Henry Shakeshaft and T. T. Taylor	
Charles River Country Club.....	Boston
F. H. Wilson, Jr., and G. J. Rommell, Jr.	
Country Club of Virginia.....	Richmond
Douglas Call and Dominic Larusso	
Detroit Golf Club.....	Detroit
Alex McPherson and M. Milenow	
Hyde Park Golf and Country Club.....	Cincinnati
William Harig	
Indian Trails Golf Course.....	Grand Rapids
Floyd Metcalf, Carl Fiedler, and Robert Cullin	
Lochmoor Club.....	Detroit
W. F. Beaupre	
Meadowbrook Country Club.....	Detroit
Thomas Slessor	
Niagara Falls Municipal Golf Course.....	Niagara Falls
Frank Bulges and Albert Bulges	
Oakmont Country Club.....	Pittsburgh
Emil Loeffler and Lois Miller	
Philadelphia Country Club.....	Philadelphia
M. E. Farnham, Benjamin Webber, and H. A. Murphy	
Upper Montclair Country Club.....	Metropolitan District
George Robertson and T. T. Taylor	
Wheatley Hills Golf Club.....	Metropolitan District
Frank Krause and T. T. Taylor	

Monthly reports on the condition of turf on the various plots are made out in duplicate, one copy being sent to the Green Section office in Washington and the other retained for home reference. These reports are made out from May to October. In most cases the notes have been made by two persons in order to give the results the advantage of combined opinions, thereby reducing the likelihood of overlooking some points of interest. During the season of 1931 continuous reports were made from 14 northern gardens. Where reports were made for only part of the season or where there was evidence of carelessness or indifference in their preparation, reports from these gardens have not been included in the summary given in this number of the Bulletin. Occasionally the report was omitted for one month due to some unusual rush of work which prevented its preparation or due to the fact that no change had occurred in the previous ratings of the plots. In order that the summary might not lack the benefit of these otherwise complete and well-prepared reports, they have been included. Where, however, reports from a garden are missing for two consecutive months the reports in their entirety have been disregarded in the preparation of this summary. Anyone who has taken careful notes regularly on a series of tests such as these will appreciate the fact that it is a tedious and somewhat monotonous task. The names of those who have cooperated to the extent of performing this task conscientiously throughout the season of 1931 are given in the foregoing list of the demonstration turf gardens cooperating with the Green Section. Readers should bear in mind that with-

out the help of these cooperators no such interesting summary as is given in this number of the Bulletin could be possible.

In addition to the above 14 gardens, similar reports were obtained from three demonstration gardens located within the Bermuda grass region. Since these gardens are located south of the region in which northern grasses are generally used on golf courses the observations are not included in the tables of this Bulletin. These gardens are as follows:

Bay Shore Golf Course.....	Miami Beach
	Fred Hoerger	
Sedgefield Country Club.....	Greensboro
	T. H. Antrim	
Tulsa Country Club.....	Tulsa
	J. C. Painter	



Summer meeting at the demonstration garden on the course of the Charles River Country Club, Boston, Mass.

Some of the preliminary results obtained during the first winter at Miami Beach, Fla., were given in the Bulletin for October, 1931. The reports from the two gardens at Greensboro, N. C., and Tulsa, Okla., will be referred to separately since they are in districts where there are turf problems in many ways distinct from those that exist where the other turf gardens are located.

In order to simplify the taking of notes it was decided to standardize the details as much as was practical. Accordingly blank forms were provided to be filled in with a few simple markings. The turf on each plot was rated as excellent, good, fair, or poor. In determining this rating of the turf it was specified that consideration be given its density, vigor, color, fineness, freedom from nap, and any other factor that would affect its quality for golf turf purposes.

No effort was made to establish any one standard of excellence by devising a score card. The ratings are therefore to be regarded as merely relative. In the series of plots of different grasses for putting greens, for instance, a report from one club might indicate that a certain grass was good whereas the report from another club might rate

the same grass as fair. As an actual fact the turf in the latter case might be fully the equal of the former, but the person or persons making the report in the latter case were probably more critical and exacting than those making the report from the club where the grass was given a rating of good. However, the person who was more exacting and held higher standards would naturally scale down all the ratings in the same degree. Since the purpose of the reports was to compare the grasses side by side rather than to compare the ratings of different sections, all reports that were made with care and fairness were equally valuable. It will be noted in the foregoing list that in the majority of cases the notes were made by two persons, which of course helped to avoid oversights.

Many who are interested in these gardens have wondered just how these records could be of value without a definite standard to guide in making the ratings. To make this clear we use a single example. Reports were received from three gardens which for convenience will be referred to as reports No. 1, No. 2, and No. 3. In report No. 1, Metropolitan bent is rated as excellent and Virginia bent as good; in report No. 2, Metropolitan is rated as good and Virginia as fair; in report No. 3, Metropolitan is rated as fair and Virginia as poor. This might be interpreted as meaning that in garden No. 1 the Metropolitan was much superior to the Metropolitan in either of the two other gardens, and that the Virginia in garden No. 1 was superior to the Metropolitan in garden No. 3. Such a conclusion is unwarranted, for these differences may merely mean that those who made out report No. 3 used a much higher standard of excellence than those who made out No. 1. Such comparisons between different course reports may or may not have some significance other than the personal factor. The important point in the three reports is that the Metropolitan proved superior to the Virginia in each instance regardless of differences in soil and climate.

From some of the gardens the reports for the entire year did not include a single rating of excellent even though the turf was well cared for and many of the plots in these particular gardens had turf which would have been a credit to most courses of that neighborhood. This merely indicates that those who prepared the notes in many instances were extremely critical and were inclined to underrate the turf rather than to assign any flattering ratings. This tendency makes the accompanying tables more interesting than would have been the case had the tendency been the other way, with ratings universally higher.

The reports on fertilizers and grasses are condensed to tables, while the points of greatest interest are emphasized in the text. The reports cover a period of six months, May to October, inclusive.

In the summaries for 1929 and 1930 the reports were arranged in three periods of two months each, representing early summer, mid-summer, and late summer or early fall. For 1931 it has been decided to change the method of preparing the tables. For several reasons it seemed desirable to change to a numerical system, which, when reduced to percentages, could be more readily summarized and thus represent more accurately the ratings as given. It was therefore decided to give a rating of *excellent* the value of 4, *good* the value of 3, *fair* the value of 2, and *poor* the value of 1. By the old method of

rating, a plot which during the 6 months received 6 ratings of excellent would be classed as equal with another receiving 6 ratings of good. By the new method the first would receive a rating of 24 and the latter a rating of 18. Although this different method might be expected to bring about decided changes in some of the ratings, an actual comparison of the ratings with the two methods has shown that the relative positions of the different plots are the same except in occasional places where the differences between plots were extremely small by either method of rating. Therefore the tables prepared by this new method of rating can be compared directly with the previously-published summaries for 1929 and 1930. The change of system was made primarily as a means for simplifying the consolidation of reports and preparation of tables.

The ratings reported during 1929 and 1930 have been converted into percentages and these percentages have been used in preparing the accompanying graphs showing the relative ratings in the four fertilizer and grass series for the three years 1929, 1930, and 1931. For 1929 the graphs represent ratings on 12 gardens in their first year; for 1930 they represent ratings on 13 gardens in their second year and 1 garden in its first year; and for 1931 they represent ratings on 11 gardens in their third year, 1 in its second year, and 2 in their first year.

The summaries of the demonstration gardens which have been published to date in the Bulletin represent the composite results obtained on several different types of soil under different climatic conditions. The relative order of ratings of the different plots varies to some extent on different gardens. These local variations will be left for discussion in the Bulletin at a later date when further data are available.

The gardens contained other tests besides the tests of grasses and fertilizers. In a general way the reports on these other tests were similar in 1931 to previous reports. Information on these may be found in the summary for the season of 1929, appearing in the Bulletin for December of that year. Many of the reports for 1931 contained interesting information concerning these other tests. A summary of these reports will, however, be left for a later number of the Bulletin, when the results over a number of years can be brought together, thereby giving more convincing figures than are available for a discussion of reports of a single season.

PUTTING GREEN FERTILIZER RATINGS

The putting green fertilizer tests were made on German mixed bent turf, with the exception of the garden on the course of the Country Club of Virginia, where Metropolitan creeping bent was used. There are 15 plots in the series, 11 receiving different fertilizers and 4 being check plots receiving no fertilizer. The check plots are so arranged that every fertilized plot is beside one which is not fertilized. The fertilizers were applied each month from May to October. The rates of application were figured on a nitrogen basis. The quantities used for a full-strength application contained 1/10 pound of nitrogen to a plot of 100 square feet. This is at the rate of 1 pound of nitrogen to 1,000 square feet, which is the amount carried in 5 pounds of sulphate of ammonia, in 16 2/3 pounds of the complete fertilizer with

an analysis of 6-12-4, or in 33 1/3 pounds of bone meal analyzing 3 per cent of nitrogen. During July and August the rates of applications were cut in half to reduce the danger from burning. Therefore in the six applications during the year each fertilized plot received 1/2 pound of nitrogen. Knowledge of the relative effects of different fertilizers, when compared on the nitrogen basis, enables anyone to determine by simple arithmetic the values of fertilizers according to his local conditions.

The complete mixed fertilizers used in the tests contain sulphate of ammonia, ammonium phosphate, superphosphate, muriate of potash, and sand. No organic material was used in their preparation. The sand was used as an inert filler to add weight to make up the desired proportions. If the strength of a 12-6-4 fertilizer is reduced by the addition of an equal amount of inert material, such as sand, it gives double its weight of a 6-3-2 fertilizer. Since all the fertilizers were applied on a nitrogen basis only half the quantity was used of the 12-6-4 as of the 6-12-4 fertilizer. Therefore this quantity would carry as much fertilizer as would have been carried in a 6-3-2 applied at the same rate as the 6-12-4. The difference in the fertilizers applied to these two plots is therefore merely a difference in proportions of phosphoric acid and potash. The 12-6-4 formula was used on the plots in preference to the diluted 6-3-2 formula merely because the modern trend of fertilizer formulas is in favor of the more concentrated mixtures to save freight charges on inert materials.

PUTTING GREEN FERTILIZER RATINGS, ON GERMAN MIXED BENT TURF, FROM 14 DEMONSTRATION GARDENS DURING 1931

(The order given is from highest to lowest rating for the year)

	May	June	July	Aug.	Sept.	Oct.	Total	Per-centage
6-12-4	50	46	43	44	45	49	277	82
12-6-4	50	46	44	41	43	49	273	81
Sulphate of ammonia.....	46	47	45	38	40	49	265	79
Ammonium phosphate	45	42	41	38	40	44	250	74
Sulphate of ammonia and compost	43	42	40	34	39	46	244	73
Activated sludge.....	35	37	42	40	42	45	241	72
Urea	37	39	36	32	40	40	224	67
Poultry manure	35	37	37	38	36	40	223	66
Lime and sulphate of am- monia	37	38	39	33	37	37	221	66
Nitrate of soda.....	36	38	38	32	37	39	220	65
Bone meal	33	30	32	34	33	30	192	57
Check 4-C (no fertilizer)...	22	21	26	22	26	26	143	43
Check 5-A (no fertilizer)...	23	20	22	25	25	28	143	43
Check 5-E (no fertilizer)...	19	19	24	22	22	27	133	40
Check 6-C (no fertilizer)...	20	21	24	22	21	21	129	38

In the accompanying four tables of putting green fertilizer ratings, fairway fertilizer ratings, putting green grass ratings, and fairway grass ratings for the season of 1931 will be found the aggregate rating for each of the six months May, June, July, August, September, and October for the 14 gardens, also the total for the six months and also the percentage which the total represents. As pre-

viously stated, the ratings have been determined by assigning a value of 4 to a rating reported from a garden as *excellent*, 3 to a rating reported as *good*, 2 to a rating reported as *fair*, and 1 to a rating reported as *poor*. A maximum rating for any one month would therefore be 56, representing an excellent report from all 14 gardens, and a total maximum rating for the six months (on which the percentages in the column on the extreme right in each table are based) would accordingly be 336.

The four inorganic fertilizers which head the list in the table this year were in the lead in the reports for both previous years.

It is interesting to note that the two complete mixed fertilizers have received the highest ratings in each of the three years in which these demonstration gardens have been conducted. As in 1930, there is a slight difference in favor of the 6-12-4 mixture.

The sulphate of ammonia plot for putting green turf has been only a trifle poorer than the best of the complete fertilizers in each of the three years, which indicates that on most of the soils where these gardens are located the use of phosphoric acid and potash results in only a small improvement over the fertilizer containing only nitrogen.

The ammonium phosphate again compared favorably with sulphate of ammonia, as it did in the two previous reports.

The plot receiving sulphate of ammonia and compost rated in fifth place as compared with seventh in 1930 and eighth in 1929. This plot receives half of its nitrogen from sulphate of ammonia, the other half is furnished by the compost.

Activated sludge this year heads the list of the organic fertilizers, attaining the highest relative position it has held in the three years.

Urea and poultry manure received the same number of points this year—at the middle position in the list.

The plot receiving both lime and sulphate of ammonia is in ninth place on the list, which is the same position it held in 1929. Some of the unfavorable reports of 1929 were due to burning as the result of the heavy application of lime and sulphate of ammonia early in the season. On this plot in 1930 and 1931 only enough lime was applied to neutralize the acid residue of the sulphate of ammonia used on the plot. A comparison of this plot with the plot receiving sulphate of ammonia alone indicates that there is no deficiency of lime in most of the soils where these gardens are located and that it would be better not to use lime under these conditions at least for the first year.

Nitrate of soda and bone meal rated tenth and eleventh—the same relative positions they held in both previous seasons.

The four check plots, which received no fertilizers, were given low ratings throughout the season, which indicates that the soil on which these gardens are planted is generally poor and in need of fertilizers. The difference of only 5 per cent between the ratings of the four check plots indicates that the soil throughout the series is fairly uniform and that the ratings of the different fertilizers can be depended upon regardless of the location of the plot.

The putting green fertilizer ratings for the two years 1929 and 1930 have also been converted into percentages. In the graph on page 239 will be found a comparison of the percentage ratings for the three years 1929, 1930, and 1931. It is a consolidation of reports of the third season in the case of 11 gardens, the first season in the case of two gardens, and the second season in one case. The ferti-

zers are arranged in the graph from left to right in the order of highest average ratings for the three years. The best fertilizer plots, as will be noticed, received average ratings approximately twice as high as the average ratings of the check plots.

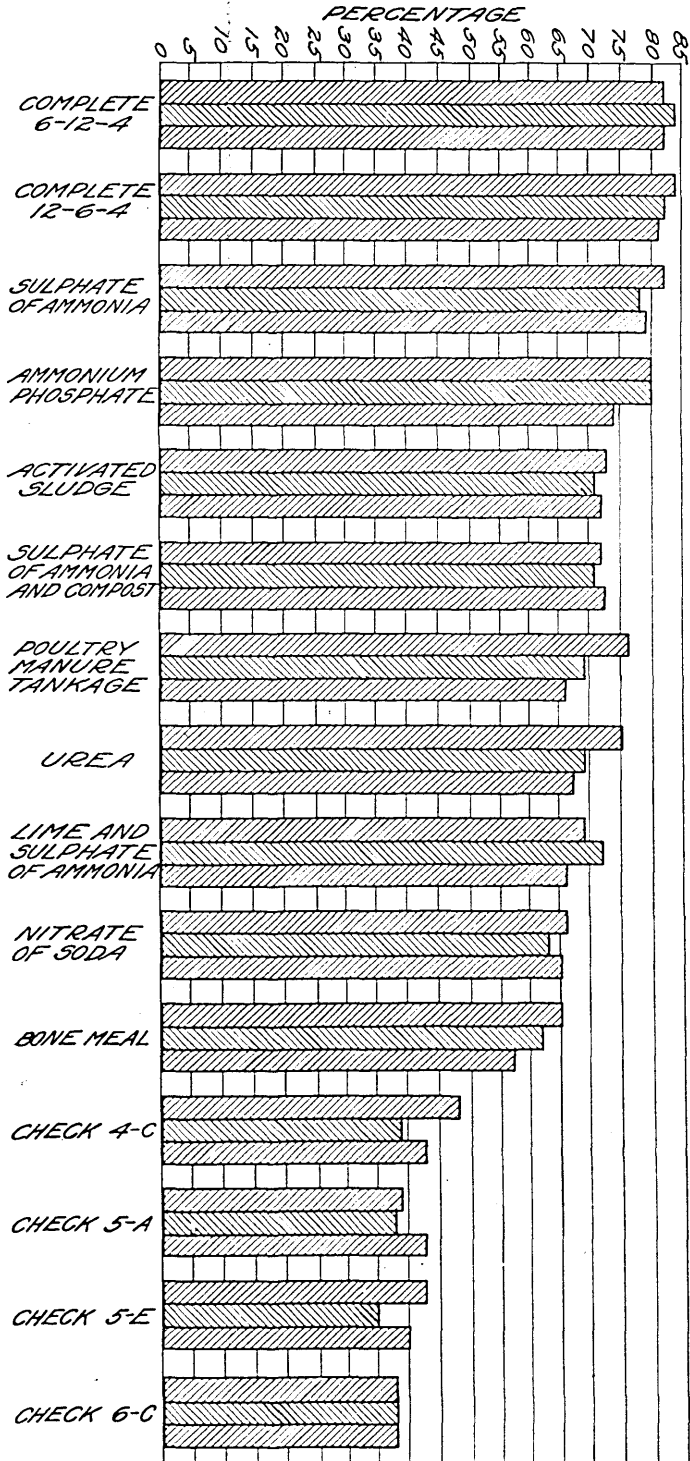
There are several instances in which some interesting differences appear in individual plots in the 3 years. Differences are shown in the poultry manure, urea, and bone meal plots, where there is a gradual stepping down of the ratings over the three-year period. The complete fertilizer 6-12-4 has the highest rating for the three years. The first and third year are the same. Plots receiving sulphate of ammonia and compost are the only ones of the fertilizer plots which received a higher rating in 1931 than in either of the two preceding years. Such seasonal variations may be of much practical value if they continue to develop in this manner over a period of several years. The tendency toward deterioration of putting green turf fertilized exclusively with bone meal has been observed to occur in other fertilizer series maintained over a period of several years. It will be interesting to learn whether this deterioration in bone meal plots will continue on these several soils, as has been observed in other experimental work.

Before arriving at any definite conclusion as to results over a short period, as is represented in these tests, one should carefully study the variation in the plots which received no fertilizer. In these plots it is evident that there are decided seasonal variations. In one plot the rating was the same over the three-year period. In each of the 3 other plots the 1930 rating was lower than the 1929 rating. In two instances the 1931 rating was lower than the 1929 rating, but in another plot the 1931 rating exceeded the 1929. In spite of these variations the reports represented in this chart are of much significance. The comparison, for instance, of the behavior of nitrate of soda and bone meal with the two complete fertilizers indicates the need of discrimination in the selection of fertilizers for putting green purposes.

The important test of a fertilizer is its ability to produce results over a period of years, and the standings shown in the graph must therefore not be regarded as final in any sense. The rearrangement of the order of standing for the season of 1931 as compared with the two preceding seasons brings out the variations in results obtained from the use of fertilizers in three consecutive seasons. The rainfall and general climatic conditions prevailing where these gardens are located are quite different in the three seasons, and such variations are known to have an important effect on the results obtained from various types of fertilizers. In spite of these variations there have already been results in this fertilizer series of much significance. A comparison of the two complete mixed fertilizers with such fertilizers as nitrate of soda and bone meal in the three seasons should furnish those in charge of golf courses with useful information in connection with the purchase of fertilizers for their putting greens.

In recent years there has been much adverse criticism of experimental turf work on the grounds that results obtained in one section do not necessarily apply under an entirely different state of soil and climatic conditions. For the first time these reports of the demonstration gardens, however, represent a consolidation of reports from gardens with entirely different soil and climatic conditions. The fairly

Relative standing of putting green fertilizers as determined by ratings of the quality of turf produced on plots receiving the various fertilizers during the three consecutive seasons 1929, 1930, and 1931. The highest standing is that of the complete mixed fertilizer 6-12-4; the lowest is that of bone meal. At the right is represented, in comparison, the value of the ratings of the quality of turf produced on four check plots in the demonstration gardens, these check plots having received no fertilizer. The three columns shown for each fertilizer and for each check plot represent, reading from left to right in each case, the ratings respectively for 1929, 1930, and 1931



consistent ratings that come from the various gardens indicate that the matter of difference in local conditions has been somewhat over-emphasized.

FAIRWAY FERTILIZER RATINGS

The fairway fertilizer series consisted of 10 plots planted with a mixture of 80 per cent of Kentucky bluegrass and 20 per cent of red-top. Three of the plots were not fertilized, to serve as checks against the seven fertilized plots. As in the putting green series, the nitrogen fertilizers were applied to give the same quantity of nitrogen for each plot. The total application of nitrogen for the season on the fairway plots was just half the rates used on the putting greens. The applications were made in spring and early fall.

FAIRWAY FERTILIZER RATINGS ON MIXED TURF OF KENTUCKY BLUEGRASS AND REDTOP FROM 14 DEMONSTRATION GARDENS DURING 1931

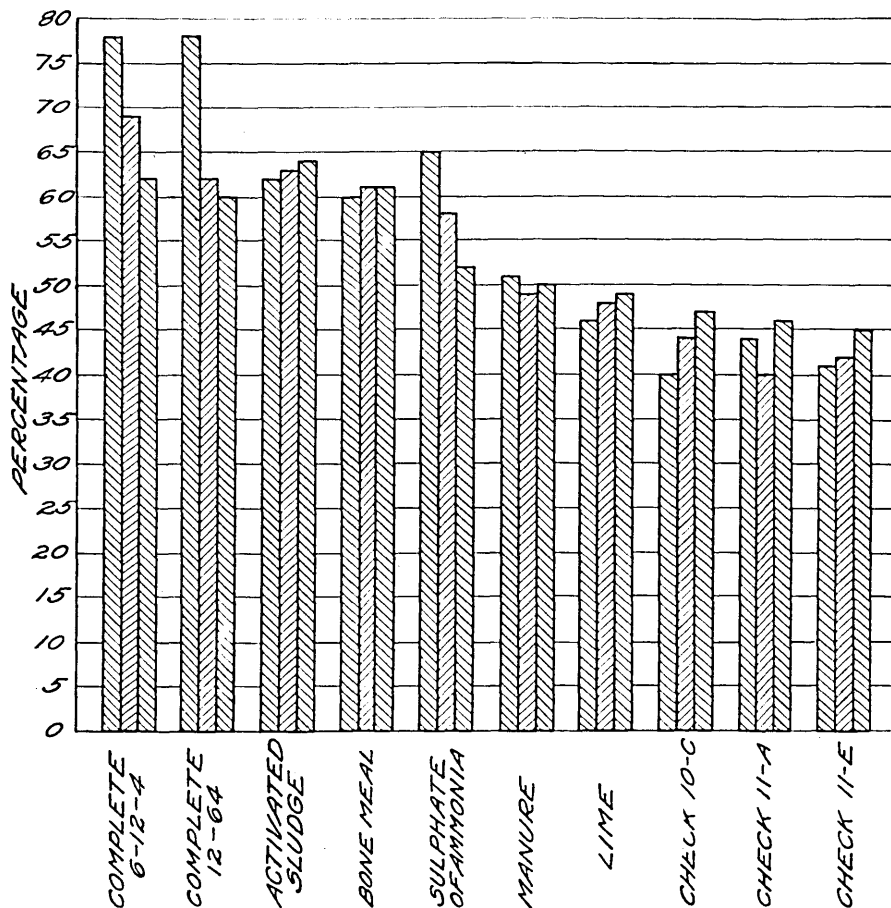
(The order given is from highest to lowest rating for the year)

	May	June	July	Aug.	Sept.	Oct.	Total	Per- cent- age
Activated sludge.....	30	34	40	38	34	38	214	64
6-12-4.....	36	33	36	33	32	37	207	62
Bone meal.....	32	32	39	36	31	35	205	61
12-6-4.....	35	32	36	31	33	36	203	60
Sulphate of ammonia.....	25	28	33	28	28	33	175	52
Manure.....	27	27	33	29	27	26	169	50
Lime.....	22	26	32	27	27	29	163	48
Check 10-C (no fertilizer) ..	23	25	31	28	26	26	159	47
Check 11-A (no fertilizer) ..	27	27	30	24	23	22	153	45
Check 11-E (no fertilizer) ..	22	24	30	27	23	24	150	44

Activated sludge headed the list of fairway fertilizers for 1931. The inorganic mixed fertilizer 6-12-4 which received the highest rating in 1929 and 1930 dropped to second place in 1931. Bone meal and the 12-6-4 fertilizer ranked third and fourth, respectively. In the table it will be noted that there is a difference of only 4 per cent in the ratings of the four highest fertilizers. These are the same fertilizers which received the four highest ratings in 1930. There is a difference of 8 per cent between the fourth and fifth places. Sulphate of ammonia, manure, and lime have only 4 per cent difference between them. There is a difference of only 3 per cent between the ratings of the three check plots; this indicates that the soil in the series is fairly uniform, that the fertilizer ratings may be regarded as reliable, and that small differences of a few per cent can not be regarded as of great importance since these variations also occur in check plots which received no fertilizer.

In the graph on page 241 will be found a comparison of the percentage ratings of the fairway fertilizers for the three years 1929, 1930, and 1931. This comparison shows somewhat more extreme variations from season to season than are shown in the putting green fertilizer series. The two complete mixed fertilizers which had the highest average rating for the three-year period show a decided reduction in the ratings each successive year. The same deterioration occurs in the ratings for sulphate of ammonia. Since the two complete mixed fertilizers contain sulphate of ammonia it seems apparent that the sulphate of ammonia was responsible for this deterioration.

In the cases of activated sludge, bone meal, and lime, on the other hand, there has been a tendency toward gradual improvement in successive years. This improvement, however, is not as marked as the improvement shown in the three check plots. The general improvement of the check plots during the three-year period serves to give greater contrast to the deterioration shown in the two complete fertilizer and the sulphate of ammonia plots. The value of the complete mixed fertilizers for giving rapid response in the first year of developing fairway turf is brought out clearly in this graph.



Relative standing of fairway fertilizers as determined by ratings of the quality of turf produced on plots receiving the various fertilizers during the three consecutive seasons 1929, 1930, and 1931 on demonstration turf gardens. The highest standing is that of the complete mixed fertilizer 6-12-4; the lowest is that of lime. The three check plots represented at the right received no fertilizer. The three columns shown for each fertilizer and for each check plot represent, reading from left to right in each case, the ratings respectively for 1929, 1930, and 1931. In the cases of the two complete mixed fertilizers 6-12-4 and 12-6-4 and the sulphate of ammonia the ratings have declined from year to year, whereas in the cases of activated sludge and lime there has been a gradual improvement. The check plots have in general improved each year

PUTTING GREEN GRASS RATINGS

In the table of putting green grass ratings the grasses tested at the turf gardens are grouped according to botanical relationship, and within the groups they are listed in order of favorable ratings.

PUTTING GREEN GRASS RATINGS FROM 14 DEMONSTRATION GARDENS DURING 1931

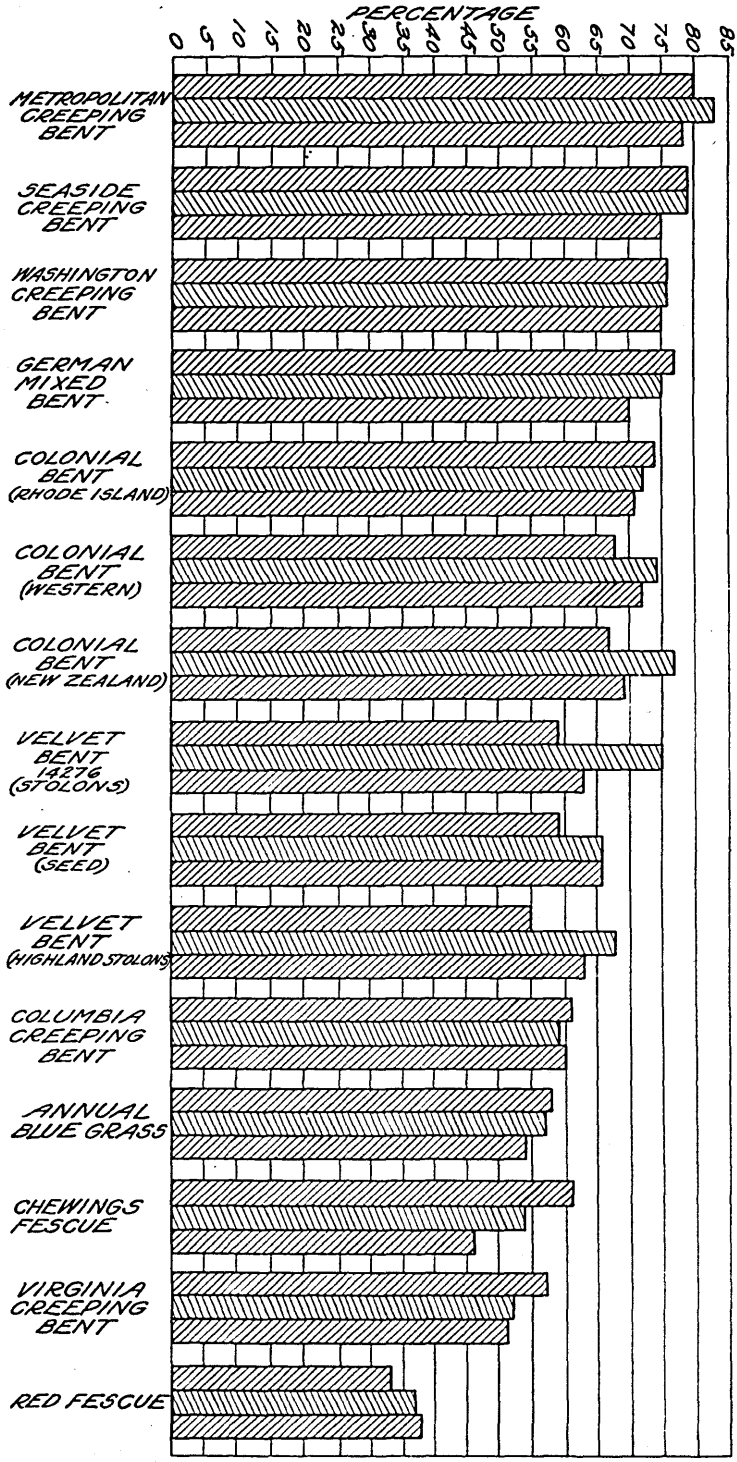
	May	June	July	Aug.	Sept.	Oct.	Total	Per-centage
Colonial bent								
Western grown.....	41	43	39	38	39	41	241	72
Rhode Island grown.....	39	42	40	38	38	43	240	71
New Zealand grown.....	39	43	39	36	37	38	232	69
Creeping bent								
Metropolitan (stolons)....	41	44	44	47	44	43	263	78
Seaside (seed).....	41	46	43	42	38	42	252	75
Washington (stolons)....	38	40	43	45	43	42	251	75
Columbia (stolons).....	35	28	35	35	34	33	200	60
Virginia (stolons).....	32	28	31	28	25	29	173	51
Velvet bent								
No. 14276 (stolons).....	39	41	38	37	36	39	230	68
Seeded* (Prince Edward Island).....	32	35	32	36	35	35	205	66
Highland (stolons).....	37	36	38	37	31	33	212	63
Mixed bent (German).....	39	41	38	38	38	43	237	70
Fescue								
Chewings.....	33	28	27	21	21	23	153	46
Red.....	28	21	22	18	20	20	129	38
Annual bluegrass*.....	31	34	27	18	23	34	167	54

The plots of colonial bent (commonly known as Rhode Island bent or browntop bent) were produced from seed coming from three different sources. The reports for 1931 again indicate that there is little difference in the turf produced by this bent grass, regardless of the origin of the seed. Curiously enough, each year a different plot has received the highest rating in this group of three plots. In 1929 the Rhode Island grown seed was superior to the other two colonial bents; in 1930 the New Zealand stock was superior; in 1931 the western-grown seed received the highest rating. The differences between the three, however, have been only minor each year.

In the group of creeping bents are four strains planted with stolons and one planted with seed. The only change in the relative ratings of the three years was the reversal of the positions of the seaside and the Washington for the season of 1929. The figures for the three years, however, show that there is actually only a small difference between the Metropolitan, seaside, and Washington strains but there continues to be a decided difference between the ratings of the three best creeping bent grasses and the two poorest. For the entire season there occurs a difference of only 3 per cent between the Metropolitan and the Washington whereas there is a difference of 15 per cent between the Washington and the Columbia strains of creeping bent. The continuation year after year of this wide difference between the group of the best creeping bents as compared with the two poorest strains under test indicates the importance of considering the strains of creeping bent to be planted on putting greens.

* Not reported from all 14 gardens.

Relative standing of putting green grasses as reported from the demonstration turf gardens during the three consecutive seasons 1929, 1930, and 1931. The highest standing is that of Metropolitan creeping bent; the lowest is that of red fescue. The three columns shown for each grass represent, reading from left to right in each case, the ratings respectively for 1929, 1930, and 1931



The mixed bent seed used in this series was the same as in the putting green fertilizer series. It was purchased in open market as a representative of the German mixed bent of the trade. Seed sold under this name is chiefly colonial bent but with a varying percentage of velvet bent and creeping bent as well as different amounts of redtop. The results on the gardens indicate that this mixture produced a turf with a rating about the same as the rating of colonial bent.

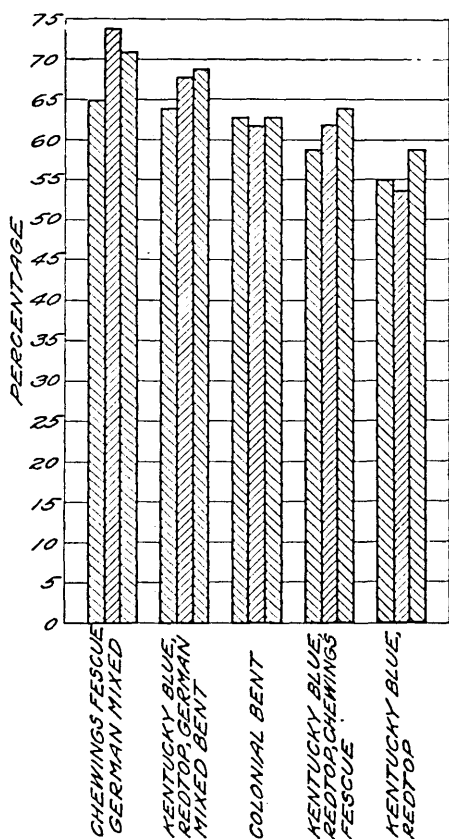
In the velvet bent group the strain No. 14276 planted with stolons again received the highest ratings. The plot of velvet bent planted with Canadian grown seed rated second, which represents an improvement over the two preceding years.

Both of the plots of fescues again were given low ratings, with the same small advantage in favor of the Chewings fescue. Both of these

plots are contaminated with bents on many of the gardens and their ratings in some instances undoubtedly were higher than would have been the case had not the covering of invading bent grasses given the plots a more favorable appearance than would have been the case had any attempt been made to keep them confined to fescue turf alone.

The plot of annual bluegrass (*Poa annua*) was planted with seed of mixed bluegrasses of which a little over 50 per cent was the annual bluegrass. This was the best seed of this grass available on the market, and, although the turf produced was by no means truly representative of the annual bluegrass turf on many putting greens in the United States, it was considered likely that the proportion of annual bluegrass would increase in the plots if the grass reseeded and crowded out the other grasses. The ratings for this grass in 1931 were somewhat lower than previously reported. Some mixed grasses were much in evidence in this plot and it was evident that annual bluegrass was unable to crowd these grasses out.

The putting green grass ratings for the two years 1929 and 1930 have also been converted into percentages. In the graph on page 243 will



Relative standing of fairway grasses and mixtures as reported by demonstration turf gardens during the three consecutive seasons 1929, 1930, and 1931. The highest standing is that of Chewings fescue and German mixed bent; the lowest is that of Kentucky bluegrass and redtop. The three columns shown for each grass represent, reading from left to right in each case, the ratings respectively for 1929, 1930, and 1931

be found a comparison of the percentage ratings for the three years 1929, 1930, and 1931. The grasses are arranged in the graph from left to right in the order of the highest average rating for the three years regardless of their botanical grouping, according to which they were arranged in the tables of rating for the respective years as they have been shown in the Bulletin. It is interesting to note that in most cases the rating for 1931 was lower than the rating for 1930. The three creeping bents, Metropolitan, seaside, and Washington, received the highest average ratings in the order given. The next four positions are held by the colonial bent group, which includes the German mixed bent, since this mixture consisted primarily of colonial bent. It is interesting to note also the fluctation at midyear in the different plots of the group planted with colonial bent seed raised in different parts of the world. Next to the group of colonial bents comes the group of three plots of velvet bent. All three plots of velvet bent received a much higher rating the second year than the first. It is interesting also to compare the velvet bents with the three creeping bents at the left of the graph. While all three creeping bents received the highest rating of all these plots, there are two creeping bents, Columbia and Virginia, which rated among the five poorest plots. There has been a gradual decline in the Chewings fescue as compared with a gradual improvement in European red fescue, which received the lowest average rating for the three years. The improvement in the red fescue plot, however, is largely due to the influence of bent grasses which have been gradually invading this plot.

FAIRWAY GRASS RATINGS

FAIRWAY GRASS RATINGS FROM 14 DEMONSTRATION GARDENS DURING 1931

	May	June	July	Aug.	Sept.	Oct.	Total	Per- cent- age
Chewings fescue and German mixed bent.....	39	40	41	38	39	41	238	71
Kentucky bluegrass, redtop, and German mixed bent..	36	38	39	41	38	37	233	69
Kentucky bluegrass, redtop, and Chewings fescue.....	38	36	41	33	31	35	214	64
Colonial bent*.....	30	32	34	32	35	36	199	63
Kentucky bluegrass and redtop	33	32	35	34	32	33	199	59

In the fairway grass series for 1931 the plot seeded with Chewings fescue and German mixed bent received the highest rating. The German mixed bent combined with Kentucky bluegrass and redtop rated only 2 per cent lower than the plot containing this same bent seed mixed with fescue. The Kentucky bluegrass and redtop mixture, as in the two preceding years, received the lowest rating. The addition of Chewings fescue to the mixture of Kentucky bluegrass and redtop raised the rating 5 per cent.

The fairway grass ratings for the two years 1929 and 1930 have also been converted into percentages. In the graph on page 244 will be found a comparison on the percentage ratings for the three years 1929, 1930, and 1931. The grasses are arranged in the graph

* Not reported from all 14 gardens

from left to right in the order of the highest average rating for the three years. The order of standing for the three years combined is the same as that for the last year except as regards the plot of colonial bent and the plot of Kentucky bluegrass and Chewings fescue. It is interesting to note that the three plots containing Kentucky bluegrass and redtop show an improvement in 1931 over the two preceding years. In the case of colonial bent alone there has been little change in the three years.

Questions and Answers

Transplanting elm trees.—We have some elm trees 15 years old which we desire to transplant. Should they be transplanted in the fall or spring? Is it necessary in moving them to retain a ball of earth around the roots? How much should they be watered after they are transplanted? (Iowa)

ANSWER.—Elm trees may be transplanted either the last of October or during November, or in the early spring as soon as the ground is dry enough to handle. In your region probably fall would be the more desirable time, because there is a longer season then when the ground is in good condition for the purpose. The disadvantage of fall transplanting in many sections, however, is the strong, dry winds of winter, which are hard on the vitality of newly planted trees. On soil inclined to be sandy, where one would not have to wait for it to dry in the spring in order to transplant, it is possible that the work might well be done in the spring; yet where hot weather comes on suddenly in the spring and the soil is inclined to be heavy, it is often almost impossible to get trees planted early enough in the spring. If trees are well dug, so that a maximum number of roots are obtained, and these roots are kept thoroughly moist at all times, it is not absolutely necessary that the trees be dug with a ball of earth. It does, however, help trees as large as yours to become more quickly established if they are dug with a ball of earth, provided the maximum number of roots are still obtained. Trees 15 years old, newly transplanted in a rather sandy soil, should preferably be watered every four or five days, a liberal soaking being given each time. On heavier soils weekly waterings are generally sufficient. On the latter soils it aids greatly in soaking the soil below the surface if a drain-tile is sunk vertically 1 foot into the soil so as to carry the water downward.

Controlling land crabs.—Our low-lying fairways are damaged by large holes made by land crabs. How can these creatures be destroyed? (Virginia.)

ANSWER.—Land crabs frequently become troublesome on low-lying fairways and may be destroyed by dropping a piece of calcium carbide into the tunnel. The carbide unites with the water at the bottom of the hole, making a gas which kills the crab. Although this treatment would seem at first thought to be almost impracticable when one considers the hundreds of burrows to the acre that are sometimes made by the crabs, yet if the treatment is done on somewhat the same plan as weeding would be attempted the crabs may quickly be controlled.