Summary

It is well known that a supply of available nitrogen must be preserved in the soil in which turf grasses are grown in order to maintain a pleasing green color as well as to provide for growth. In view of the results here shown it would be highly desirable to maintain the other mineral elements, with particular attention to phosphorus and potassium, in some degree of proportion to the nitrogen.

Effects of Shade on the Growth of Velvet Bent and Metropolitan Creeping Bent

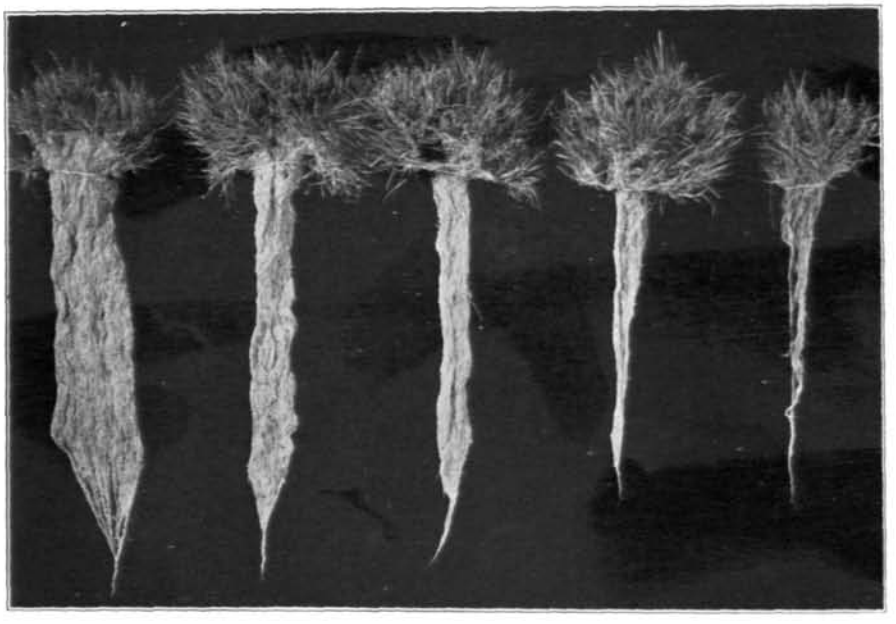
By Mary E. Reid

Many putting greens are situated in partially shaded locations. It has frequently been observed that under some conditions a certain degree of exclusion of sunlight may be beneficial but under other conditions may be detrimental to turf of putting greens and also to other parts of a golf course. Shading may vary as to intensity, quality, and time of day when it occurs. Some trees with dense foliage may be situated so as to exclude all direct sunlight over a certain area of a golf course, whereas others, with a different type of foliage, may produce a speckled shade, allowing considerable direct sunlight to filter through. The differences thus produced in size and shape of shaded areas in relation to size of individual grass plants constituting the turf is a matter of primary importance. If only certain portions of a plant are shaded, the effects on growth differ from the effects if the entire plant is shaded. There is a possibility, also, that shading in the forenoon may cause different effects from shading in the afternoon. It has, in fact, been observed that grass growing in areas shaded in the forenoon and later suddenly exposed to full sunlight may wilt more quickly than grass in areas exposed all day to full sunlight. Moreover, the soil in the full sunlight area may actually appear to be drier than that in the areas in which the grass suffers from wilting.

A possible explanation for this peculiar behavior may be found in the effects of shading on the development of the roots, as is shown in the results of some experiments conducted during the past summer. Although these tests dealt chiefly with velvet bent and Metropolitan creeping bents, it is considered probable, on the basis of general observations, that other grasses, such as Kentucky bluegrass, would respond similarly to the effects of shading. The grasses experimentally employed were grown both in pots and in plots under turf conditions. The results with velvet bent and Metropolitan creeping bent grown in pots were so striking that it seems worth while to report them here briefly. In one experiment a liberal supply of superphosphate was mixed into the clay loam soil used for the test, and in another a small addition only of superphosphate was made. In the experiments with velvet bent a relatively light addition of sulphate of ammonia was also made.

Cultures in duplicate of velvet bent were grown under each of the following conditions: full sunlight; sunlight until 12, then shade; shade until 12, then full sunlight; speckled shade; and moderately deep shade. Shading was accomplished by setting the cultures under trees in locations which would furnish the desired conditions. Plants which had developed from a single plant of the 14276 strain of velvet

bent were planted, the same number in each pot. The grass was cut to a height of ¾ inch several times during the course of the experiment. The water content of the soil of the various cultures was kept approximately uniform.



Cultures of velvet bent grown under five different conditions of light. Reading from left to right, (1) fully exposed to sun all day, (2) fully exposed to sun forenoon only, (3) fully exposed to sun afternoon only, (4) speckled sun all day. (5) shade all day.

The yield in grams of clippings from cultures grown under the different light conditions employed is shown in table 1. The grass kept in full sunlight grew more rapidly during the early phases of the experiment, but by the time the first cutting was made, September 10, there was no difference between the yield of clippings from these cultures and those which received full sunlight only in the forenoon. Plants that were kept in direct sunlight in the afternoon only did not grow quite so rapidly as those which were in sunlight in the forenoon only. Throughout the course of the experiment, growth of the grass shaded the entire day was much less rapid than

TABLE 1.—EFFECT OF SHADE ON VELVET BENT.

WEIGHT (IN GRAMS) OF CLIPPINGS OBTAINED AT THREE DIFFERENT DATES UNDER VARIOUS CONDITIONS OF LIGHT.

	Sun all day	*Sun forenoon only*	*Sun afternoon only*	*Speckled sun all day*	*Shade all day*
September 10	9.9	10.0	7.6	7.9	3.8
September 26	4.6	7.7	5.5	5.3	1.7
October 12	8.3	8.8	9.0	9.0	1.1
Total green weight of clippings	22.8	26.5	22.1	22.2	6.6
Total dry weight of clippings	5.2	5.7	4.7	3.5	1.6

that of cultures receiving direct sunlight for either the entire day or for half a day. Plants grown in speckled sunlight produced about the same yield of clippings as those grown in full sunlight all day or half of each day. During the latter part of the experiment the plants kept in full sunlight all day grew less rapidly than those kept in sunlight only part of the time. Undoubtedly this was because scarcity of nitrogen had become a limiting factor in growth. At the end of the test the leaves of these plants were of a lighter and more yellowish green color than those of the others,—a condition here considered to be indicative of nitrogen starvation. If more nitrogen had been supplied, undoubtedly the differences in growth between plants in sun all day and those in shade would have been considerably greater than they were in this test.

TABLE 2.—EFFECT OF SHADE ON VELVET BENT.

WEIGHT (IN GRAMS) OF TOPS AND ROOTS PRODUCED AT END OF TEST (OCTOBER 30) UNDER VARIOUS CONDITIONS OF LIGHT.

	Sun all day	*Sun forenoon only*	*Sun afternoon only*	*Speckled sun all day*	*Shade all day*
Green weights:					
Tops	25.3	27.9	25.4	28.5	10.5
Roots	44.4	18.1	14.3	7.4	2.9
Total	69.7	46.0	39.7	35.9	13.4
Dry weights:					
Tops	6.1	5.7	5.1	4.6	2.1
Roots	9.8	3.1	2.5	1.4	.5
Total	15.9	8.8	7.6	6.0	2.6
Ratio of tops to roots:					
Green weight	.6	1.5	1.7	3.9	3.6
Dry weight	.6	1.8	2.1	3.2	3.9

Table 2 shows the weights of tops and roots of the grass at the end of the experiment, October 30, and the illustration shows the appearance of the plants. The weights of tops and roots of duplicate cultures for each of the five different conditions of illumination were in close agreement with those of the corresponding plants shown in the photograph. There was not much difference in the growth of tops of the first four groups, all of which received some direct sunlight. The shaded plants had much less branching at the crown than those of the four groups receiving direct sunlight. The leaves were long, slender, weak, and of a bright but comparatively light green color. During the ten weeks' period of growth a complete ground cover was not produced, as was true under each of the four other conditions for growth. The individual plants could be readily discerned.

In contrast to the similarity in yield of tops of the four groups of plants receiving some direct sunlight were the striking differences in the weight, number, and length of roots produced. There appeared to be a direct relation between the amount of root growth and the length of daily duration of exposure to direct sunlight,—the longer the period, the larger the root system. The plants grown in full sunlight produced a dry weight of roots 18 times greater than the plants grown in shade, 7 times greater than those grown in speckled shade, and more than 3 times greater than those receiving full sunlight in the forenoon or afternoon only.

Table 3 summarizes the quantitative results of the entire experiment (clippings plus plants at final harvest) calculated on a green-weight basis. The differences in ratios of weights of tops to weights of roots under the different conditions for growth suggest an important reason why grass may wilt more quickly under one condition than under another. If atmospheric conditions are such as to produce rapidly drying effects, plants with poorly developed root systems will naturally suffer more quickly than those with extensively developed roots.

TABLE 3.—EFFECT OF SHADE ON VELVET BENT.

SUMMARY OF RESULTS SHOWN IN TABLES 1 AND 2 (FOR GREEN WEIGHTS ONLY) AT TIME OF FINAL HARVEST.

	Sun all day	*Sun forenoon only*	*Sun afternoon only*	*Speckled sun all day*	*Shade all day*
Cuttings, total weight (table 1)	22.8	26.5	22.1	22.2	6.6
Tops Oct. 30 (table 2)	25.3	27.9	25.4	28.5	10.5
Tops, grand total	48.1	54.4	47.5	50.7	17.1
Roots, total weight (table 2)	44.4	18.1	14.3	7.4	2.9
Ratio of tops to roots	1.1	3.0	3.3	6.9	5.9

The unfavorable effects resulting from weakly developed root systems are usually augmented by another factor. When exposed to conditions favoring rapid evaporation, such as high temperature, dry atmosphere, and wind, some grasses have a greater tendency than most plants to give off moisture through the leaves faster than they take it in through the roots. Their leaves are thus rather poorly adapted for conserving moisture. The mechanism controlling the opening and closing of the breathing pores may be less effectively developed for conserving moisture than that of most other types of leaves.

If velvet bent were grown in situations having a comparatively moist atmosphere in which there would never be danger of producing dessication effects (such as those previously mentioned, in which a weakly developed root system would be inadequate for its needs), it might thrive in partially shaded situations as well as if not better than in full sunlight. As far as top growth is concerned, there is evidence that in partial shade it may grow as well as if not better than in full sunlight. Its response to sunlight or partial shade would be dependent upon the type of soil. In poor soils it might grow faster in partial shade; in highly fertile soils faster in full sunlight.

Somewhat similar experiments were also conducted with Metropolitan creeping bent. Some cultures were grown in full sunlight, others in partial shade. The latter condition was attained by placing the plants under a lath screen so constructed as to reduce the direct sunlight to less than one-half the normal amount. The 1½-inch laths were placed 1 inch apart with a north-to-south direction. With this arrangement every portion of each culture was in direct sunlight for a portion of the day.

It was found that Metropolitan creeping bent was less tolerant of shade than velvet bent. The tops of the partially shaded plants

grew so slowly that it seemed advisable to leave them uncut throughout the course of the experiment. As with velvet bent, there was very little proliferation, the stems were weak, internodes long, and the leaves light green in color. Table 4 gives the quantitative results. It may be observed that shading had a more restricting effect on root than on top growth. The green weight of roots of the plants kept in full sunlight was 8 times greater than that of the partially shaded plants. Under the experimental conditions employed, there was no benefit in any way resulting from the shading of the Metropolitan bent. Possibly some benefits might have been observed had somewhat more light been provided to the partially shaded cultures.

TABLE 4.—EFFECT OF SHADE ON METROPOLITAN CREEPING BENT.

WEIGHT (IN GRAMS) OF CLIPPINGS, TOPS, AND ROOTS PRODUCED UNDER FULL SUNLIGHT AND PARTIAL SHADE.

	Full sunlight	*Partial shade*
Weight of clippings removed at end of experiment	24.7	Left uncut
Weight of tops at end of experiment	40.2	19.3
Total weight of clippings and tops	64.9	19.3
Weight of roots at end of experiment	19.4	2.3
Ratio of weight of tops to roots	3.3	8.3

The results of these experiments as shown in the tables and photograph give definite evidence that shade, if not too intense, may have a beneficial effect upon top growth of velvet bent in a soil of low fertility, but that root growth may be dangerously restricted, the reduction being approximately in proportion to the degree of exclusion of light. No beneficial results of shading Metropolitan creeping bent were observed under the conditions of shading employed. It is possible, however, that somewhat different results would be obtained if the plants were under less shaded conditions.

Violet rays an aid in seed identification.—Although it makes little difference to southern golf clubs whether they use perennial (English) ryegrass or Italian ryegrass as a winter turf on their dormant Bermuda greens, the seed analyst is often called upon to identify these two kinds of seed. Sometimes seeds of these two grasses are indistinguishable by ordinary means. It has been discovered that violet rays would produce a glow on white filter paper on which the roots of certain plants are growing. With ryegrass seeds it is found that these rays when falling upon paper on which Italian ryegrass seeds are germinating will produce this glow, but not so with perennial ryegrass seeds. The reason for this peculiar behavior of the two varieties of seed is an entire mystery, but the test is admirably adapted for identification of the two varieties. The first experiments were conducted with a special violet-ray lamp, but later experiments revealed that an ordinary lamp would answer the purpose if a special light filter is used to shut out the visible rays.

Chemical fertilizers may be mixed with compost at any time that is convenient provided the compost is kept under cover. These fertilizers do not lose their strength under such conditions.