

depth of 9 to 48 inches, and was placed on the polyethylene tarps laid to either side of the ditch to minimize damage to the established turf.

(3) The tiles were carefully installed and each joint was wrapped with tar paper as shown in the accompanying photographs.

(4) Tiles then were covered with 8 inches of gravel, and the soil was carefully replaced and tamped.

(5) The lifted sod was relaid.

All was done so well that hardly anyone realized the fairway had been touched. How long did it take? Being

in on preliminary conversations, I was amused at the "pop-eyed" reaction of the Soil Conservation representatives when Walter Gallagher, Frank Murphy, Otie Reed, and John Henley — club officials and superintendent, respectively—said, "We'll get the job done tomorrow!" They couldn't believe that Congressional's representatives were serious. Didn't they realize the magnitude of the project? Well, it took two tomorrows, but the job was beautifully done, and the USDA men went away convinced that to get beautiful grass to grow underfoot the Congressional officials would stop at nothing!

## Turf Management at Brae Burn

By ARTHUR E. ANDERSON, Golf Course Superintendent

This article is a description of the turf management program at Brae Burn Country Club, Newton, Mass., beginning in the 1930s and developing from recommendations, observations, experiments and results. Help from other superintendents, the USGA Green Section, university turf specialists and commercial men in formulating this program was very considerable and is gratefully acknowledged by the writer. Use of the word "experiment" is misleading because these "experiments" were very roughly qualitative; there were no control plots, and treated areas were later obliterated by what was determined to be the best management program, as the area was part of an operational golf course rather than a turf research field station. Readers are cautioned to interpret this report in terms of the results obtained with the reservation that specifically how and why this program succeeded cannot be pinpointed closely.

The present course evolved during the period from 1897 to 1928 with several greens remaining unmodified since the beginning. It is located on an area of fine sandy loam except for two holes that are on a former peat bog. In early days manures were used as fertilizers, bringing in many weeds, and commercial fertilizers had rations like 4-8-4 or 8-6-6. In 1934 limestone at one ton per acre was applied to greens, tees, and fairways and repeated the next year at one-half this rate. By the late 1930s the pH reading of soils ran from 5.0 to 5.5, and phosphorus and potassium levels were reported to be very high. Basic grasses in fairways were Kentucky bluegrass and bentgrass, but they did not predominate because of the abundance of broad-leaved weeds, annual bluegrass, and crabgrass. In 1937 grubs greatly reduced the amount of basic grasses, leaving essentially clover and annual bluegrass with severe summer infesta-

tions of knotweed and crabgrass. Tees and greens especially were covered with annual bluegrass.

The "modern" program began generally in 1938 with adoption of modified or new practices. Several observations seemed pertinent with respect to improvement of turf. One was that roughs, unfertilized, unlimed and cut at two inches, comprised a good stand of basic grasses. Further, paths through rough made by fairway mowers, which traveled between fairways and cut at fairway height, also had a good proportion of basic grasses, especially bentgrass. Near approaches to some greens the limit of travel by the fairway fertilizer spreader was marked by a distinct line. On the fairway side turf was poor, while on the other side, where fertilizer applications had not been extended to the approach sufficiently, turf was good. A similar condition existed where fairways were constricted by the intrusion of bunkers. Here the fertilizer spreader passed over a given area within the constriction twice or more, giving a much larger dose of fertilizer than was intended. Turf in these areas was especially poor and, indeed, was the last to be improved in recent times by the present program. My tentative conclusion was that too much fertilizer had been used on the course.

#### **New Fertilizer Program**

The high phosphorus and potassium fertilizers were abandoned and we began to use a natural organic product as our source of nitrogen. On fairways the fertilizer was usually applied in the spring and early fall at rates giving one pound of nitrogen per 1,000 square feet per application. With the advent

of fairway watering from 1946 to 1950 it appeared that turf became too lush. The total fertilizer amount was cut in half, and this amount was applied in four or five applications per season, giving a total dose of nitrogen at one pound per 1,000 square feet. In recent years the organic nitrogen has been used less, and there has been a tendency to reduce or omit application of phosphorus and potassium. Sometimes urea alone has been applied several times per season with a rotary fertilizer spreader. Since 1935 limestone has been applied once—during the mid-1950s—at the rate of one ton per acre. The pH levels remain about 5.5 throughout.

There is a different program, of course, for greens. Generally the total nitrogen dosage is two to three pounds per 1,000 square feet for the season by means of 15 to 20 applications of such materials as ammonium sulfate, diammonium phosphate, urea, sludge and cottonseed meal. It is my belief that excessive uncontrolled thatch formation is in part caused by single heavy fertilizer applications, and for this reason light, frequent applications are employed. Potassium and phosphorus total about a pound per 1,000 square feet for the season with muriate of potash supplemented in the fall. Each green is considered by itself with respect to fertilizer dosage and some receive different amounts than others. This is rather easy when proportioners are used. Limestone is added every other year at the rate of 10 to 15 pounds per 1,000 square feet.

In 1937 lead arsenate at 350 pounds per acre was applied to greens, fairways and most tees, except a few in

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shady locations where annual bluegrass is deliberately cultivated. It was applied dry on fairways and tees and with a proportioner onto greens. Applications were repeated in 1940, 1944, 1947, 1951, 1955, 1959, and one is projected for this year. In addition, sodium arsenite was sprayed in the spring on fairways four times at one pound in seven gallons of water per acre.

Over a period of years, bentgrass, which had been present in small quantities, began gradually to become distinct and crowd out other plants. Weeds such as knotweed and crabgrass disappeared quickly. Annual bluegrass also diminished but tended to re-invade when fairway watering was installed. Yet, on the other hand, the take-over by bentgrass was accelerated rapidly with fairway watering. Even dandelion and plantain disappeared even though phenoxy acids have never been used. Today, greens, fairways and large sunny tees are covered with superior clones of bentgrass that have coalesced

virtually into a solid carpet. These clones are mostly Colonial bentgrass, although some creeping and velvet bentgrasses and probable hybrids are present among all three species. They are superior individuals that have been given their chance to push everything else out of existence, even annual bluegrass, which is hard to find even on narrow aprons that bear the heaviest traffic.

With the presence of such vigorous bentgrass, which forms thatch readily, aeration has been a necessary part of the program. Aerating our fairways with a thatch spoon rather than with the open type has proved better since it tears less and reduces the chance for annual bluegrass to re-invade. Also, aerating at the same time that lead arsenate is applied helps check annual bluegrass. Thinning out bentgrass with vertical slicing machines has been beneficial on greens, and it would appear that fairways could use thinning now that there are machines developed for this purpose.