

unfavorably wet or dry conditions, prevent caking or hardening of the fertilizer mass, and so make for greater ease in distributing the fertilizer either by broadcasting or by special distributing machinery. Without fillers, or organics, the fertilizer mixtures are more apt to get moist and set, and much greater care is necessary in preparing and storing them. For this reason, low-analysis fertilizers are more fool-proof and safer to use. The higher the analysis, the greater care and scientific information concerning the properties of the materials is required; but with this, greater advantages are derived by both fertilizer user and manufacturer—less material to handle, less bagging and hauling, and above all less freight to pay, so that the active plant food can be more economically put on the soil in the high-analysis fertilizers.

The fixation of the nitrogen of the air, and also improved methods of manufacture in phosphate fertilizers, are now making the production of really concentrated fertilizers possible, so that four or even three bags will contain as much plant food as twelve bags of the older formulae. Fertilizers containing as much as 40 or 60 per cent plant food are already on the market, and some compounds as high as 75 per cent have been manufactured. These concentrated products of the chemist's skill bring with them new problems in fertilizer usage and distribution, but they hold forth much promise of greater economic application and lower cost of fertilizer with increased benefits.

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## Renovating the Fairways of the Algonquin Golf Club

By A. J. Goetz

The course of the Algonquin Golf Club, at Webster Groves, near St. Louis, Missouri, was laid out in its present location about 1904. The fairways are rolling. The soil is a residual limestone, grading from a fair clay loam to yellow clay. The native vegetation is mostly post oak, red oak, and elm. Tests of these soils in 1925 showed them to be very acid—not a natural bluegrass soil, by any means. The turf is a mixture of Kentucky bluegrass, annual bluegrass (*Poa annua*), redbottom, some white clover, bent grass, and rough-stalked bluegrass (*Poa trivialis*), the Kentucky bluegrass predominating.

The fairway program, before I took charge in the fall of 1925, was to seed in the spring and fall and apply stable manure in the winter. No commercial fertilizers were used. More than \$10,000 was spent for seed and manure during the four years preceding my time, but even the best areas had only a thin, sickly stand of bluegrass. Crab grass, goose grass, dandelion, dock, plantain, and chickweed were much in evidence.

In the spring of 1926 a series of fertilizer tests was conducted with sulphate of ammonia, nitrate of soda, bone meal, acid phosphate, muriate of potash, and lime. These fertilizers were tested both alone and in combination, the results being observed carefully and the comparative costs figured.

In July, 1926, 4,000 pounds per acre of finely ground limestone was applied to all the fairways. About the first of September the fairways were seeded with 40 pounds of bluegrass and 10 pounds of redbottom per acre. As soon as this seed was up well, about the first of October, 400 pounds of raw ground bone and 125 pounds of sulphate of

ammonia were applied to all the fairways with the exception of three where nitrate of soda was used in place of sulphate of ammonia. On these three fairways nitrate of soda had been used all along, while on the others sulphate of ammonia had been employed. After two years I can see no difference on these areas with regard to quality of turf and weed control. However, it cost considerably more to apply a given amount of nitrogen in nitrate of soda than in sulphate of ammonia. In all cases, as the grass thickens the weeds become less evident.

About the first of April, 1927, 300 pounds of cottonseed meal and 125 pounds of sulphate of ammonia were applied per acre. In early May this was followed with 500 pounds of activated sludge and 125 pounds of sulphate of ammonia. Again, in September, 400 pounds of raw ground bone meal and 125 pounds of sulphate of ammonia were applied. In April, 1928, 600 pounds of sludge and 200 pounds of nitrate of soda were used on about one-half of the course, and 600 pounds of sludge and 200 pounds of calcium nitrate on the rest of the course. These fertilizers were employed inasmuch as there was no sulphate of ammonia available at the time.

All these fertilizers were applied with a lime sower drawn by a tractor. This lime sower is designed for spreading large quantities of material, and will not apply small quantities satisfactorily. I now have a machine in view which I think will apply smaller quantities, so that it will not be necessary to make up so much bulk. I plan to depend on sulphate of ammonia with just sufficient filler to facilitate application. I think our fairways have enough phosphorus for some time to come.

The clay slopes were given about one extra application of these fertilizers approximately once a year. I plowed up several packed areas and one clay hill last fall and worked into the soil from 25 to 50 tons per acre of manure, depending on the condition of the soil. I then planted them with creeping bent, and we now have a splendid turf on these areas, where we failed to get grass started by seeding.

With regard to our tees, some are creeping bent, others were sodded with Kentucky bluegrass, and last fall some were seeded with rough-stalked bluegrass and redtop. They are fertilized about once a month with sulphate of ammonia, which is applied either dry or in solution, depending on circumstances, the solution being applied by the barrel method.

None of our fairways are watered, except those areas planted with creeping bent last fall, where it was necessary to water the stolons until they became established and were growing well. I doubt if it would be wise to water bluegrass fairways in this section, even though the cost were not prohibitive, as it is here. The watering of bluegrass during its dormant stage, which lasts for ten or twelve weeks, appears to result merely in a dense growth of crab grass, which is not at all desirable. I believe it is better to let nature take its course. Kentucky bluegrass seems to come back stronger than ever after a period of drought. Crab grass, however, will cause great damage by smothering turf unless it is cut very close and prevented from forming runners.

The improvement in our fairway turf during the past two years has been truly wonderful; and now that the fairways are in good condition, I am sure that the cost of keeping them so will be much less than the cost of building them up again.