

With the judicious use of the chemicals, there may be expected an improvement in the turf over a period of time.

Certain precautions against poisoning and fire must be observed where any of the chemicals are used.

Sulphate of iron and sulphate of ammonia, alone or in combinations, gave no indications of satisfactory crabgrass control but proved applicable to the control of broad-leaved, low-growing weeds, particularly those in putting greens.

Calcium cyanamid yielded no favorable results when applied as a dust at the rate of 780 pounds to the acre.

The perchlorates of ammonium and potassium proved unsatisfactory as weedkillers.

The experiments have not been carried out to a sufficient extent on sandy soils to permit of definite conclusions. The greater part of the data has been gathered from results obtained on loams, silt loams, and clay loams.

Results with chemicals are affected by a number of factors to an undetermined extent, indicating the necessity for more extensive investigations of the problem.

Weeding Bermuda Grass Out of Creeping Bent Turf

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The Valley Club of Montecito was opened for play in the fall of 1928. The putting greens had been sown with seaside creeping bent and the fairways with Bermuda grass. Both got a good start, and the season of 1929 opened auspiciously.

In the summer of 1930 the greens began to show a considerable amount of Bermuda grass. In spite of some surface weeding and patching, this grass continued to increase in the putting greens through this season and also in 1931. We then tried the method of turning back the sod and weeding the Bermuda from underneath. This method proved to be much more effective even though it was more costly than the other methods. Since the putting greens were so badly infested with the Bermuda grass, it was necessary to devote the entire services of one man to this work.

A careful workman was selected, and the first week he was assigned to the turf nursery to practice the technique. The second week he was moved to the croquet court, which was seldom used and not kept up as carefully as the putting greens. By then he had acquired proficiency and was ready to start on the regular greens. He worked five 8-hour days a week, turning back an average of 25 sods a day. From May to July it was a struggle to hold his own with new patches showing up constantly; but it was a cool summer and the Bermuda grass was a little late in sprouting. I decided to put on another man on July 1, and by the first of August we had it pretty well under control and one man finished the season. By the first of November the greens were practically free from Bermuda grass. How successfully the method worked out has been proved this season. Only a few scattered patches of Bermuda grass appeared in 1933. Of the many thousand sods turned back, only a small number had to be replaced. At no time during the season were any of the greens marred or their putting surfaces disturbed.

With the accompanying photographs, the method of weeding can be easily understood.

The first photograph shows the workman about to lift the sod after having cut three sides around the measuring board with a revolving-disc edger. We tried a number of different sized boards but finally decided on one 9 by 18 inches. Cutting larger sods might have saved a little time, but 9 by 18 inches was a size so handy to work with that we used it exclusively. On some soils it might be practical to use a somewhat larger measuring board. The workman,



Starting to lift the bent sod.



Sod turned, disclosing a Bermuda rhizome.

after cutting three sides of the sod, two long and one short, lifts the board and places it at the narrow, cut end. He uses it for leverage and to protect the turf by the edge of the measured turf when he lifts it with a spade. We tried different lifting tools but found an ordinary spade was the best. Lifting the turf is a very important part of the work. If it is cut an even thickness, there is much less danger of finding a hollow or bump after the turf is replaced. It takes continued care, but it is not difficult to cut it evenly after some practice.

It is hard to advise a definite thickness to cut the turf. That has to be gauged by the density of the Bermuda roots. It is best to cut it as thin as is practical; but if it is cut too thin, tearing out the roots would weaken the turf too much. On the other hand, if it is cut thicker than necessary it is difficult to find all of the Bermuda roots, and in taking them out so much soil is removed that it is hard to avoid soft spots when the turf is replaced. Soft spots will eventually become depressions. The larger proportion of sods are cut from $1\frac{1}{2}$ to $1\frac{3}{4}$ inches in thickness.

The second photograph shows the sod turned back; a heavy Bermuda rhizome can be plainly seen. It will be noted that the sod

is turned back in the shade of an umbrella. In the hot sun that is important. Before we began to use the umbrella we noticed that sods turned back in the hot sun were slightly brown after replacing even though we used plenty of water. After we began to use the umbrella we had no more trouble that way.

The workman first clears the soil beneath. For that work a small trowel is a handy tool. If the rhizomes run beyond the soil exposed it will be necessary to lift another piece of turf. Though Bermuda grass sometimes grows to prodigious depths it seldom goes down far under a green unless it is left to develop year after year. We had little trouble in clearing the exposed soil.



Extracting the rhizome. The work should be done under an umbrella to shade the sod.

Weeding the sod turned back is the most difficult part of the process. We found the handiest tool for that work was a 10-inch length of stiff wire with a loop in the middle for a grip and one or both ends turned back to make approximately a $\frac{1}{8}$ -inch hook. The wire must be stiff enough to stand substantial leverage, as some of the heavy rhizomes require it. Nothing but patience and care will achieve good results. It is most important to get out all of the rhizomes. Any left will mean further growth and labor wasted. When the rhizomes are all cleared from the bottom it is easy to pull out the surface growths from the top.

When the sod has been thoroughly weeded the low spots should be filled with moist soil. We found the best way to do this was to have the soil the consistency that would make a good mud pie, and handle it with a trowel the way a bricklayer would handle cement. Next to the actual weeding, this is the most difficult part of the process, as the soil must not only be spread evenly but the depressions must be filled so that when the sod is turned back it will lie smoothly and with a uniform consistency.

If the work is expertly done the marks of cutting will disappear within a few days. We have found it better to cut the sod at a slight angle so as to make it a shade wider at the top. When the sod is replaced the line of the cut should be hardly perceptible.

There are no especial precautions to advise except to keep the sod in the shade while it is turned back and to use plenty of water on hot days.

There will occasionally be a patch of Bermuda grass so thick that there is little soil left in the turf after weeding. In such a case it would be necessary to fit a new piece of sod. It is surprising though how few times that is necessary. We used not more than 20 to 25 new sods throughout the season; and our greens were certainly

thick with Bermuda grass. On one green during the first thorough weeding we took out nearly 7 buckets of rhizomes and shoots from the sods lifted and from the soil beneath.

It might seem as if too much labor was involved in this process of weeding Bermuda grass from bent greens; but it must be borne in mind that our greens were so badly infested that with only surface weeding it would have meant a steady increase year after year and more and more labor required for weeding, with the highly unsatisfactory knowledge that we were losing ground and eventually would have to perform some major operation to the greens. By that time the rhizomes would have penetrated so deep that nothing but new construction would be practical. The winters here are not severe enough to kill Bermuda grass. It just lies dormant for a few months.

On golf courses which have Bermuda fairways and bent greens there will always be a problem of keeping the Bermuda grass out of the greens. A certain amount of surface weeding will be necessary every year. That is usually all that is done, but it is not enough. If the rhizomes are allowed to develop, it will certainly mean trouble in the future. The only sure methods of treatment are to patch if it can be done successfully or else to weed by turning back the sod as I have described. In either case it should be done as soon as the Bermuda grass appears. There is danger in neglecting to weed promptly and in allowing the rhizomes to develop.

It has been estimated that American agriculture suffers annual losses reaching hundreds of millions of dollars from ground squirrels, prairie dogs, jack rabbits, pocket gophers, woodchucks, bobcats, stray domestic cats, moles, porcupines, mice, and rats. That golf courses share to some extent in these losses is evident to anyone who has observed turf uprooted or killed from tunneling or who has seen half-eaten carcasses of birds strewn on a fairway or in the rough. Though it is true that certain of the rodent pests destroy quantities of grubs working beneath the surface, it is considered that on the whole they are more of a detriment than a benefit to a golf course. No general program can be outlined for the control of pests of this kind. Some can be controlled only by poisoning, others by trapping. Each case must be handled individually. In one year over 100,000 farmers took advantage of opportunities offered them to wage cooperative warfare on these pests under trained leadership.

Don't place any faith in rain-making devices. As long ago as 1880 Daniel Ruggles obtained a patent on a rain-making device consisting of balloons equipped with explosive cartridges and torpedoes to be set off by an electric wire trailing on the ground. In 1891 Louis Gathmann obtained a patent on a device for spraying liquid carbon dioxide gas high up in the air, the evaporation of which was to cool the air sufficiently to cause rain. Since then other rain-making devices have been patented. The science of meteorology is still, however, in its infancy, and the growers of plants are as much at the mercy of the elements for their rain as were their ancestors thousands of years ago. Numerous devices are still being offered to farmers by professional rain-makers. Fortunately most golf courses are not so extensive but that they can equip themselves with reliable means of watering fairways and therefore offer little appeal to rain fakers.