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## Controlling Grubs and Earthworms with Arsenate of Lead

By B. R. Leach

Arsenate of lead is being extensively used on golf courses in the United States for the control of grubs, earthworms, and weeds. It has been conservatively estimated that more than 200 tons were employed during the 1928 season in the Philadelphia district alone, which is near the center of the Japanese beetle infestation. Although the use of this chemical is fast becoming a recognized part of green-keeping, it must be remembered that it is a relatively new practice and that therefore each year will see new developments, for some time at least. The purpose of this article is to review briefly the developments of the season of 1928.

Those who have followed the previous reports of my experimental work with arsenate of lead will recall that it has been conducted at Riverton, N. J., near Philadelphia. The grasses used in these tests were bent grass grown from seed, bent grass produced from stolons, Kentucky bluegrass, and some of the other grasses common in this section. Nothing was done with Bermuda or other grasses commonly occurring on golf courses in the South. As the use of arsenate of lead began to spread to other sections, including the South, I must confess that I viewed with no little apprehension the possibility of trouble arising from the application of this chemical to Bermuda grass, since we had no information regarding what the results might be. Recently inquiries were made to obtain opinions from those in the South who had used arsenate of lead on Bermuda grass. All of the 25 or more answers received indicated that the effect of the chemical upon Bermuda grass was entirely satisfactory. It would appear therefore that southern golf courses will be able to use arsenate of lead with impunity in the control of one of the South's greatest turf insect enemies, the June beetle.

In the Philadelphia and New York districts much is being done in rendering turf, especially on greens, proof against grub infestation in order to prevent injury by grubs of the Japanese beetle, the Oriental beetle, and the Japanese garden beetle. However, the following remarks apply equally as well to those sections where injury by our native species of grubs is more or less prevalent. Greens treated under these conditions are proof against the attack of the grubs, but the untreated approaches and fairways are often badly damaged before those in authority are aware of the true state of affairs. Although arsenate of lead applied at this late stage will quickly check the feeding of the grubs and kill them in about three weeks, it will not restore the turf to its former vigorous condition. Such grub-riddled turf goes into the winter in a decidedly weakened condition, serious winterkilling results, and much money must be spent the following season to restore the damaged areas.

In 1928 I supervised the treatment of extensive areas of fairways in order to kill the grubs which were rapidly ruining the turf. Golf clubs faced with a fairway crisis of this sort are usually in more or less of a financial predicament. No allowance has been made in the annual budget for an emergency of this kind, and yet something must be done if the fairway turf is to be maintained. Under these conditions the golf club involved invariably asks for treatment at the lowest possible cost. In view of the limitations imposed by their budget for the current year they are not, at that time, particularly interested in treating the turf so that it will be proof against grub infestation for a period of years; they desire simply to kill off the grubs for the time being. Under the circumstances it will not be amiss at this time to detail the method I have found most practical and inexpensive for a temporary grub campaign for those finding themselves in this predicament.

I have sought during the season to standardize the application of arsenate of lead at the rate of 5 pounds to 1,000 square feet of turf, or 250 pounds to the acre. This dose will render turf proof against grub infestation for a period of at least three years, and probably longer. However, those who wish simply to kill off a grub infestation, with no thought to making the turf immune to future infestation, can do so with an application at the rate of 3 pounds to 1,000 square feet, or 150 pounds to the acre. I have made extensive tests with this lower rate of application during the past two years and have determined that within a week after the application of the chemical it will sicken the grubs to such an extent that they will cease feeding; within three weeks most of the grubs will be killed and the turf will be reasonably proof against further infestation during the following year.

In the last analysis the initial cost of the 150-pound rate of application is lower for material, but the effects do not last as long as with the 250-pound rate.

In treating large areas of turf with arsenate of lead the chemical is mixed with a dry filler and applied by means of a lime spreader. Until recently the filler employed has consisted of dry, sifted sand or soil, and where these are available in quantity they are entirely satisfactory. Unfortunately, these materials are not generally available in quantity, and the cost of drying sand or soil by artificial means is prohibitive. During the past season in large-scale operations I have had very successful results by using one of the organic fertilizers as a filler for adding bulk to the application. In addition to the plant food value, some of these pulverized fertilizers possess certain qualities which render them particularly desirable as fillers for use with arsenate of lead. These finely ground types of organic matter are easily mixed with arsenate of lead, and the exceedingly fine particles of the chemical cling tenaciously to the larger particles of the fertilizer. Consequently, when a lime spreader is used for applying the mixture it flows readily through the openings in the bottom of the spreader and very little of the arsenate of lead is lost by blowing, since most of the chemical clings to the particles of fertilizer. The past season's work has shown that the two materials should be mixed at the rate of 1 pound of arsenate of lead to about 5 pounds of fertilizer. As the mixture falls upon the turf it filters down through the blades of grass and comes in contact with the soil. In this situation

it is acted upon by rains and dews, the arsenate of lead killing the grubs as it is washed into the soil. As soon as the grubs cease feeding, the grass which remains begins to develop new roots and make new growth. At this point the fertilizer in the mixture becomes apparent, hastening the recovery of the turf, fortifying it against the approach of cold weather, and reducing winterkill to a minimum.

All my recommendations regarding the application of arsenate of lead to turf have been based on the use of a mixture of the chemical with some dry or slightly moist filler, such as sand, soil, or, of late, a dry organic fertilizer. That there are reasons for my dislike of the system of applying arsenate of lead to turf by mixing the chemical with water and making application by means of watering cans or sprayers is fairly obvious. Arsenate of lead, although a fluffy, impalpable powder, is, nevertheless, much heavier than water, and settles to the bottom of the container very rapidly unless the mixture is constantly agitated. Sufficient agitation is impossible when using watering cans, buckets, or barrel sprayers. As a consequence the chemical is applied unevenly to the turf and an uneven grub control results. When power sprayers are employed and the mixture with water is applied by means of fine-jet nozzles, the wind becomes a factor to be reckoned with, and again an uneven application frequently results. If coarse nozzles are employed, a flooding action results, the low spots in the turf receiving more than their share. My chief objection to the use of water as a carrier for arsenate of lead is that much of the chemical clings to the blades of grass, which are very tender, and surface burning results, with a consequent temporary check in the growth of the grass.

In earthworm control, arsenate of lead is being used all over the country, and very satisfactorily. In spite of all that has been written on the subject, there is still a marked tendency among golf course officials to stop at the edge of the green in applying the chemical. It must be remembered that earthworms—and this applies also to the grub of the June beetle—are migratory, constantly creeping into the green from the surrounding turf. Although the turf of the green may have been poisoned with the chemical, wormcasts will, nevertheless, be in evidence, since these invading creatures must make at least one burrow before they get a dose of the poison. If you want a green entirely free from wormcasts, it is therefore absolutely necessary to apply the arsenate of lead to the turf for a distance of at least 15 feet beyond the edge of the green. When this is done, earthworms creeping toward the green are poisoned before the green is reached. A golf course manager from Chicago told me not long ago that on some of the older courses in that vicinity the wormcasts were so numerous on the fairways that they had to drag a mat over the turf before it could be mowed. He added that on his course the difficulty had been rectified by the application of arsenate of lead at the rate of 250 pounds to the acre.

From now on we may expect to hear rumors of injury to turf following the application of arsenate of lead, whether justified or not. It would be unwise, however, to give credence to unfavorable reports until the evidence is fully sifted. If you, as a user of the chemical, find that something of an untoward nature subsequently develops with your turf, do not be in haste to lay the blame on the arsenate of lead. Review carefully the steps in your greenkeeping program,

being sure in particular that your drainage and your top-dressing materials are what they should be. As a prominent golf architect said to me not long ago, "Greens are always going bad, more or less." In golf turf, arsenate of lead gradually loses its toxicity and becomes chemically inert, as so much sand or cinders. The cumulative action of this chemical is improbable, if not impossible.

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### A Classification of the Bent Grasses

We have recently received a pamphlet entitled "Commercial Bent Grasses (*Agrostis*) in Canada," written by Dr. M. O. Malte, botanist in charge of the herbarium of the National Museum of Canada, Ottawa. This treatise appears in the annual report of the museum for 1926 (Bulletin No. 50). It is a technical discussion, but since it contains much of interest and value to those interested in the production of bent turf, we offer this brief review for the benefit of our readers to whom this information might not otherwise be available.

The increased interest in recent years in fine turf, especially for putting greens, has stimulated the demand for bent and has led to the opening of new seed sources in the maritime provinces of Canada, especially in Nova Scotia and Prince Edward Island. Dr. Malte expresses the opinion that the production of commercial bent grasses will be of increasing importance in that section of Canada. "In the writer's opinion, however," he says, "the success with which seed growing on a commercial scale may be met will, to a very great extent, depend upon the confidence which seedsmen as well as the purchasing public will have in the genuineness and trueness to name of the seed produced. Such confidence can be obtained only if the characteristics of the 'varieties' can be precisely defined and if, based thereon, a supply of pure seed, true to name, can be offered to the trade. At present, tens of thousands of dollars are wasted annually on account of a loose and, in many cases, quite misleading application of so-called scientific names to commercial varieties of bent grasses. For this the seedsmen must not be criticised too seriously as there exist, as will be seen in the following, very great differences of opinion among taxonomic botanists as to the systematic relationship between the various species and forms, differences which are quite natural on account of the perplexing variability of the different species." It is the purpose of Dr. Malte's treatise to give his "conception of the relationship of the various species and varieties of the genus *Agrostis* which are of commercial interest to Canada."

"In most Canadian seed catalogues," he writes, "only three so-called varieties of bent grasses are listed, viz. redtop, creeping bent, and Rhode Island bent. Occasionally the names 'herd's grass' and 'florin' occur, and quite recently the name 'Prince Edward Island bent' has been introduced by a few seedsmen."

Concerning redtop, the tallest and most important agriculturally of the bent grasses in Canada, he writes, "It grows anywhere from 1 to 3 feet high or more and generally possesses runners or stolons which are either wholly underground or from a subterranean start develop into upright, aerial, leafy shoots. On account of its upright growth and plentiful foliage, it is of importance as a hay grass, especially on wet land. Its relative coarseness, however, and in many