

on hand a good supply of dry, fine sand to be used in mixing. If the mixture proves to be too moist to distribute well, a larger quantity of dry sand may be used or the mixture may be permitted to dry out until the right consistency is reached. The effectiveness of the chemical will not be changed by such drying.

CONTROLLING WEBWORMS

This is the season of the year when webworms usually injure turf most seriously. Because of the drought conditions in the Central West, it may be expected that these pests will congregate in putting greens due to the parched condition of the grasses in fairways and rough.

The webworms prefer succulent grass, which they eat off very close to the soil level. In dense velvet bent turf it is not unusual to find the grass blades eaten off at the bottom and still standing to shrivel and form the characteristic brown lines over the silk-lined tunnels. The webworms' work in such turf closely resembles that of the clothes moth in plush, and in both cases the caterpillars (larvae) do the damage rather than the moths. The turf is usually injured by birds searching for the worms.

A rather complete description of the life of the webworms has been published in *The Bulletin of the United States Golf Association Green Section*, Vol. 10, p. 115, Vol. 12, p. 14, and in the latter volume is summarized the efficiency of various control treatments.

The life cycle of the webworm begins with the eggs dropped promiscuously on turf by the moths at night. These soon hatch into naked caterpillars. They grow rapidly and construct tunnels of silk covered with bits of grass or soil in which they feed. As they reach mature size, about one inch, they burrow into the soil and go into the chrysalid or pupa stage, from which they emerge as grayish white moths. The moths rest with the head down and with wings folded close to the body. In one important species there are three more or less distinct broods during the year.

The webworms prefer to feed in turf which is dense or tall enough to offer a hiding place, and are most active at night or when the sky is overcast during the day.

If conditions are suitable, the larvae reach maturity in two or three weeks, which means that if injury is to be prevented the measures for control should be applied as soon as their presence is noticed.

The control measures fall into two groups: contact poisons and stomach poisons. Among contact poisons are kerosene emulsion and extracts of pyrethrum, derris and rotenone, applied with a sprinkling can or barrel cart. The most effective stomach poison seems

The mixture may be kept moist in storage by covering the container tightly or by the occasional covering with wet burlap.

The preparation of stock solutions as above described will be found to offer many advantages in applying these fungicides with the liquid method also.

to be arsenate of lead, either in a spray or a dust.

The kerosene emulsion method is not recommended for putting greens because of the likelihood of injuring the grass.

The pyrethrum, derris and rotenone materials are not injurious to the grass when applied at a dilution of 1 - 400, which has been found effective. The rate of application should be approximately 100 gallons to 1,000 square feet. The larvae are brought to the surface by these materials in much the same way as earthworms treated with corrosive sublimate. The disadvantage of the contact method is the cost of the extracts, which may amount to \$4.00 for 1,000 square feet.

The stomach poison, arsenate of lead, has been found to give good control applied as a spray at the rate of 1½ or 2 pounds in approximately 5 gallons of water to 1,000 square feet. It is important that the spray be directed downward in order to coat the base of the leaves and stems with the poison.

One of the dusting methods consists of applying a mixture of 2 pounds of the arsenate of lead with 4 to 6 quarts of dry, finely-screened sand to each 1,000 square feet. The application is made either by hand or with a wheelbarrow spreader. The poison is carried down by the weight of the sand particles and dusts off enough to coat the leaves lightly. The turf is discolored less when the poison is applied in this way and no expensive equipment is needed.

The arsenate of lead treatments should be applied when clear weather is predicted. Greens should be well watered before the poison is applied and further watering should be suspended so that the poison may remain on the leaves where the grubs are feeding during one or two nights.

From the economy point of view the arsenate of lead spray or sand methods are the most practical since the applications for webworms probably carry sufficient poison to control earthworms and grubs as well.

It must be remembered that arsenate of lead is a dangerous poison which is slowly eliminated from the body. The greenkeeper's staff should be protected from the dust or spray as much as possible by covering the nose and the mouth with a towel or a mask during any work involving this compound.

COPPER FUNGICIDES

During the last two or three years there has been some renewed interest in the use of copper fungicides for the control of turf diseases. It therefore seems well to again warn against the use on turf of chemicals containing copper. It is well known that the copper fungicides will effectively control brownpatch. As a matter of fact, the first chemical control of brownpatch was with copper compounds.

We quote from *The Bulletin of the United States Golf Association Green Section*, Vol. 12, pp. 119, 120, as follows:

"Experiments with Bordeaux mixture and other copper compounds led to injuries which were far worse than the disease they were intended to cure. This injury was copper poisoning, resulting from the accumulation of copper in the soil; it is likely to develop more rapidly in some soils than in others. Some of the golf courses which had used Bordeaux mixture for several years were forced to rebuild some of their putting greens to eliminate the soil containing copper."

On page 120 of that number of *The Bulletin* is published a picture of turf injury due to copper poisoning.

There is no test which can be made of soil to indicate where copper is likely to be poisonous and where it may prove harmless to grass. Therefore, the only way to determine this point is by trial. This trial method is on a par with the method of testing whether a mushroom is a poisonous or an edible species. One simply eats the mushroom, and if it kills him it is a poisonous variety and if it causes no harm it is an edible variety. Those who insist on using this method on their putting greens may in a few years have to pay dearly for the experiment.

Some of the copper compounds now offered for sale to golf clubs are not Bordeaux mixture. However, the Green Section experimental tests at Arlington included forms of copper other than Bordeaux mixture. The results clearly indicated that the question of toxicity was one of how much copper was used and not one of chemical combination. Therefore, we warn clubs against any extensive use of copper compounds on turf, regardless of the lure of a somewhat reduced cost in controlling disease. It is far better to let attacks of the disease go untreated than to risk permanent injury from copper poisoning.